Structural Geotechnical Report

Proposed US 41 Culvert Reconstruction
North of Illinois 173 to South of Westleigh
Wadsworth, Gurnee and Lake Forest
Lake County, IL

Reinforced Concrete Box Culvert Modifications
SN-049-0228, SN-049-2016, SN-049-2015, SN-049-0575

Prepared for:

Illinois Department of Transportation

IDOT PTB 191-002
Contract: 62J26

Project Design Engineer:
Quigg Engineering Inc.

Prepared by:

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September 1, 2020

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September 1, 2020

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Structural Geotechnical Report
Reinforced Concrete Box Culverts
Proposed US 41 Culvert Reconstruction
IDOT PTB 191-002
Contract: 62J26
Lake County, IL

Dear Mr. Ahmed:

Attached is a copy of the Structural Geotechnical Report for the above referenced project. The report provides a brief description of the site investigation, site conditions, and geotechnical recommendations for the proposed improvements. The site investigation included advancing seven (7) borings to depths of 40 feet and collecting twelve (12) pavement cores.

Should you have any questions or require additional information, please call us at 630-994-2600.

Sincerely,

Rachel Miller, P.E.
Project Engineer

Dawn Edgell, P.E.
Sr. Project Engineer

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1.0 INTRODUCTION

On behalf of the Illinois Department of Transportation (IDOT), Quigg Engineering Inc. (Quigg) retained GSG Consultants, Inc. (GSG) to complete a geotechnical investigation and to provide recommendations regarding the proposed US 41 Culvert Reconstruction. The four structures (SN-049-0228, SN-049-2016, SN-049-2015 and SN-049-0575) are located along US 41, from north of Illinois 173 to south of Westleigh Road. Structure SN 049-0228 is located in the Village of Wadsworth; SN 049-2015 and SN 049-2016 are located in the Village of Gurnee; and SN 049-0575 is located in the City of Lake Forest, Illinois. The location of the project corridor is marked below **(Project Location Map – Exhibit 1)**.

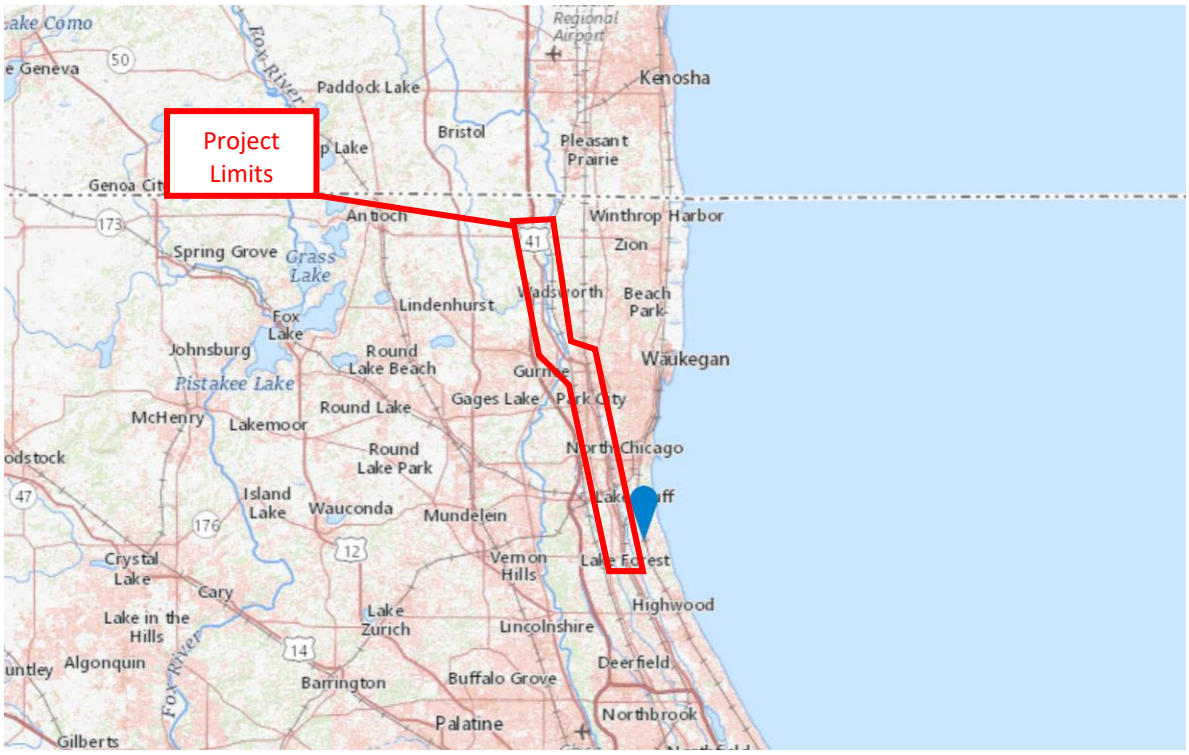


Exhibit 1: Project Location Map

1.1 Existing Site Conditions

There are four (4) existing drainage structures which will be modified as part of the proposed US 41 Culverts Reconstruction project. Each existing culvert structure (SN-049-0228, SN-049-2016, SN-049-2015 and SN-049-0575) consists of a 6'x 6' concrete box culvert conveying unnamed creeks under US 41.

1.2 Proposed Reconstruction

According to the 'FAP 346 (US Route 41) over Unnamed Creeks' provided by Quigg, portions of the existing drainage structures will be removed and replaced. At structure 0228, the wingwalls and approximately 7 feet of culvert, will be removed and replaced at each end of the culvert; the culvert bottom slab will remain. A corrugated steel liner plate arch will be installed within the culvert, and the area between the existing culvert and proposed culvert liner plates will be filled with grout or controlled low strength material (CLSM).

At structure 2016, the wingwalls and approximately 7 feet of culvert, will be removed and replaced at each end of the culvert, and the remaining portions of the top slab and sidewalls will be repaired.

At structure 2015, the wingwalls and approximately 7.5 feet of culvert, will be removed and replaced at each end of the culvert; the remaining sections of the top slab and sidewalls will be repaired.

At structure 0575, portions of the top slab, wingwalls and headwalls of the box culvert will be removed. Two new manholes will be constructed inside the culvert at the median and the west end of the culvert; a 24-inch storm sewer will be installed within the western portion of the existing culvert to connect the new manholes. The space between the existing culvert and the proposed storm sewer will be filled with CLSM.

It is anticipated that temporary sheet piling will be necessary at each of the locations for construction. **Table 1** presents a summary of the drainage structures. The design plans prepared by HBM, dated 06/01/2020 and 08/21/2020, are attached in **Appendix A**.

Table 1 – Summary of Existing Culverts

Structure Number	Proposed Structure	Proposed Stationing at Structure Center[1]	U.S. Inv. Elevation (ft.)	D.S. Inv. Elevation (ft.)	Slope (%)	Total Length
SN-049-0228	6'x 6' Concrete Box Culvert	50+01.91	682.4	681.7	0.48	138' 3"
SN-049-2016	6'x 6' Concrete Box Culvert	379+99.95	660.3	659.8	0.37	112' 9.5"
SN-049-2015	6'x 6' Concrete Box Culvert	393+60.24	661.2	660.5	0.55	112' 11"
SN-049-0575	6'x 6' Concrete Box Culvert	70+00.25	Manhole Inv. 670.89	SS Inv. 673.2	0.50	99' 10"

[1] Based on existing US 41 Stationing

1.3 Regional Geology

GSG reviewed several published documents in an effort to determine the regional geological setting in the area of the site. The site is located in Lake County. The surficial geologic deposits in this area are typically glacial drift deposited during the Wisconsin Age and sediments deposited by the Des Plaines River and various high-level states of Lake Michigan. The subsurface profile in the area of the site is variable and consists of deposits of silty clay, sand, and/or gravel extending to approximately 100 to 200 feet below ground surface, at which point bedrock is encountered. Deposits in the area are primarily from the Mackinaw Member of the Henry Formation and Blodgett Moraine of the Lake Border Morainic System. Underlying the surficial deposits, the bedrock is predominantly from the Silurian System, Niagaran Series, which consist almost entirely of dolomite.

2.0 SITE SUBSURFACE EXPLORATION PROGRAM

This section describes the subsurface exploration program and laboratory testing program completed as part of this project. The subsurface exploration program was performed in accordance with applicable IDOT geotechnical manuals and procedures.

2.1 Subsurface Exploration Program

The subsurface soil investigation was conducted between March 12 and March 31, 2020 and included advancing a total of seven (7) soil borings to depths of 40 feet. Boring location 2015-B-2 was terminated on an obstruction at a depth of 1.5 feet, then offset approximately 5 feet, and drilled to 40 feet (boring 2015-B-2A). The borings were completed through the existing shoulder and median pavement on US 41. The soil boring locations were selected by GSG based on the proposed plans provided by Quigg and completed at locations based on field conditions and site accessibility. **Table 2** presents a list of the borings completed along with their location information.

Table 2 – Summary of Subsurface Exploration Borings

Boring	Location	Existing Ground Elevation (ft)	Depth (ft)
SN-049-0228-B-1	Northbound Shoulder	691.76	40
SN-049-0228-B-2	Southbound Shoulder	689.78	40
SN-049-2016-B-1	Northbound Shoulder	668.33	40
SN-049-2016-B-2	Southbound Shoulder	668.50	40
SN-049-2015-B-1	Northbound Shoulder	669.18	40
SN-049-2015-B-2A	Southbound Shoulder	669.60	40
SN-049-0575-B-2	Southbound Shoulder	679.08	40

The existing ground surface elevations for the borings were based on the field survey performed by GSG. The approximate locations of the soil borings are shown on the **Boring Location Plans (Appendix B)**.

The soil borings were drilled using a truck mounted Diedrich D-50 and truck mounted Mobile B-57 drill rig, using 3¼-inch I.D. hollow stem augers and automatic hammers. 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 depths of 15 feet and 5-foot intervals thereafter to soil boring termination. GSG's field representative inspected, visually classified and logged the soil samples during the subsurface exploration activities and performed unconfined compressive strength tests on cohesive soil samples using a calibrated hand penetrometer in accordance with IDOT procedures and requirements. Representative soil samples were collected from each sample interval, were placed in jars, and returned to the laboratory for further testing and evaluation.

2.2 Laboratory Testing Program

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area of the proposed improvements. Moisture content tests (ASTM D2216 / AASHTO T-265) were performed on representative soil samples. The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (2015), and per ASTM and AASHTO requirements. Based on the laboratory test results, the soils encountered were classified according to the AASHTO and the Illinois Division of Highways (IDH) classification systems. The results of the laboratory testing program are shown along with the field test results in the **Soil Boring Logs (Appendix C)**.

2.3 Existing Pavement Conditions

The borings generally encountered 6 to 18 inches of asphalt; the pavement cores encountered 6.5 to 14 inches of asphalt. Gravel/sand subbase material was not encountered below the pavement. In addition to the soil borings, twelve pavement cores were completed along the shoulders of US 41 in the vicinity of the culverts. A summary of the pavement thicknesses from the borings and pavement cores is shown in **Table 3**. Photographs of the pavement cores collected are included in **Appendix D**.

Table 3 – Pavement Summary

Boring ID/Pavement Core ID	Location	Asphalt Thickness (in.)	Subbase Thickness (in.)	Total Pavement and Subbase Thickness (in.)
SN-049-0228-B-1	Northbound Shoulder	6.0	None	6.0
SN-049-0228-B-2	Southbound Shoulder	6.0	None	6.0
SN-049-2016-B-1	Northbound Shoulder	8.0	None	8.0
SN-049-2016-B-2	Southbound Shoulder	7.0	None	7.0
SN-049-2015-B-1	Northbound Shoulder	8.0	None	8.0
SN-049-2015-B-2A	Southbound Shoulder	8.0	None	8.0
SN-049-0575-B-2	Southbound Shoulder	18.0	None	18.0
SN-049-0228-PC-1	Southbound Outside Shoulder	6.5	None	6.5
SN-049-0228-PC-2	Southbound Gore Area	9.75	None	9.75
SN-049-0228-PC-3	Southbound Inside Shoulder	10.0	None	10.0
SN-049-0228-PC-4	Northbound Inside Shoulder	9.0	None	9.0
SN-049-0228-PC-5	Northbound Outside Shoulder	8.0	None	8.0
SN-049-2016-PC-1	Southbound Inside Shoulder	12.0	None	12.0
SN-049-2016-PC-2	Southbound Outside Shoulder	8.0	None	8.0
SN-049-2015-PC-1	Northbound Inside Shoulder	7.5	None	7.5
SN-049-2015-PC-2	Northbound Outside Shoulder	6.75	None	6.75
SN-049-0575-PC-1	Southbound Outside Shoulder	11.0	None	11.0
SN-049-0575-PC-2	Northbound Outside Shoulder	9.0	None	9.0
SN-049-0575-PC-3	Southbound Inside Shoulder	14.0	None	14.0

2.4 Subsurface Soil Conditions

This section provides a brief description of the soils encountered in the borings performed. Variations in the general subsurface soil profile were noted during the drilling activities. Detailed descriptions of the subsurface soils are provided in the soil boring logs. The soil boring logs provide specific conditions encountered at each boring location. The soil boring logs include soil

descriptions, stratifications, penetration resistance, elevations, location of the samples, and laboratory test data. Unless otherwise noted, soil descriptions indicated on boring logs are visual identifications. The stratifications shown on the boring logs represent the conditions only at the actual boring locations and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

SN-049-0228

Borings SN-049-0228-B-1 and SN-049-0228-B-2 were drilled in the vicinity of structure 0228 over an unnamed creek in Wadsworth, Illinois. The borings were drilled through the existing pavement on the shoulder of US 41, and initially noted 6 inches of asphalt. Beneath the asphalt, a mixture of silty clay fill, silty clay loam fill and sand fill soils were encountered to a depth of 11.5 feet below grade. At boring 0228-B-2 the fill soils were underlain by very stiff to stiff, brown and gray to gray silty clay soils, to the boring termination at 40 feet. At boring location 0228-B-1 the fill soils were underlain by a mixture of very stiff to hard, brown to gray, cohesive silty clay, sandy clay loam, and loose to dense, brown to gray silty sand and sandy loam.

The unconfined compressive strength values of the native silty clay and sandy clay loam soils ranged between 1 tsf and 4.5 tsf. The SPT blow count 'N' values of the granular soils ranged between 9 and 32 blows per foot (bpf).

SN-049-2016

Borings SN-049-2016-B-1 and SN-049-2016-B-2 were drilled in the vicinity of structure 2016 over an unnamed creek in Gurnee, Illinois. The borings were drilled through the existing pavement on the shoulder of US 41, and initially noted 7 to 8 inches of asphalt. Beneath the asphalt, a mixture of brown, gray and black silty clay fill and silty clay loam fill were encountered to a depth of 13.5 to 14 feet below grade. The fill soils were underlain by medium stiff to very stiff, brown and gray to gray, native silty clay to the soil boring termination at 40 feet. Granular silt and sandy clay seams were observed at depths of 28.5 and 29 feet.

The unconfined compressive strength values of the native silty clay ranged between 0.8 tsf and 3.1 tsf.

SN-049-2015

Borings SN-049-2015-B-1, and SN-049-2015-B-2A were drilled in the vicinity of structure 2015 over an unnamed creek in Gurnee, Illinois. The borings were drilled through the existing pavement on the shoulders of US 41, and initially noted 8 to 9.5 inches of asphalt. Beneath the asphalt, a mixture of silty clay fill, silty clay loam fill and sand fill soils were encountered to depths of 8.5 to 14 feet below grade. The fill soils were predominantly underlain by hard to stiff, brown and gray silty clay soils (with some sandy clay) to the boring termination at 40 feet. Very loose to medium dense, gray sand strata were interspersed within the silty clay from about 30 to 40 feet.

The unconfined compressive strength values of the native silty clay and sandy clay soils ranged between 1.5 tsf and 4.5 tsf. The SPT blow count 'N' values of the granular soils ranged between 3 and 17 bpf.

SN-049-0575

Boring SN-049-0575-B-2 was drilled in the vicinity of structure 0575 over an unnamed creek in Lake Forest, Illinois. The boring was drilled through the existing pavement on the outside southbound shoulder of US 41, and initially noted 18 inches of asphalt. Beneath the asphalt, a mixture of brown, gray and black silty clay fill and silty clay loam fill, with some organics, sand and gravel, were encountered to a depth of 18 feet below grade. The fill soils were underlain by stiff, gray silty clay soils to the boring termination at 40 feet. The unconfined compressive strength values of the native silty clay and sandy clay soils ranged between 1 tsf and 1.9 tsf.

2.5 Groundwater Conditions

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed. Groundwater was typically encountered while drilling at depths ranging from 18.5 to 38.5 feet, Water was not encountered at boring locations 0228-B-2 and 2015-B-2. Groundwater was not encountered after drilling in any of the boring locations.

Based on the observed water levels and color change from brown to gray, it is anticipated that the long-term groundwater level could range from 13.5 to 33.5 feet below grade, at the various locations along the corridor. The water level the in the vicinity of the proposed culverts may rise to near the level of the adjacent unnamed creeks. Water level readings were made in the

boreholes at times and under conditions shown on the boring logs and stated in the text of this report. However, it should be noted that fluctuations in groundwater level may occur due to variations in rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported herein.

3.0 GEOTECHNICAL ANALYSIS

This section provides GSG's geotechnical analysis and recommendations for the design of the proposed improvements based the results of the field exploration, laboratory testing, and geotechnical analysis. Subsurface conditions in unexplored locations may vary from those encountered at the boring locations. If structure locations, loadings, or elevations are changed, we request that GSG be contracted so that we may re-evaluate our recommendations.

3.1 Derivation of Soil Parameters for Design

GSG determined the geotechnical parameters to be used for the project design based on the results of the field and laboratory test data on individual boring logs as well as our experience. Unit weights, friction angles and shear strength parameters were estimated using standard penetration test (SPT) results for the fill and cohesionless soils and in-situ and laboratory test results for cohesive soils. The SPT values were corrected for hammer efficiency and overburden weight. The hammer efficiency correction factor considers the use of a safety hammer/rope/cat-head system, generally estimated to be 60% efficient. Thus, correlations should be based upon what is currently termed as N_{60} data. The efficiency of the automatic hammers for the truck mounted Diedrich D-50 drill and the truck mounted Mobile B-57 drill were estimated to be approximately 88% and 90%, respectively, based on GSG's most recent calibrations records. The correction for hammer efficiency is a direct ratio of relative efficiencies. The following equation should be used in calculating the corrected blow counts for the purposes of design and analysis:

$$N_{60} = N_{Field}*(88/60) \text{ (Diedrich D-50)}$$
$$N_{60} = N_{Field}*(90/60) \text{ (Mobile B-57)}$$

*Where the N_{Field} value is the field recorded blow counts during drilling activities.

Based on the field investigation data collected, generalized soil parameters for the soils for use in design at each of the culvert locations are presented in **Tables 4a** thru **4d.**

Table 4a – Summary of Soil Parameters
(SN-049-0228)

Depth / Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
	New Engineered Clay Fill	125	1,000	0	50	25
	New Engineered Granular Fill	125	0	30	0	30
0-1.7 (690-688.3) **B-1 only**	FILL Brown and Gray Sand	136	0	26	0	26
0.7-11.7 (689.3-678.3) **B-2 only**	FILL Brown and Gray Silty Clay Loam	120	0	30	0	30
1.7-9.7 (688.3-680.3) **B-1 only**	FILL Brown, Gray and Black Silty Clay	135	3,000	0	300	25
9.7-40.2 (680.3-649.8)	Brown to Gray Stiff to Hard Silty Clay	134	2,800	0	280	28
16.7-21.7 (673.3-668.3) **B-1 only**	Brown Loose Silty Sand	120	0	30	0	30
21.7-31.7 (668.3-658.3) **B-1 only**	Brown Very Stiff Sandy Clay Loam	131	2,250	0	220	28
31.7-36.7 (658.3-653.3) **B-1 only**	Gray Dense Sandy Loam	132	0	35	0	35

Table 4b – Summary of Soil Parameters
(SN-049-2016)

Depth / Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
	New Engineered Clay Fill	125	1,000	0	50	25
	New Engineered Granular Fill	125	0	30	0	30
0-14 (668.5-654.5)	FILL Brown and Gray and Black Silty Clay	138	1,860	0	75	25
0.8-8.7 (667.7-659.9) **B-1 only**	FILL Black and Gray Silty Clay Loam	138	1,860	0	75	25
14-40 (654.5-628.5)	Gray Medium Stiff to Very Stiff Silty Clay	137	1,730	0	175	26

Table 4c – Summary of Soil Parameters
(SN-049-2015)

Depth / Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
	New Engineered Clay Fill	125	1,000	0	50	25
	New Engineered Granular Fill	125	0	30	0	30
0.1-2.9 (668.9-666.1) **B-2A**	FILL Brown Sand	136	0	30	0	30
0.5-3.3 (668.5-665.7) **B-1 only**	FILL Brown Silty Clay Loam	132	0	26	0	26
3-11 (666-658)	FILL Brown and Gray Silty Clay	139	4,000	0	400	25
11-32 (658-637)	Brown and Gray Hard to Stiff Silty Clay	136	3,300	0	330	28
28.9-33.9 (640.1-635.1) **B-2A only**	Gray Medium Dense Sand	123	0	34	0	34
33.8-38.8 (635.2-630.2) **B-1 only**	Gray Very Loose Sand	105	0	28	0	28
33.9-39.8 (635.1-629.2)	Gray and Brown Very Stiff Silty Clay	133	2,550	0	250	28

Table 4d – Summary of Soil Parameters
(SN-049-0575)

Depth / Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
	New Engineered Clay Fill	125	1,000	0	50	25
	New Engineered Granular Fill	125	0	30	0	30
0-7 (679.1-672.1)	FILL Brown, Gray and Black Silty Clay Loam	121	0	26	0	26
7-10 (672.1-669.1)	FILL Brown and Gray Silty Clay	133	2,500	0	250	25
10-13 (669.1-666.1)	FILL Brown and Black Silty Clay Loam	133	0	30	0	30
13-18 (666.1-661.1)	FILL Brown and Gray Silty Clay	147	7,300	0	300	25
18-40 (661.1-639.1)	Gray Stiff Silty Clay	135	1,500	0	150	28

3.2 Seismic Parameters

The seismic hazard for the site was analyzed per the IDOT Geotechnical Manual, IDOT Bridge Design Manual, and AASHTO LRFD Bridge Design Specifications.

The Seismic Soil Site Class was determined per the requirements of All Geotechnical Manual Users (AGMU) Memo 9.1, Design Guide for Seismic Site Class Determination, and the "Seismic Site Class Determination" Excel spreadsheet provided by IDOT. A global Site Class Definition was determined for this project, and was found to be Soil Site Class D. The Seismic Performance Zone (SPZ) was determined using Figure 2.3.10-2 in the IDOT Bridge Manual and was found to be Seismic Performance Zone 1.

The AASHTO Seismic Design Parameters program was used to determine the peak ground acceleration coefficient (PGA), and the short (S_{DS}) and long (S_{D1}) period design spectral acceleration coefficients for each of the proposed structures. For this section of the project, the S_{DS} and the S_{D1} were determined using 2017 AASHTO Guide Specifications as shown in **Table 5**. Given the site location and materials encountered, the potential for liquefaction is minimal.

Table 5 – Seismic Parameters

Building Code Reference	PGA	S_{DS}	S_{D1}
2017 AASHTO Guide for LRFD Seismic Bridge Design	0.035g	0.123g	0.076g

4.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

This section provides the results of GSG's geotechnical evaluation of the existing foundation system and design recommendations in accordance with the most current AASHTO LRFD 8th Edition (2017) and IDOT Geotechnical Manual (2015). The foundations for the proposed culvert extensions and wingwalls must provide sufficient support to resist the dead and live loads.

4.1 Culvert and Wingwall Foundation Recommendations

GSG evaluated the soils for the proposed culverts extensions and improvements. The recommendations in this report are based on plan drawings provided by HBM, dated 06/01/2020 and 08/21/2020. GSG's evaluation included recommending allowable bearing capacities and construction recommendations for the installation of new culvert extension and horizontal wingwalls. For the design of the foundations, the total live load, impact loads, and dead loads, including the load of the overburden soils, should be considered. Design should be completed in accordance with the IDOT Culvert Manual (2017).

4.2 Shallow Foundation Bearing Capacity and Settlement

GSG evaluated the soils at bearing grade for the base of the proposed culvert extensions. Bearing resistance shall be evaluated at the strength limit state using load factors and factored bearing resistance. The bearing resistance factor, ϕ_b, for shallow foundations in clay and sand are 0.50 and 0.45 per AASHTO Table 10.5.5.2.2.1. The bearing resistance shall be checked for the extreme limit state with a resistance factor of 1.0. **Table 6** presents the proposed bearing elevation and recommended bearing resistances of suitable materials to support the proposed culvert extensions and wingwalls.

Table 6 – Recommended Bearing Resistance

Proposed Structure	Approximate Bearing Elevation (feet)*	Nominal Resistance (ksf)	Factored Bearing Resistance (ksf)	Bearing Resistance for 1-inch Settlement Service Limit (ksf)	Anticipated Bearing Soil
SN-049-0228	681.0	10.1	5.0	5.0	Silty Clay Loam FILL/Silty Clay FILL
SN-049-0228 Wingwalls	679.0	5.8	2.9	5.8	Silty Clay Loam FILL/Silty Clay
SN-049-0575	669.5	14.0	7.0	5.8	Silty Clay FILL
SN-049-2015	659.5	18.2	9.1	4.4	Silty Clay Fill/ Very Stiff Silty Clay
SN-049-2015 Wingwalls	657.0	18.9	9.5	9.0	Silty Clay Fill/ Very Stiff Silty Clay
SN-049-2016	655.0	6.4**	3.2**	3.3	New Engineered Granular Fill
SN-049-2016 Wingwalls	655.0	5.7**	2.9**	5.7	New Engineered Granular Fill

*Elevations based on invert elevations on GP&E drawings dated June 1, 2020 and August 21, 2020

**Bearing resistances based on 48-inch granular engineered fill platform over native clay soils encountered at El. 655 ft

The subgrade soils at bearing grade should be evaluated per the guidelines provided in Section 8.9 of IDOT Geotechnical Manual (2015) for suitability/workability prior to placing any portion of the proposed culvert structures. 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 culverts SN-049-0228 and SN-049-2015 the soil under the culvert shall be undercut to the bottom of the toe wall and backfilled with compacted granular engineered fill consisting of rock fill capped with 6 inches of porous granular material.

For culvert SN-049-2016 and the associated wingwalls, GSG recommends undercutting the low strength clay soils encountered in boring B-1 to the native very stiff clay soils at elevation 655 feet. The undercut depth should be verified in the field during construction and backfilled with compacted granular engineered fill, consisting of rock fill capped with 6 inches of porous granular material, to support the proposed culvert and wingwalls.

Settlement depends on the foundation size and bearing resistance, as well as the strength and compressibility characteristics of the underlying bearing soil. Assuming the foundation subgrades have been prepared as recommended and the service limit bearing resistances for different settlements are used, settlement of the culvert extensions and wingwalls will be on the order of 1.0 inch.

The wingwalls will be constructed as horizontal cantilever walls attached to the culvert walls. Wingwalls should be designed based on the information and typical sections shown in Section 4.2 of the IDOT Culvert Manual (IDOT 2017). Headwalls should be designed based on the information provided in Section 4.1.5 of the IDOT Culvert Manual (IDOT 2017).

4.3 Sheet Pile Wall Design

Sheet pile walls are typically used in cut areas when continuous support must be provided to maintain existing structures or other adjacent facilities. To provide lateral resistance against the retained soil, the walls can be designed to act as a cantilever or can use tie backs behind the wall. The installation of sheet pile walls requires the use of specialty equipment to drive the sheets into the ground. The walls maintain the existing site conditions with minimal disturbance to existing structures and can be installed relatively quickly. Due to the presence of stiff to hard clays and the occasional presence of cobbles (at borings SN-049-0228-B-2 and SN-049-2015-B-2A), we recommend using a heavier pile section with a minimum thickness of 0.4 inch to alleviate any damage to the pile section during driving. Grade 50 steel should be used for the sheet pile. The interlocks could be partially clogged during driving and after installation due to fine soil particle migration. The steel sheet piles may be subject to corrosion. Corrosion rates are typically a function of temperature, soil pH, access to oxygen, and chemistry of the environment surrounding the pile. The walls are intended to be temporary, but if the walls are to remain in place as a long-term wall, corrosion deterioration should be considered on the sheet pile wall design.

4.4 Lateral Load Resistance

4.4.1 Culverts and Wingwalls – Lateral Resistance

The culvert walls will be subject to uneven loading and should be evaluated for anticipated lateral loads. Lateral earth pressures for permanent underground structures will be dependent on the type of backfill used, whether it is in a drained or undrained state, as well as loading conditions. The proposed culvert sidewalls should be designed using the at-rest earth pressure coefficients provided in **Tables 7a** through **7d**.

The lateral earth pressures for the headwalls and wingwalls should be designed per the guidance provided in Section 4 of the IDOT Culvert Manual (2017). Wall sections that are independent of the box culvert should be designed using the Rankine active earth pressure coefficient, K_a. Headwalls and wingwalls that are fixed to the box culvert to resist movement should be designed using an at-rest earth pressure coefficient. Lateral design parameters provided in **Tables 7a** through **7d** could be used in the design of the proposed structures.

4.4.2 Sheet Pile Walls – Lateral Resistance

The sheet pile walls shall be designed to withstand earth and live lateral earth pressures. The lateral earth pressures on retaining walls depend on the type of wall (i.e. restrained or unrestrained), the type of backfill and the method of placement against the wall, and the magnitude of surcharge weight on the ground surface adjacent to the wall. Sheet pile walls are considered flexible and such the earth loads may be calculated using active earth pressure for load above the design grade, and both active and passive earth pressures below the design grade. The active earth pressure coefficient (K_a), and the passive earth pressure coefficient (K_p) were determined in accordance with AASHTO Section 3.11.5.3 and 3.11.5.4, respectively.

The design should include a structural evaluation of the sheet pile section to meet applied shear and moment, and an evaluation of overturning to determine embedment depth and other design requirements. The simplified earth pressure distributions shown in the AASHTO Standard Specifications for Highway Bridges could be used for the wall design. **Tables 7a thru 7d** provide recommended lateral soil modulus and soil strain parameters that can be used for laterally loaded pile analysis via the p-y curve method based on the encountered subsurface conditions. The passive resistance in front of the sheet pile wall should be ignored for the upper 3.5 feet due to excavation activities and frost-heave conditions.

Traffic and other surcharge loads should be included in the sheet pile retaining wall design where applicable. A live load surcharge of 250 psf (or the equivalent weight of 2 feet soil overburden) should be applied where vehicular load is expected to act on the surface of the backfill. Heavy equipment should not be allowed closer than five (5) feet to the retaining wall to prevent inducing high lateral earth pressures and causing wall yielding and/or other damage.

Table 7a –Lateral Load Resistance Soil Parameters

(SN-049-0228)

Depth / Elevation Range (feet)	Soil Description	Lateral Earth Pressure Coefficient			Lateral Modulus of Subgrade Reaction (pci)	Soil Strain (ε_{50})
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)		
	New Engineered Clay Fill	0.41	2.46	0.58	100	0.007
	New Engineered Granular Fill	0.33	3.00	0.50	25	N/A
0-1.7 (690-688.3) **B-1 only**	FILL Brown and Gray Sand	0.39	2.56	0.56	25	N/A
0.7-11.7 (689.3-678.3) **B-2 only**	FILL Brown and Gray Silty Clay Loam	0.33	3.00	0.50	25	N/A
1.7-9.7 (688.3-680.3) **B-1 only**	FILL Brown, Gray and Black Silty Clay	0.41	2.46	0.58	1,500	0.005
9.7-40.2 (680.3-649.8)	Brown to Gray Stiff to Hard Silty Clay	0.36	2.77	0.53	1,400	0.005
16.7-21.7 (673.3-668.3) **B-1 only**	Brown Loose Silty Sand	0.33	3.00	0.50	25	N/A
21.7-31.7 (668.3-658.3) **B-1 only**	Brown Very Stiff Sandy Clay Loam	0.36	2.77	0.53	1,120	0.005
31.7-36.7 (658.3-653.3) **B-1 only**	Gray Dense Sandy Loam	0.27	3.69	0.43	125	N/A

Table 7b –Lateral Load Resistance Soil Parameters
(SN-049-2016)

Depth / Elevation Range (feet)	Soil Description	Lateral Earth Pressure Coefficient			Lateral Modulus of Subgrade Reaction (pci)	Soil Strain (ε_{50})
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)		
	New Engineered Clay Fill	0.41	2.46	0.58	100	0.007
	New Engineered Granular Fill	0.33	3.00	0.50	25	N/A
0-14 (668.5-654.5)	FILL Brown and Gray and Black Silty Clay	0.41	2.46	0.58	930	0.007
0.8-8.7 (667.7-659.9) **B-1 only**	FILL Black and Gray Silty Clay Loam	0.41	2.46	0.58	930	0.007
14-40 (654.5-628.5)	Gray Medium Stiff to Very Stiff Silty Clay	0.39	2.56	0.56	860	0.007

Table 7c –Lateral Load Resistance Soil Parameters

(SN-049-2015)

Depth / Elevation Range (feet)	Soil Description	Lateral Earth Pressure Coefficient			Lateral Modulus of Subgrade Reaction (pci)	Soil Strain (ε_{50})
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)		
	New Engineered Clay Fill	0.41	2.46	0.58	100	0.007
	New Engineered Granular Fill	0.33	3.00	0.50	25	N/A
0.1-2.9 (668.9-666.1) **B-2A**	FILL Brown Sand	0.33	3.00	0.50	90	N/A
0.5-3.3 (668.5-665.7) **B-1 only**	FILL Brown Silty Clay Loam	0.39	2.56	0.56	25	N/A
3-11 (666-658)	FILL Brown and Gray Silty Clay	0.41	2.46	0.58	2,000	0.004
11-32 (658-637)	Brown and Gray Hard to Stiff Silty Clay	0.36	2.77	0.53	1,660	0.005
28.9-33.9 (640.1-635.1) **B-2A only**	Gray Medium Dense Sand	0.28	3.53	0.44	90	N/A
33.8-38.8 (635.2-630.2) **B-1 only**	Gray Very Loose Sand	0.36	2.77	0.53	20	N/A
33.9-39.8 (635.1-629.2)	Gray and Brown Very Stiff Silty Clay	0.36	2.77	0.53	1,270	0.005

Table 7d –Lateral Load Resistance Soil Parameters

(SN-049-0575)

Depth / Elevation Range (feet)	Soil Description	Lateral Earth Pressure Coefficient			Lateral Modulus of Subgrade Reaction (pci)	Soil Strain (ε_{50})
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)		
	New Engineered Clay Fill	0.41	2.46	0.58	100	0.007
	New Engineered Granular Fill	0.33	3.00	0.50	25	N/A
0-7 (679.1-672.1)	FILL Brown, Gray and Black Silty Clay Loam	0.39	2.56	0.56	25	N/A
7-10 (672.1-669.1)	FILL Brown and Gray Silty Clay	0.41	2.46	0.58	1,250	0.005
10-13 (669.1-666.1)	FILL Brown and Black Silty Clay Loam	0.33	3.00	0.50	90	N/A
13-18 (666.1-661.1)	FILL Brown and Gray Silty Clay	0.41	2.46	0.58	3,650	0.004
18-40 (661.1-639.1)	Gray Stiff Silty Clay	0.36	2.77	0.53	760	0.007

5.0 CONSTRUCTION CONSIDERATIONS

All work performed for the proposed project should conform to the requirements in the IDOT Standard Specifications for Road and Bridge Construction (SSRBC) (2016) and the IDOT Subgrade Stability Manual (2005). Any deviation from the requirements in the manuals above should be approved by the design engineer.

5.1 Site Preparation

Any topsoil encountered during construction should be stripped and stockpiled as per Section 211.03 of the IDOT Standard Specifications for Road and Bridge Construction (SSRBC). The topsoil should be separated from other materials being stockpiled onsite for reuse or haul off. Base coarse aggregate encountered at the site should be evaluated to determine suitability for reuse as general fill. The contractor should not mix the existing base course materials, if any, with existing subgrade soils during the stripping and stockpiling activities.

5.2 Scour Considerations

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.

5.3 Site Excavation

Site excavations are expected to encounter various types of soils as described in the Subsurface Exploration section of this report. The contractor will be responsible to provide a safe excavation during the construction activities of the project. All excavations should be conducted in accordance with applicable federal, state, and local safety regulations, including, but not limited to the Occupational Safety and Health Administration (OSHA) excavation safety standards. In accordance with OSHA Regulation 29 CFR 1926 Subpart P Appendix B, the maximum allowable slopes for excavations less than 20 feet should be completed per the OSHA Excavation Slopes shown in **Table 8**. Excavations made in layered soil systems shall use the maximum allowable slope for each layer as prescribed in the OSHA Regulation. Excavations greater than 20 feet deep should be designed by a registered professional engineer; any shoring or bracing systems should be designed by a licensed structural engineer.

Table 8 – OSHA Excavation Slopes

Soil or Rock Type	Maximum Allowable Slope (H:V) for less than 20 feet
Stable Rock	Vertical (90°)
Type A	¾:1 (53 °)
Type B	1:1 (45 °)
Type C	1 ½:1 (34 °)

Excavation stability and soil pressures on temporary shoring are dependent on soil conditions, depth of excavations, installation procedures, and the magnitude of any surcharge loads on the ground surface adjacent to the excavation. Surcharge loads from the excavated materials, construction equipment, and vehicles should be included in the design of the excavation system. Excavation near existing structures and underground utilities should be performed with extreme care to avoid undermining existing structures.

If water seepage occurs during excavation or where wet conditions are encountered such that the water cannot be removed with conventional sumping, GSG recommends placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation below the water table. The CA-7 stone should be placed to 12 inches above the water table, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation beneath the footings should be backfilled using approved structural fill consisting of granular materials such as IDOT CA-6.

5.4 Borrow Material and Compaction Requirements

If borrow material is to be used for onsite construction, it should conform to Section 204 "Borrow and Furnish Excavations" of the IDOT SSRBC (2016). The fill material should be free of organic matter and debris and should be placed and compacted in accordance with Section 205, Embankment, of the IDOT Construction Manual. Earth-moving operations should be avoided during excessively cold or wet weather to avoid freezing of softening subgrade soils. All backfill materials around the culvert must be pre-approved by the site engineer. Backfill materials for undercut areas beneath the culvert should be placed in 8 inches loose lifts and should be compacted to 95% of the maximum dry density as determined by AASTHO T-180, Modified Proctor Method.

5.5 Groundwater Management

it is anticipated that the long-term groundwater level could range from 13.5 to 33.5 feet along the project corridor. However, the water level the in the vicinity of the culverts may rise to near the level of each adjacent unnamed creek. GSG anticipates groundwater related issues may occur during construction activity due to the extent of the proposed improvements for the culvert and the anticipated time frame for the excavation construction. To avoid potential ground water issues during construction, GSG recommends that the sheet piles incorporate interlocking edges and extend into the clay soils, to act as a cutoff wall to help prevent ground water from entering the site. If rainwater run-off or groundwater is accumulated at the base of excavations, the contractor should remove accumulated water using conventional sump pit and pump procedures and maintain a dry and stable excavation. The location of the sump should be determined by the contractor based on field conditions. During earthmoving activities at the site, grading should be performed to ensure that drainage is maintained throughout the construction period. Water should not be allowed to accumulate in the foundation area either during or after construction. Undercut and excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

If water seepage occurs during the excavations on the shorelines or where wet conditions are encountered such that the water cannot be removed with conventional sumping, we recommend placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation below the water table. The CA-7 stone should be placed to 12 inches above the water table, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation beneath the footings should be backfilled using approved structural fill.

6.0 LIMITATIONS

This report has been prepared for the exclusive use of the Illinois Department of Transportation and its consultant team. The recommendations provided in the report are specific to the project described herein and are based on the information obtained from the soil boring locations within the proposed project limits. The analyses have been performed and the recommendations have been provided in this report are based on subsurface conditions determined at the location of the borings. This report may not reflect all variations that may occur between boring locations or at some other time, the nature and extent of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations presented herein.

APPENDIX A

GENERAL PLANS (DATED 06/01/2020)

Benchmark: Chisled square in concrete base of weigh station sign in the center median of US-41 (Located approximately 100' South of SN 049-0228). Elevation 688.47.

Existing Structure: The structure at US 41 located 0.5 miles north of IL Route 173 is a single-cell reinforced concrete box culvert. The culvert is 138'-3" in length (out-to-out headwalls). The cell width and height are both approximately 6 ft. The structure spans east to west and carries two northbound lanes, two southbound lanes, and one southbound ramp lane for a total of five traffic lanes. A metal guardrail is present on both sides of the culvert.

Salvage : No Salvage

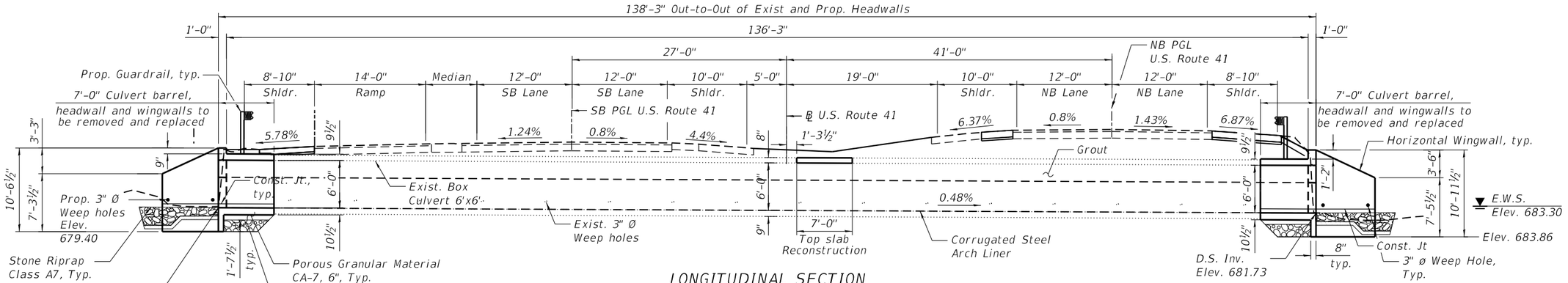
Precast Alternative is not allowed

LOADING HS-20

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

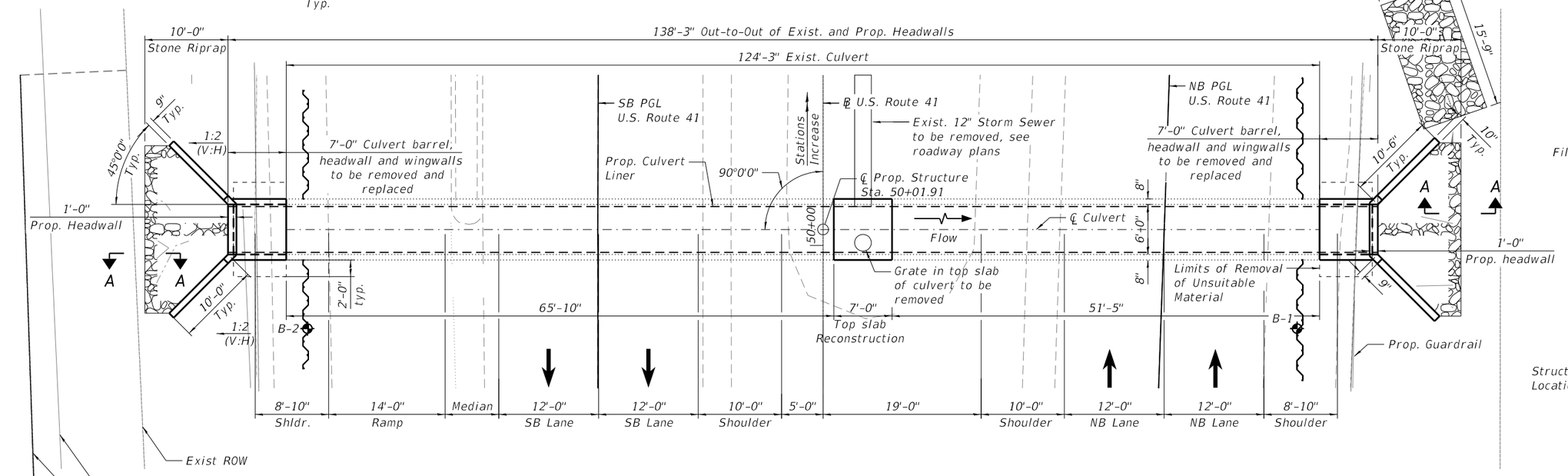
DESIGN SPECIFICATIONS

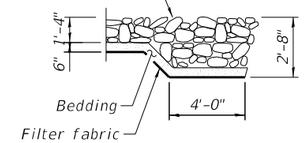
2017 AASHTO LRFD Design Specifications, 8th Edition



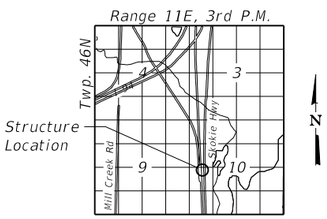
LONGITUDINAL SECTION

(Dimesnions at Rt. ℒ's to ℄ Roadway)
(Looking Upstation)





SECTION A-A



LOCATION SKETCH

LEGEND

- Temporary Sheet Piling
- Soil Boring
- Limits of Removal of Unsuitable Material
- Stone Riprap, Class A7

Boring	Station	Offset
B-1	49+90.00	57ft Rt.
B-2	49+90.00	62ft Lt.

PLAN

N

NOTE

For General Notes, Scope of Work, Index of Sheets and Bill of Material, see Sheet S1-02.

STATE OF ILLINOIS
MOUSSA A. ISSA
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LICENSED STRUCTURAL ENGINEER

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Dr. Moussa A. Issa, S.E.
Il. Lic. No. 081-005738
Expires 11-30-2020

Date _____
For Sheets S1-01 Thru S1-12
(Total of 12 Sheets)

GENERAL PLAN
U.S. 41 (SKOKIE HIGHWAY) OVER UNNAMED CREEK
F.A.P. 346 SECTION 2019-049-T
LAKE COUNTY
STA. 50+01.91
STRUCTURE NO. 049-0228

HBM ENGINEERING GROUP, LLC

USER NAME =	DESIGNED - FL, LAB	REVISED -	
	CHECKED - MI, MAI	REVISED -	
PLOT SCALE =	DRAWN - FL	REVISED -	
PLOT DATE =	DATE - 8/21/2020	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

S.N. 049-0228 US 41 (SKOKIE HIGHWAY) OVER UNNAMED CREEK

SHEET S1-01 OF S1-12 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	2019-049-T	LAKE	139	65
		CONTRACT NO. 62J26		
		ILLINOIS	FED. AID PROJECT	

MODEL: Default
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Bench Mark: Cutcross on top of barrier wall (Located approximately 250' North of SN 049--2016). Elevation 670.86.

Existing Structure: The structure at US 41 is located 0.6 miles north of Stearns School Rd is a single cell reinforced concrete box culvert. The culvert is approximately 112'-9½" in length (out-to-out headwalls). The cell width and height are both approximately 6'-0". The structure spans east to west and carries two lanes of northbound and southbound traffic for a total of four traffic lanes. A metal guardrail is present on both sides of the culvert.

Salvage: No Salvage.
Precast alternative is not allowed.

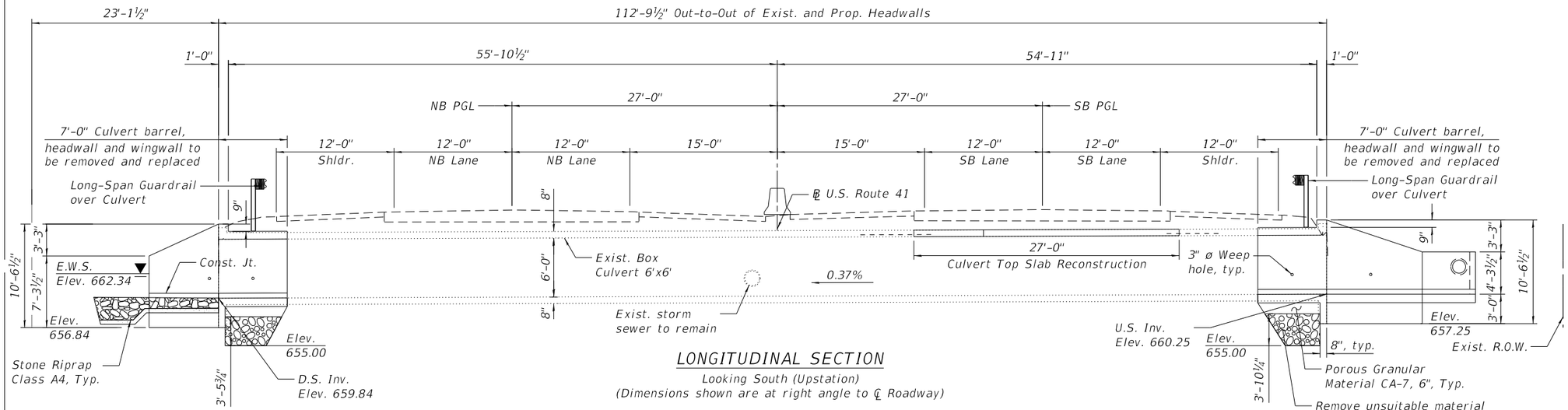
Boring	Station	Offset
B-1	370+00	45.00' Rt.
B-2	360+00	45.00' Lt.

NOTE:

1. For General Notes, Scope of Work, Waterway Information Table, Index of Sheets and Bill of Material, see Sheet S2-02.

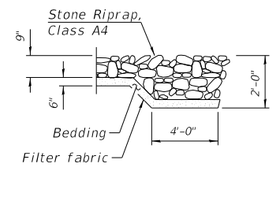
DESIGN SPECIFICATIONS

2017 AASHTO LRFD Design Specifications, 8th Edition

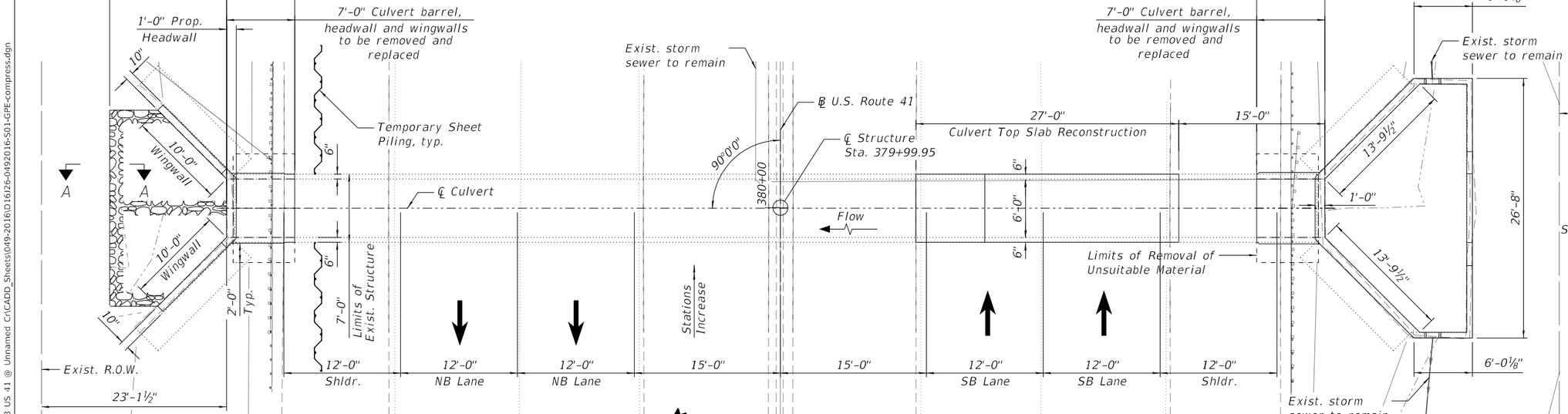


LONGITUDINAL SECTION

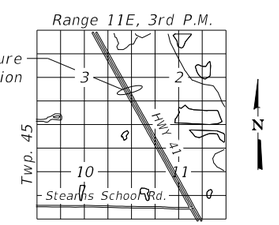
Looking South (Upstation)
(Dimensions shown are at right angle to ℄ Roadway)



SECTION A-A



PLAN



LOCATION SKETCH

LEGEND:

- Temporary Sheet Piling
- Prop. Guardrail
- Limits of Removal of Unsuitable Material

STATE OF ILLINOIS
MOUSSA A. ISSA
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Dr. Moussa A. Issa, S.E. Il. Lic. No. 081-005738
Expires 11-30-2020

Date _____
For Sheets S2-01thru S2-14
(Total of 14 Sheets)

GENERAL PLAN

U.S. 41 (SKOKIE HIGHWAY) OVER SMALL CREEK

F.A.P. 346 SECTION 124X

LAKE COUNTY

STA. 380+00.00

STRUCTURE NO. 049-2016

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HBM ENGINEERING GROUP, LLC

USER NAME =	DESIGNED - EBK, FL	REVISED -	
	CHECKED - MI, MAI	REVISED -	
PLOT SCALE =	DRAWN - AMS	REVISED -	
PLOT DATE =	DATE - 8/21/2020	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

S.N. 049-2016 US 41 (SKOKIE HIGHWAY) OVER UNNAMED CREEK

SHEET S2-01 OF S2-14 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	2019-049-T	LAKE	139	77
		CONTRACT NO. 62J26		
	ILLINOIS	FED. AID PROJECT		

Bench Mark: Cutcross on top of barrier wall (Located approximately 230' South of SN 049-2015). Elevation 672.15.

Existing Structure: The structure at US 41 is located 0.5 miles north of IL Route 21 is a single cell reinforced concrete box culvert. The culvert is approximately 112'-11" in length (out-to-out headwalls). The cell height and width are approximately 6'-0". The structure spans east to west and carries two lanes of northbound and southbound traffic for a total of four traffic lanes. A metal guardrail is present on both sides of the culvert.

Salvage: No Salvage.
Precast Alternative is not allowed.

NOTE:

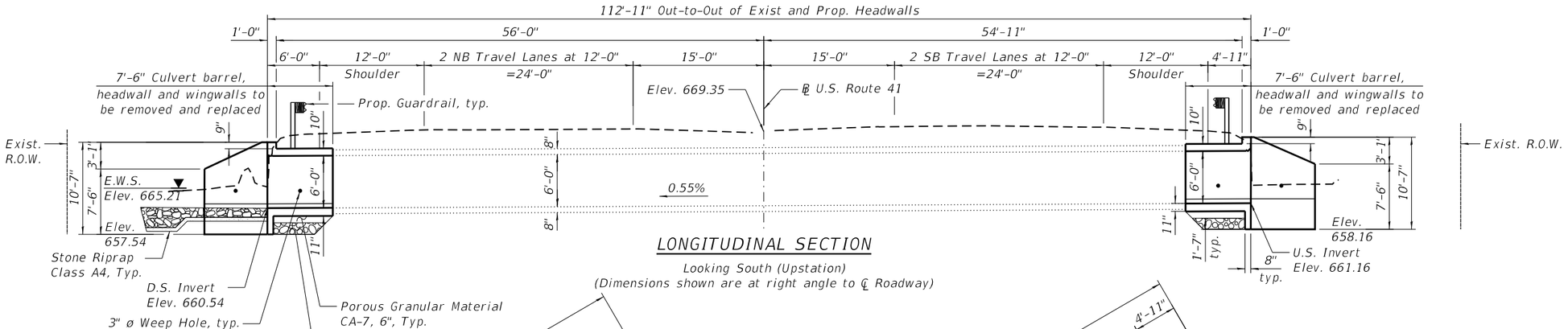
For General Notes, Scope of Work, Waterway Information Table, Index of Sheets and Bill of Material, see Sheet S3-02.

LOADING HS-20

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

DESIGN SPECIFICATIONS

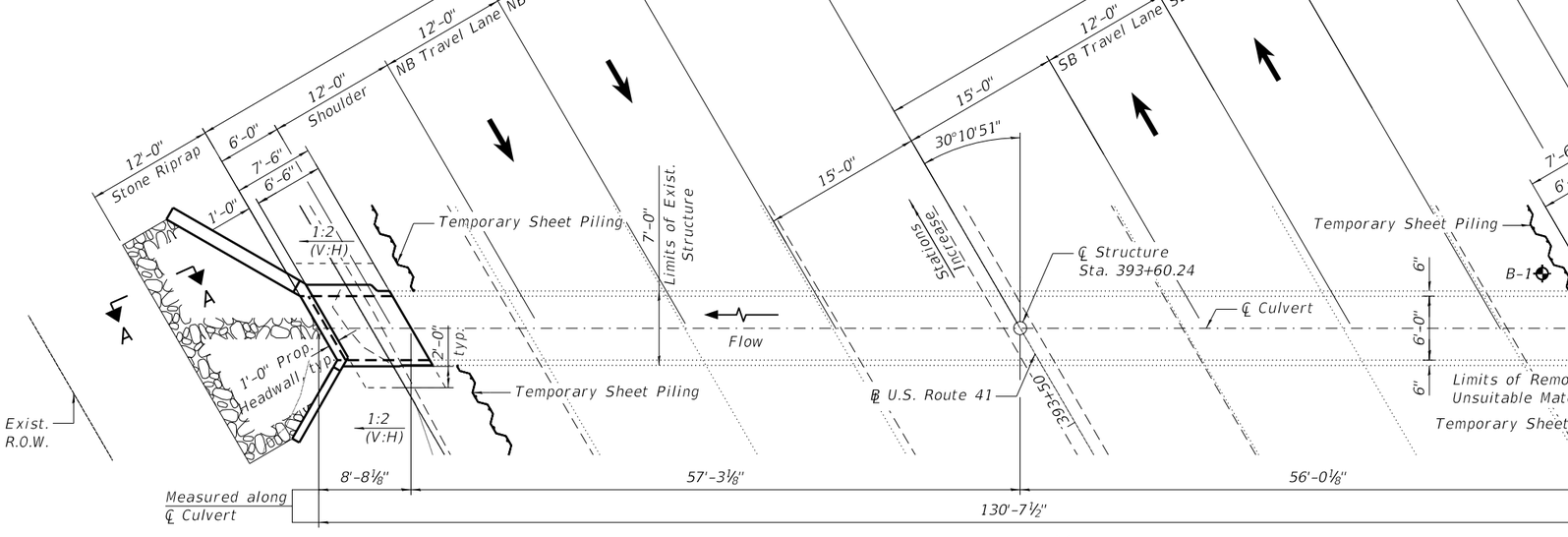
2017 AASHTO LRFD Design Specifications, 8th Edition



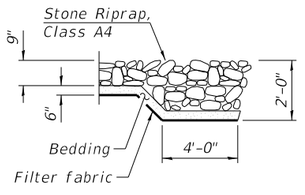
LONGITUDINAL SECTION

Looking South (Upstation)
(Dimensions shown are at right angle to ℄ Roadway)

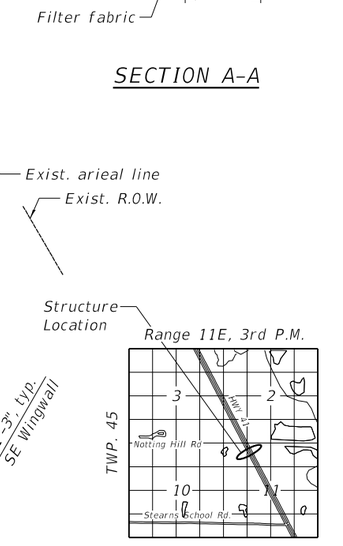
Boring	Station	Offset
B-1	393+40	45.00' Rt.
B-2A	393+50	42.00' Lt.



PLAN



SECTION A-A



LOCATION SKETCH

LEGEND

- Temporary Sheet Piling
- Prop. Guardrail
- Limits of Removal of Unsuitable Material
- Soil Boring
- B-2A

STATE OF ILLINOIS
MOUSSA A. ISSA
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Expires 11-30-2020

Date _____
For Sheets S3-01 thru S3-11
(Total of 11 Sheets)

GENERAL PLAN
U.S. 14 (SKOKIE HIGHWAY) OVER SMALL CREEK
F.A.P. 346 SECTION 2019-049-T
LAKE COUNTY
STA. 393+60.24
STRUCTURE NO. 049-2015

HBM ENGINEERING GROUP, LLC

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	CHECKED - MI, MAI	REVISED -
PLOT SCALE =	DRAWN - JMI	REVISED -
PLOT DATE =	DATE - 8/21/2020	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

S.N. 049-2015 US 41 (SKOKIE HIGHWAY) OVER UNNAMED CREEK

SHEET S3-01 OF S3-11 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	2019-049-T	LAKE	139	91
		CONTRACT NO. 62J26		
	ILLINOIS	FED. AID PROJECT		

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Benchmark: XX

Existing Structure: S.N. 049-0575 Located on US 41 over a unnamed creek is a concrete single cell box culvert. The culvert is 99'-10" in length with no skew; the cell width and height are both approximately 6 ft. The wingwalls are 6'-6" long on the east end of the culvert with a 2'-6" high headwall with a 45° angle to the rest of the structure on both ends of the structure. On the west end of the culvert, the wingwalls are 7'-6" long with 1'-3" high headwall. The original construction took place in 1935 under P.W.S Project 8873 Section 21 as a cattle pass structure. The structure has since been widened, but no structural plans of the widening were found.

DESIGN STRESSES

EXISTING UNITS

f'c = 1,200 psi (Concrete)
fs = 20,000 psi (Reinforcement)

LOADING HL-93

Allow 50 #/sq. ft. for Future Wearing Surface

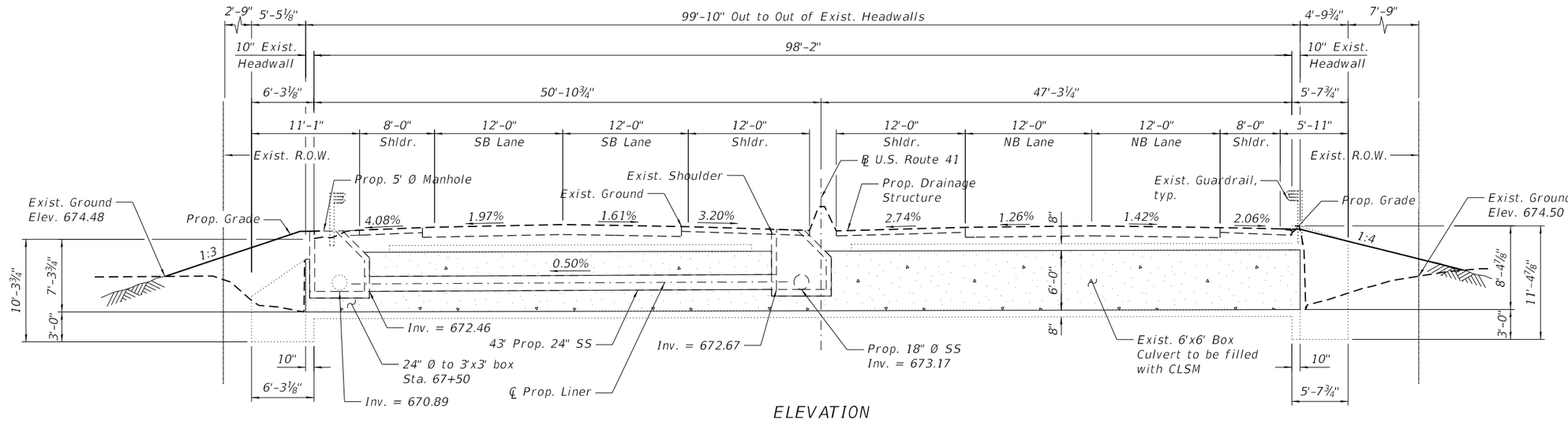
DESIGN SPECIFICATIONS

AASHTO Standard Specifications for Highway Bridges, 17th Edition, 2002

STATE OF ILLINOIS
MOUSSA A. ISSA
081-005738
CHICAGO, ILLINOIS
LICENSED STRUCTURAL ENGINEER

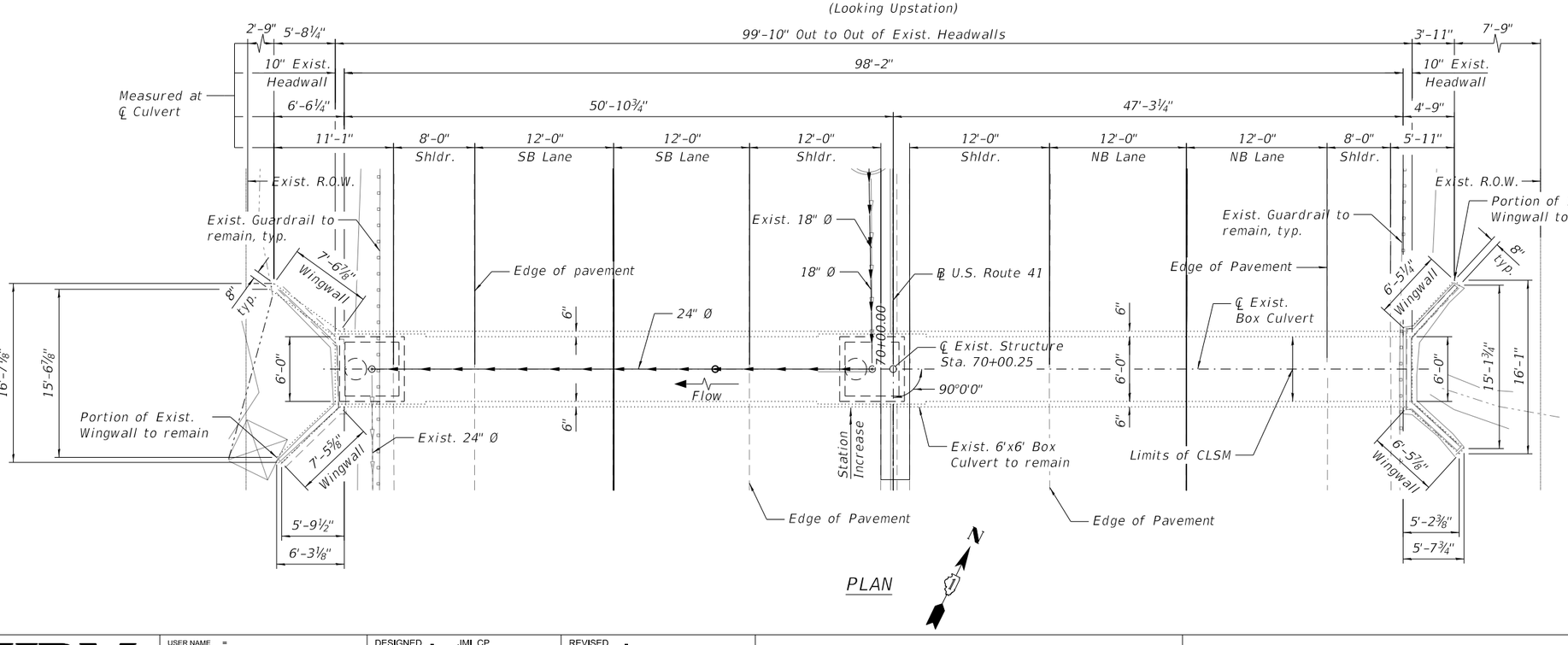
Signed _____
Dr. Moussa A. Issa, S.E.
Il. Lic. No. 081-005738
Expires 11-30-2020

Date _____
For Sheets S4-01 Thru S4-04 (Total of 4 Sheets)



ELEVATION

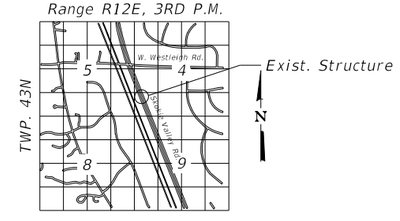
(Looking Upstation)



PLAN

LEGEND

- Prop. Storm Sewer
- Prop. Manhole
- Prop. Catch Basin
- Exist. Storm Sewer
- Exist. Guardrail
- NB Northbound
- SB Southbound



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
US ROUTE 41 OVER DITCH
F.A.P. RTE 346 - SECTION 2019-049-T
LAKE COUNTY
STATION 70+00.25
STRUCTURE NO. 049-0575

MODEL: Default
FILE NAME: P:\1710-745 PTB185-002 AES\WO#18 US 41 @ Unnamed Cr\CADD_Sheets\049-0575\D162126-0490575-S01-GPE.dgn
6/1/2020 3:14:04 PM

HBM ENGINEERING GROUP, LLC

USER NAME =	DESIGNED - JMI, CP	REVISED -	
	CHECKED - MI, MAI	REVISED -	
PLOT SCALE =	DRAWN - JMI, CP	REVISED -	
PLOT DATE =	DATE - 6/1/2020	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

S.N. 049-0575 US 41 (SKOKIE HIGHWAY) OVER UNNAMED CREEK

SHEET S4-01 OF S4-04 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	2019-049-T	LAKE	110	77
		CONTRACT NO. 62J26		
		ILLINOIS	FED. AID PROJECT	

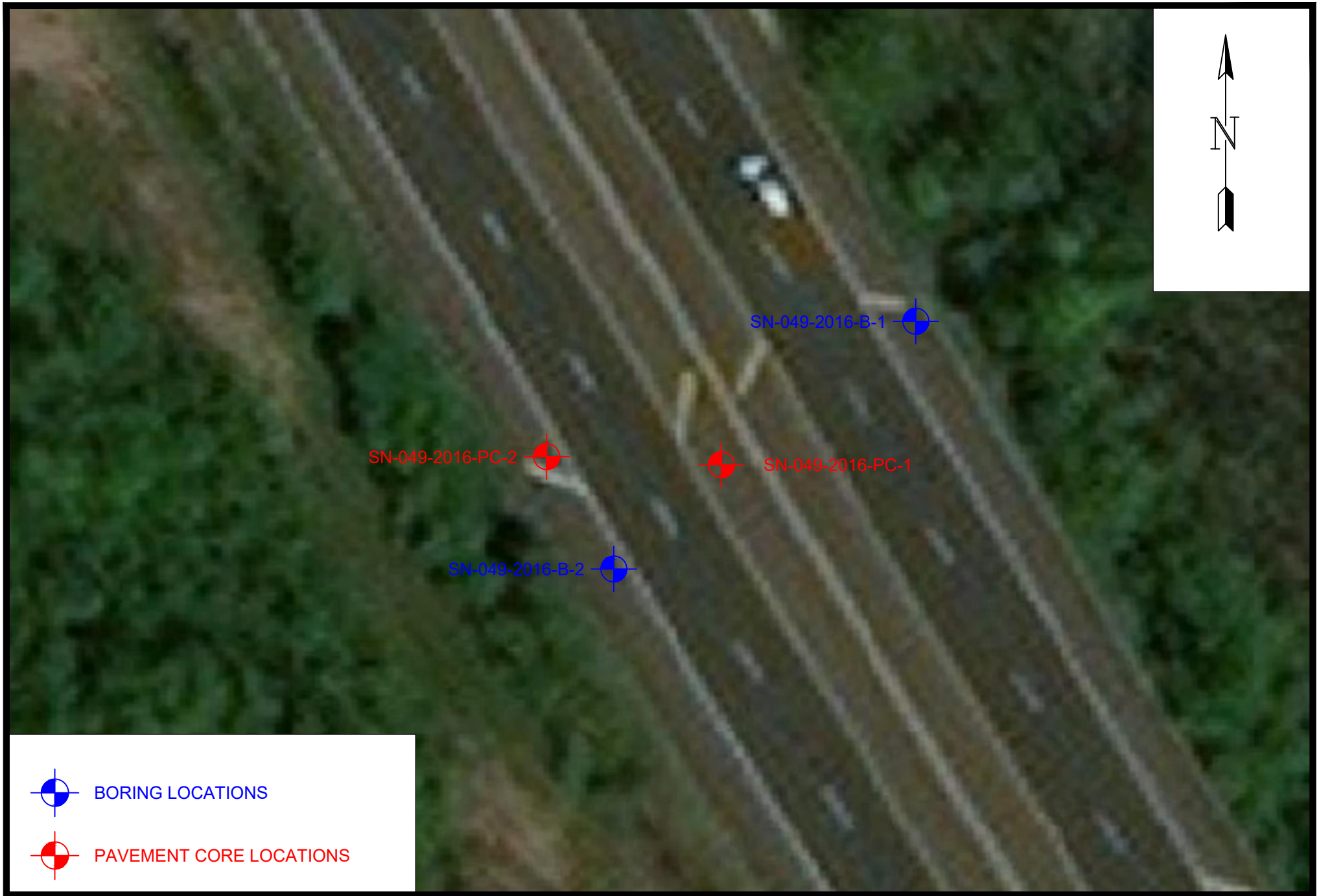
APPENDIX B

SOIL BORING LOCATION PLANS

GSG CONSULTANTS, INC.
623 Cooper Court • Schaumburg, IL 60173
Tel: 630.994.2600 • Fax: 312.733.5612
www.gsg-consultants.com
Integrity | Quality | Reliability

BORING LOCATION PLAN
US 41 IDOT CULVERTS
SN-049-0228

DRAWN BY:	AN	DATE:	4/6/2020
CHECKED BY:	RM	SCALE:	1:30



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623 Cooper Court • Schaumburg, IL 60173
Tel: 630.994.2600 • Fax: 312.733.5612
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BORING LOCATION PLAN
US 41 IDOT CULVERTS
SN-049-2016

DRAWN BY:	AN	DATE:	4/6/2020
CHECKED BY:	RM	SCALE:	1:30

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BORING LOCATION PLAN
US 41 IDOT CULVERTS
SN-049-2015

DRAWN BY:	AN	DATE:	4/6/2020
CHECKED BY:	RM	SCALE:	1:30

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BORING LOCATION PLAN
US 41 IDOT CULVERTS
SN-049-0575

DRAWN BY:	AN	DATE:	4/6/2020
CHECKED BY:	RM	SCALE:	1:30

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation
Division of Highways
GSG Consultants INC

SOIL BORING LOG

Date 3/26/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** ES/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-0228, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN-049-0228
Station 50+01.8

BORING NO. SN-049-0228-B-1
Station 49+90
Offset 57.00ft Right
Ground Surface Elev. 691.76 ft

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

Groundwater Elev.:
First Encounter 673.3 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				6 inches of Asphalt
				691.26
				Brown and Gray, Moist
	9			FILL: SAND, with gravel
	5			
	5			
				688.26
	3			Brown, Gray and Black, Moist
	4	4.5		FILL: SILTY CLAY, trace gravel
-5	8	P		
	2			
	2	2.0		
	3	P		
	1			
	2	2.5		
-10	3	P		
	3			
				680.26
	5	3.0		Very Stiff
	4	P		Brown, Moist
				SILTY CLAY (CL/ML)
	2			
	2	3.5		
-15	4	P		
				673.26 ▼
	2			Loose
	4			Brown, Moist
-20	5			SILTY SAND, with gravel (SM)

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Loose
				Brown, Moist
				SILTY SAND, with gravel (SM)
				(continued)
				668.26
	3			Very Stiff
	4	2.0		Brown, Moist
-25	5	P		SANDY CLAY LOAM
	2			
	6	2.5		
-30	9	P		
				658.26
	7			Dense
	19			Gray, Moist
-35	13			SANDY LOAM, with gravel and clay
				653.26
	7			Hard
	13	4.5		Gray, Moist
-40	40	P		SILTY CLAY, trace gravel (CL/ML)
				651.76

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 3/26/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** ES/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-0228, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN-049-0228
Station 50+01.8

BORING NO. SN-049-0228-B-1
Station 49+90
Offset 57.00ft Right
Ground Surface Elev. 691.76 ft

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

Groundwater Elev.:
First Encounter 673.3 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Limestone fragments at 39.5 feet			
End of Boring			
-45			
-50			
-55			
-60			

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 3/13/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** PS/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-0228, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-0228
Station 50+01.8

BORING NO. SN-049-0228-B-2
Station 49+90
Offset 62.00ft Left
Ground Surface Elev. 689.78 ft

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

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
689.28 6 inches of Asphalt			
Brown and Gray, Moist to Wet FILL: SILTY CLAY LOAM, with sand, some gravel	3		
	5 4	1.9 B	20
	2		
-5	2 3	0.4 B	22
	2		
	3 5	2.9 B	18
	2		
-10	2 3	1.0 P	20
678.28	3		
Very Stiff Gray and Brown, Moist SILTY CLAY, trace sand and gravel (CL/ML)	6 7	3.5 B	18
	6		
-15	12 10	2.9 B	15
671.28	3		
	5 8	2.9 B	17
-20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Stiff to Stiff Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML) *(continued)*			
Pushed rock at 23.5 feet	5		
-25	6 8	1.0 B	20
Cobble at 28.5 feet	16		
-30	9 7	1.9 B	20
	3		
-35	6 9	3.1 B	19
	5		
649.78 -40	8 9	1.7 B	19

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 3/16/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** PS/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-0575, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-0575
Station 70+00.25

BORING NO. SN-049-0575-B-2
Station 69+90
Offset 40.00ft Left
Ground Surface Elev. 679.08 ft

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

Groundwater Elev.:
First Encounter 645.6 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
18 inches of Asphalt			
677.58	2		
Brown and Gray and Black, Moist to Wet FILL: SILTY CLAY LOAM, with sand, some gravel	3 7	4.2 B	5
	2		
-5	3 3	2.0 P	21
Organics and plant roots at 5 feet			
	2		
672.08	4 5	1.9 B	22
Brown and Gray, Moist FILL: SILTY CLAY, trace sand, trace gravel			
	2		
669.08 -10	2 5	3.1 B	16
Brown and Black, Wet FILL: SILTY CLAY LOAM, trace gravel			
	4		
	9 13	4.2 B	16
666.08			
Brown and Gray, Moist FILL: SILTY CLAY, trace sand, trace gravel			
	4		
-15	8 12	7.3 B	16
661.08			
Stiff Gray, Moist SILTY CLAY, trace sand, trace gravel (CL/ML)	2		
-20	4 5	1.9 B	15
Stiff Gray, Moist SILTY CLAY, trace sand, trace gravel (CL/ML) *(continued)*			
	3		
-25	5 6	1.0 B	16
	3		
-30	4 7	1.7 B	18
▼	3		
-35	5 6	1.5 B	18
	3		
639.08 -40	4 4	1.5 B	18

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 3/12/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** PS/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-2015, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-2015
Station 393+60.24

BORING NO. SN-049-2015-B-1
Station 393+40
Offset 45.00ft Right
Ground Surface Elev. 669.18 ft

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

Groundwater Elev.:
First Encounter 635.2 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				8 inches of Asphalt
				668.51
				Brown, Moist
	2			FILL: SILTY CLAY LOAM, with fine
	5	0.6	10	grained sand, some gravel
	5	B		
				665.68
	2			Brown and Gray, Moist to Very
	3	2.5	25	Moist
-5	5	P		FILL: SILTY CLAY, trace sand and
				gravel
	3			
	4	2.9	15	
	6	B		
	2			
	5	4.2	18	
-10	7	B		
	4			
	10	5.4	18	
	13	B		
	3			
				655.18
	6	4.2	20	Hard to Stiff
-15	7	B		Gray and Brown, Moist
				SILTY CLAY, trace sand and gravel
				(CL/ML)
	1			
	3	2.5	18	
-20	6	B		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Hard to Stiff
				Gray and Brown, Moist
				SILTY CLAY, trace sand and gravel
				(CL/ML) *(continued)*
	2			
	4	1.9	19	
-25	6	B		
	2			
	4	2.3	19	
-30	6	B		
				635.18 ▼
	0			
	1		25	Very Loose
-35	2			Gray, Wet
				SAND, fine grained (SP)
	4			
				630.18
	5	2.1	25	Very Stiff
-40	6	B		Gray and Brown, Very Moist
				629.18

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 3/12/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** PS/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-2015, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-2015
Station 393+60.24

BORING NO. SN-049-2015-B-1
Station 393+40
Offset 45.00ft Right
Ground Surface Elev. 669.18 ft

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

Groundwater Elev.:
First Encounter 635.2 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
SILTY CLAY, trace sand and gravel (CL/ML)				
End of Boring				
-45				
-50				
-55				
-60				

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 3/31/20

ROUTE US-41 **DESCRIPTION** US Router 41 Culvert Repair **LOGGED BY** ES/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-2015, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-2015
Station 393+60.24

BORING NO. SN-049-2015-B-2A
Station 393+50
Offset 42.00ft Left
Ground Surface Elev. 669.60 ft

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

Groundwater Elev.:
First Encounter 631.1 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				8 inches of Asphalt
				668.93
	6			Brown, Moist FILL: SAND, with gravel
	6 7			
				666.10
	3			Brown and Gray, Moist FILL: SILTY CLAY, trace gravel
-5	6 8	4.5 P		
	4			
	7 11	4.5 P		
				661.10
	4			Hard to Very Stiff Brown and Gray, Moist SILTY CLAY, trace gravel (CL/ML)
-10	6 10	4.5 P		
	5			
	6 8	4.0 P		
	2			
-15	4 6	3.0 P		
	3			
-20	4 7	3.0 P		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Hard to Very Stiff Brown and Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*
	9			
-25	7 7	4.5 P		
	6			Cobbles at 29 feet
				640.60
-30	11 6			Medium Dense Gray, Moist SANDY CLAY (CLS)
				640.10 Medium Dense Gray, Moist SAND (SP)
	2			
-35	5 8	3.0 P		635.10 Very Stiff Gray, Moist SILTY CLAY (CL/ML)
	3			▼ 630.60
-40	4 7			Medium Dense Gray, Moist 629.60

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 3/31/20

ROUTE US-41 **DESCRIPTION** US Router 41 Culvert Repair **LOGGED BY** ES/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-2015, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-2015
Station 393+60.24

BORING NO. SN-049-2015-B-2A
Station 393+50
Offset 42.00ft Left
Ground Surface Elev. 669.60 ft

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

Groundwater Elev.:
First Encounter 631.1 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND (SP)			
End of Boring			
-45			
-50			
-55			
-60			

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 3/12/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** PS/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-2016, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-2016
Station 379+99.95

BORING NO. SN-049-2016-B-1
Station 370+00
Offset 45.00ft Right
Ground Surface Elev. 668.33 ft

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

Groundwater Elev.:
First Encounter 639.8 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				8 inches of Asphalt
				667.66
	2			Black and Gray, Moist to Wet FILL: SILTY CLAY LOAM, some fine grained sand, trace gravel
	5 6	3.0 P	12	
	2			
-5	1 2	0.8 P	18	
	2			
	1 3	1.8 P	33	
				659.83
	1			Gray and Brown, Moist to Very Moist FILL: SILTY CLAY, trace sand and gravel
-10	2 3	0.8 B	24	
	1			
	2 2	0.4 B	25	
				654.83
	4			Very Stiff Brown and Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)
-15	9 13	2.7 B	18	
				650.33
	3			Very Stiff to Stiff Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)
-20	5 5	2.5 B	23	
				Very Stiff to Stiff Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML) *(continued)*
	2			
-25	3 5	1.0 B	20	
				▼ Sandy clay seam at 28.5 feet
-30	5 3	1.3 B	19	
	4			
-35	5 6	3.1 B	20	
	4			
-40	4 4	1.0 B	18	
				628.33 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 3/13/20

ROUTE US-41 **DESCRIPTION** US Route 41 Culvert Repair **LOGGED BY** PS/RM

SECTION North of Illinois 173 to South of Westleigh **LOCATION** SN-049-2016, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY Lake **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. SN 049-2016
Station 379+99.95

BORING NO. SN-049-2016-B-2
Station 360+00
Offset 45.00ft Left
Ground Surface Elev. 668.50 ft

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

Groundwater Elev.:
First Encounter 639.5 ft ▼
Upon Completion N/A ft
After ____ **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
7 inches of Asphalt 667.92				
Brown, Gray and Black, Dry to Moist FILL: SILTY CLAY, with fine grained sand, some gravel		3		
		5 4		1
		2		
	-5	4 4	1.3 B	22
		2		
		3 4	0.8 B	19
660.00				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand, gravel and roots		3		
	-10	6 8	3.3 B	20
		4		
		6 8	4.6 B	20
654.50		2		
Medium Stiff to Very Stiff Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)	-15	4 5	2.1 B	22
		2		
	-20	3 3	0.8 B	19
Medium Stiff to Very Stiff Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML) *(continued)*		2		
	-25	5 5	1.9 B	20
		3		
Silt seam at 29 to 33.5 feet	-30	5 8	1.0 B	18
		4		
	-35	5 6	2.5 B	24
		3		
628.50	-40	4 6	1.9 B	23

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)

BBS, form 137 (Rev. 8-99)

APPENDIX D

PAVEMENT CORE PHOTO LOGS

SN-049-0228-PC-1–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0228 southbound outside shoulder	6.5

*Pictures of the core measurements may differ from measured values

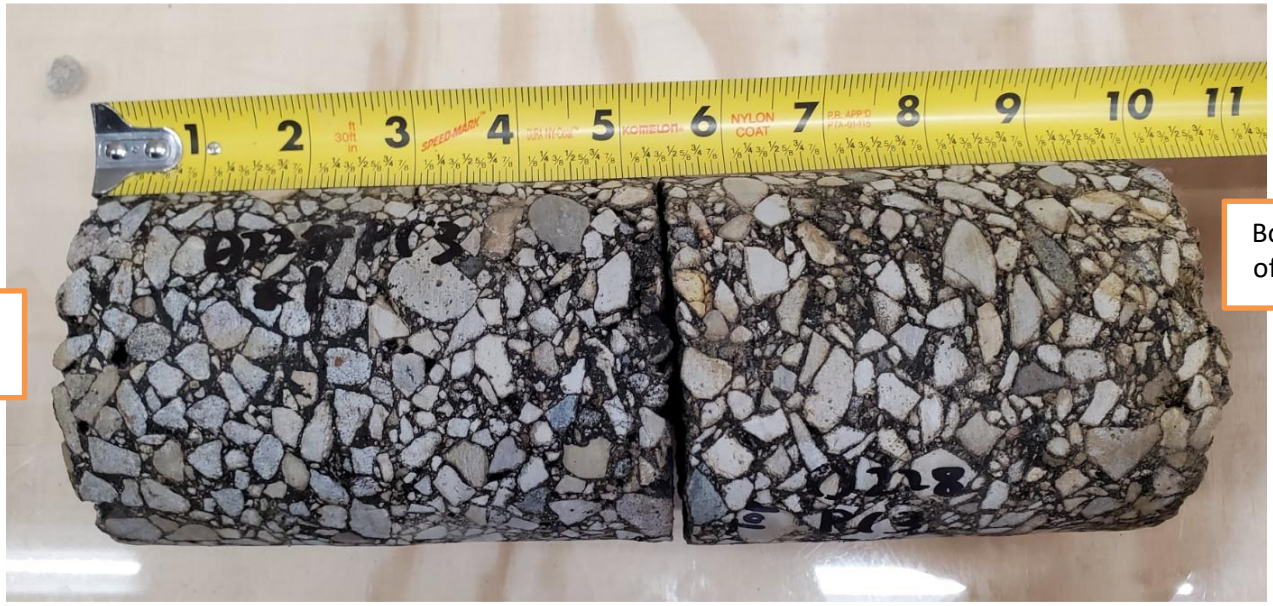
Top of Core

Bottom of Core

SN-049-0228-PC-2–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0228 southbound gore area	9.75

*Pictures of the core measurements may differ from measured values



SN-049-0228-PC-3–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0228 southbound inside shoulder	10.0

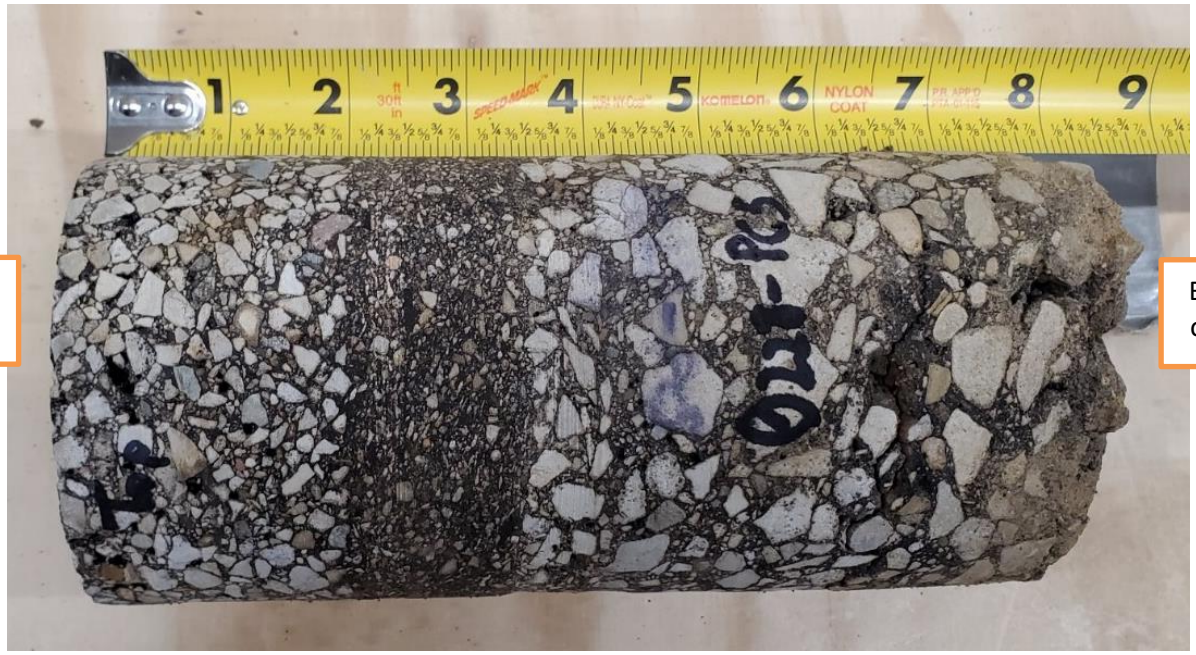
*Pictures of the core measurements may differ from measured values

SN-049-0228-PC-4–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0228 northbound inside shoulder	9.0

*Pictures of the core measurements may differ from measured values

Top of Core



Bottom of Core

SN-049-0228-PC-5–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0228 northbound outside shoulder	8.0

*Pictures of the core measurements may differ from measured values

SN-049-2016-PC-1–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-2016 southbound inside shoulder	12.0

*Pictures of the core measurements may differ from measured values

SN-049-2016-PC-2–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-2016 southbound outside shoulder	8.0

*Pictures of the core measurements may differ from measured values

Top of Core

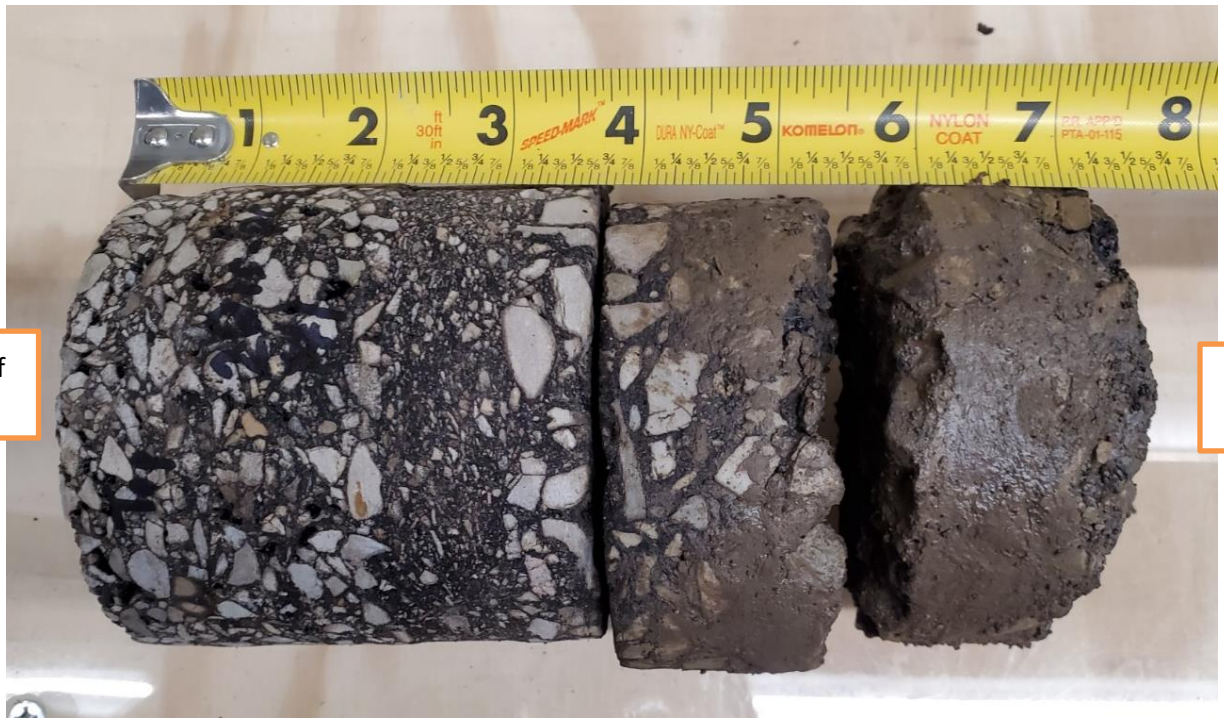
Bottom of Core

SN-049-2015-PC-1–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-2015 northbound inside shoulder	7.5

*Pictures of the core measurements may differ from measured values

Top of Core



Bottom of Core

SN-049-2015-PC-2–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-2015 northbound outside shoulder	6.75

*Pictures of the core measurements may differ from measured values

SN-049-0575-PC-1–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0575 southbound outside shoulder	11.0

*Pictures of the core measurements may differ from measured values

SN 049-0575-PC-2–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0575 northbound outside shoulder	9.0

*Pictures of the core measurements may differ from measured values

SN-049-0575-PC-3–Pavement Core

Location	Asphalt Thickness (in.)
SN-049-0575 southbound inside shoulder	14.0

*Pictures of the core measurements may differ from measured values