Millennia Professional Services, Ltd

11 Executive Drive, Suite 12, Fairview Heights, Illinois 62208 618-624-8610

Structural Geotechnical Report

Culvert Replacement – FAU Route 2860/Chicago Road Over Thorn Creek Tributary
Cook County, Illinois
Job Number D-91-003-18
Work Order #21
PTB185-012
Existing Structure 016-1341
Proposed Structure 016-2305

Prepared For:
HBM Engineering Group, LLC
4415 West Harrison Street, Suite 231
Hillside, Illinois 60162
708-236-0900

Prepared By:
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MPS Project Number ME18029.21
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Cook County, Illinois

1.0 Project Description and Proposed Structure Information

1.1 Introduction

This report summarizes the results of a geotechnical investigation performed for the design of the culvert replacement carrying Chicago Road over the Thorn Creek tributary in Chicago Heights, Illinois. The purpose of this study was to provide a geotechnical assessment of the planned replacement structure, based on subsurface conditions encountered at two borings performed by Millennia in May, 2019. This report describes the exploration procedures used, presents the field and laboratory data, includes an assessment of the subsurface conditions in the area, and provides geotechnical recommendations for the construction.

1.2 Project Description

The project consists of the removal and replacement of the existing culvert. The general site area is shown on the attached Vicinity Map, Figure 1 in Appendix A. A plan that shows the approximate locations of the borings performed for this study is presented as the Boring Location Plan, Figure 2 in Appendix A. The Thorn Creek tributary is oriented east and west beneath the Chicago Road and flows in a eastern direction. The existing culvert is a single box culvert with dimensions of approximately 14 feet by 5 feet. It is our understanding that the existing structure will be replaced with new triple box culvert with a slight grade raise along the roadway. Based on the information provided, it appears that staged construction will not be required to maintain traffic during construction. Instead, the road will be closed during construction.

1.3 Proposed Structure Information

The proposed structure will consist of a triple box culvert with each cell having dimensions of approximately 12 feet wide, about 78 feet long, and an opening of approximately 6 feet in height. The culvert will be a cast-in-place structure with horizontal cantilevered wingwalls with a total height of about 13.4 feet (about 10.5 feet exposed) with lengths of 10.0 to 11.5 feet.

2.0 Subsurface Exploration and Laboratory Testing

2.1 Subsurface Exploration

On May 22, 2019, MPS conducted a subsurface exploration at the site, consisting of two soil borings, designated as Borings C-1 and C-2. The approximate locations of the borings are indicated on the Boring Location Plan, Figure 2.

The borings were advanced using hollow-stem auger drilling methods. Samples were obtained at 2.5-foot intervals until a depth of about 30 feet, and at 5-foot intervals thereafter to boring termination. The borings were each extended to a depth of approximately 35 feet. Split-spoon samples were recovered using a 2-inch outside-diameter sampler, driven by a 140-pound hammer. The split-spoon samples were placed in containers for later testing in the laboratory. The sampling sequence for each boring is summarized on the boring logs in Appendix B.

Unconfined compression tests were performed on selected split-spoon samples using a Rimac field testing machine. The resulting unconfined compressive strengths are reported on the boring logs.

2.2 Laboratory Testing

A laboratory testing program consisting of natural moisture contents was conducted by MPS to determine selected engineering properties of the obtained soil samples. The results of the individual tests are presented on the boring logs in Appendix B.

3.0 Subsurface Conditions

Details of the subsurface conditions encountered at the borings are shown on the boring logs. The general subsurface conditions encountered and their pertinent engineering characteristics are described in the following paragraphs. Conditions represented by the borings should be considered applicable only at the boring locations on the dates shown; the reported conditions may be different at other locations and at other times.

3.1 Geology

The site lies near the boundary of the Wheaton Morainal Country and the Chicago Lake Plain of the Till Plains Section of the Central Lowland Physiographic Province. The surficial deposits surrounding the upland areas around the project site consist of Wisconsinan Till of the Carmi and possibly Wadsworth Till Formations. Alluvial deposits are also likely present near the banks of the tributary. The alluvium may consist of deposits of sand, silt, and clay, with local deposits of sandy gravel.

3.2 Generalized Subsurface Profile

The existing pavement section encountered at the borings consists of approximately 2.0 inches of asphalt over approximately 9.5 to 10.0 inches of Portland cement concrete and underlain by about 4.0 to 6.0 inches of crushed limestone.

Natural cohesive soils encountered at the site are predominantly made up of silty clay and silty clay loam. The thickness of the cohesive material varies from about 25.5 to 31.0 feet. The natural soils contain variable amounts of sand, sand seams, and sand layers. Moisture contents vary from 17 to 49%, with one value of 6% noted in the uppermost sample of Boring C-1. The standard penetration test (N) values range from weight-of-hammer (0) to 14 blows per foot (bpf). Rimac unconfined compression test values on samples range from 0.1 to 2.6 tons per square foot (tsf).

Natural granular soils were encountered below the cohesive layer and generally consist of sand and sandy gravel. N-values in the granular soils vary from 9 to 12 bpf.

3.3 Groundwater

Groundwater was observed at both of the borings during drilling or at completion, at depths ranging from 6.0 feet (Elevation 637.6) to 7.5 feet (Elevation 638.8). The presence or absence of groundwater at a particular location does not necessarily indicate that groundwater will be present or absent at that location at other times. Groundwater levels may vary significantly over time due to the effect of seasonal variations in precipitation, the water level in the Thorn Creek tributary or other factors not evident at the time of exploration.

4.0 Geotechnical Evaluations

4.1 Slope Stability

Grade changes will be minimal along the roadways. Therefore, slope stability is not a concern at this time.

4.2 Bearing Capacity Recommendations

Foundation soils consisting of soft to medium stiff, silty clay is anticipated to be encountered beneath the planned culvert at variable depths. The thickness of the soft soil varies from about 4 to 10 feet. For the planned box culvert, MPS recommends that the soils be overexcavated to approximately Elevation 631 at the upstream end and to approximately Elevation 629 at the downstream end. The unsuitable soils should be replaced with compacted, crushed limestone such as RR-01 or CS-01, per the Special Provision for Aggregate Subgrade Improvement for subgrade thicknesses of more than 12 inches. An initial bridge lift of larger crushed stone such as CS-01 may be needed if the gradation of RR-01 is chosen. If areas of subgrade replacement of less than 12 inches are exposed during the excavation, then a smaller aggregate gradation, such as CA-6 would also be applicable. The compacted fill should be capped with 6 inches bedding consisting of CA-7. It is recommended that a non-woven geotechnical fabric be placed to separate the aggregate improvement and CA-7 aggregate cap material, if the CS-01 material is chosen. MPS recommends showing the removal and replacement under the entire proposed culvert. MPS also recommends that the removal and replacement extend a minimum of 2 feet beyond each side of the culvert. The limits and quantities of removal and replacement may be modified by the District Geotechnical and Field Engineers for variable surface conditions encountered in the field. This is based on the understanding that the bearing elevation of the proposed box culvert will be approximately 635.

Any undercutting should be conducted in such a manner that limits or minimizes the potential for disturbance of the subgrade. To prevent unnecessary disturbance of the subgrade soils, trucks and other heavy construction vehicles should be restricted from traveling through the finished subgrade area. If disturbed areas develop, they should be reworked and compacted as necessary. These remedial actions will likely improve the bearing capacity of the planned culvert.

The culvert structure may be designed for a factored bearing pressure (pressure in excess of adjacent overburden pressure) of up to 3,000 pounds per square foot (psf) for structural dead load plus maximum live load, if constructed based on recommendations outlined above. For the soil conditions encountered at the site, a bearing resistance factor of 0.5 was applied.

4.3 Settlement

The proposed grade changes will be minimal for the new culvert profile. Therefore, issues related to significant settlement are not anticipated relating to the roadway grade changes.

Based on the conditions encountered at the boring locations, along with the understanding that the proposed undercutting recommendations will be implemented, the maximum anticipated settlement of the proposed box culvert should be no more than one inch, and the maximum differential settlement should be less than one half the total settlement. The majority of the settlement should take place during construction as the structural loads are applied to the foundation.

4.4 Mining Activity

A review of abandoned coal mines was made using the Illinois State Geological Survey (ISGS) website for mapped coal mines in Cook County, Illinois. Based on this information, the project site is unlikely to be undermined. No known mines are present in the project vicinity.

4.5 Lateral Earth Pressures

Lateral earth pressure parameters are provided for the design of the culvert and wingwalls. Structures that are restricted from movement at the top should be designed to resist at-rest earth pressures. Structures that are free to move and deflect at the top may be designed to resist active earth pressures. A horizontal deflection at the top of the structure of approximately 1% of the freestanding height is typically required to permit active pressure to develop. Earth pressures are a function of the excavation configuration and the backfill materials. The following design parameters are recommended for backfill materials:

Lateral Earth Pressure Parameters

No factor of safety has been applied to the values below. pcf = pounds per cubic foot

Parameter		Crushed Limestone		Cohesive Soil	
		Earth Pressure Coefficient	Equivalent Fluid Pressure	Earth Pressure Coefficient	Equivalent Fluid Pressure
Active	Drained	0.27	35 pcf	0.42	50 pcf
	Submerged		80 pcf		85 pcf
At-Rest	Drained	0.42	55 pcf	0.58	70 pcf
	Submerged		90 pcf		95 pcf
Passive	Drained	3.71	480 pcf	2.40	295 pcf
	Submerged		310 pcf		205 pcf
Soil Moist Unit Weight		130 pcf		120 pcf	
Angle of Internal Friction		35^{o}		25^{o}	
Assumed Surcharge Condition		None		None	
Slope Profile		Horizontal		Horizontal	

Submerged values should be used for the calculation of lateral pressures for those portions of the walls that extend below the highest level of anticipated groundwater. The values for submerged fluid pressure for active and at-rest conditions include hydrostatic pressures.

Significant horizontal movement would be necessary to develop the full values of passive pressure; typically the passive values stated are reduced by up to one-half for design. The effects of vertical surcharge or seismic loads, or sloping ground behind vertical structures, are not included for the stated fluid pressures. Vertical loading may be accounted for by assuming that a lateral force equal to 0.5 times the vertical load will act at the midpoint of the structure. To limit unbalanced hydrostatic pressure behind the structures, a free-draining granular backfill material encased in a nonwoven geotextile should be placed behind the structures, in conjunction with weep holes or perforated pipes draining by gravity to daylight, to allow free drainage of the backfill.Resistance to sliding may be analyzed using a friction factor of 0.3 for mass concrete on soil. No factor of safety has been included in this friction factor.

5.0 Construction Considerations

5.1 Groundwater Control

Groundwater was encountered during drilling at elevations from approximately 637.6 to 638.8. The estimated water surface stream elevation is approximately 640. The groundwater level may fluctuate due to seasonal variations and other considerations that may not have been evident at the time the measurements were made, which may require temporary water diversion and control. Groundwater seepage into the excavations should be anticipated and the contractor should be prepared to handle dewatering the excavations. We believe that dewatering measures consisting of stream diversion will be required.

If groundwater conditions encountered during construction differ than those observed during the course of this study, then MPS should be consulted for additional guidance on groundwater control options.

5.2 Excavations

The construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction. Trenching, excavating, and bracing should be performed in accordance with Occupational Safety and Health Administration (OSHA) regulations, and other applicable regulatory agencies. All soil materials present throughout the project, whether fill, alluvium, or other, and whether or not saturated, are considered Class C, which requires a side slope for excavations no steeper than 1.5H:1.0V. However, worker safety and classification of the excavation soil is the responsibility of the contractor. According to OSHA requirements, any excavation extending to a depth of more than 20 feet must be designed by a registered professional engineer. We are currently unaware of any excavations at a depth of 20 feet or more for this project. Where the excavation lies within the zone of influence of existing pavements, buildings, utilities, or other structures, the integrity of those elements should be maintained by a properly designed earth retention system, underpinning, or other suitable means.

Portions of the excavations may be constructed within a few feet horizontally of existing utilities. Some of these utilities are likely backfilled with granular material. The granular backfill may contain free water and could be unstable when excavating beneath or adjacent to it. The undermining of these utilities and the adjacent area could occur due to running and caving of the granular backfill and surrounding soils. Temporary support of any utilities, if present, that cross over or lie adjacent to the excavations will likely be required.

5.3 Earthwork - Subgrade, Fill, and Backfill

Earthwork activities including backfill and fill should be performed in accordance with Section 205 of the Standard Specifications.

The construction areas should be stripped of vegetation and organic soil prior to site excavation and grading.

Construction areas should be properly drained in order to reduce or prevent surface runoff from collecting on the subgrade. Any ponded water on the exposed subgrade should be removed

immediately. To prevent unnecessary disturbance of the subgrade soils, trucks and other heavy construction vehicles should be restricted from traveling through the finished subgrade area. If disturbed areas develop, they should be reworked and compacted.

Fill for general site grading should be placed in layers not exceeding eight inches in loose thickness and compacted to a dry density of not less than 95 percent of the modified Proctor, or at the discretion of the resident engineer. Backfill compacted by handheld equipment should be placed in layers not greater than six inches. The layer thickness may be increased if tests indicate that compaction could be achieved uniformly throughout the layer using a greater thickness.

MPS recommends porous granular backfill for the wingwalls and culvert meeting the requirements for granular backfill for structures for IDOT. Gradations such as CA-7 and CA-11 appear to be applicable.

Backfill placed next to walls or foundations should be compacted with hand-operated compaction equipment and not large self-propelled or machine-operated equipment. The operation of large pieces of equipment adjacent to these structures can result in overcompaction and higher lateral pressures than those recommended herein for design. Compaction should be reduced within approximately 1 foot of the wall. Structures should be observed periodically during backfilling for signs of movement. If movement is detected, it may be necessary to change backfilling procedures.

There is a misconception among some builders that open-graded (also known as “clean”) limestone and other granular materials do not require compaction when placed as fill or backfill. Settlement of such granular materials that had not been compacted when originally placed is a common cause of damage to foundations and concrete slabs, including the development of substantial gaps beneath the concrete caused by the settlement.

Any crushed rock, gravel, or sand placed as structural fill or backfill that will underlie future foundations, floor slabs, walkways, or pavements must be placed in lifts (layers) of controlled loose thickness and compacted in accordance with the recommendations that appear in this report. Open-graded and well-graded limestone, gravel, and sand should be compacted with a vibratory compactor, whether a self-propelled roller, backhoe-mounted plate, or walk-behind sled.

7.0 Closing

This report has been prepared for the exclusive use of HBM Engineering, LLC and the Illinois Department of Transportation for use in the design and construction of the proposed culvert replacement project in Cook County, Illinois. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made to the professional advice and recommendations included herein. This report is not for use by parties other than those named or for purposes other than those stated herein. It may not contain sufficient information for the use of other parties or for other purposes.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed by MPS to determine the applicability of the analyses and recommendations considering the changed conditions and time lapse. The report should also be reviewed by MPS if changes occur in structure location, size, and type, or in the planned loads, elevations, grading plans, and project concepts.

These analyses and recommendations are based on data obtained from site reconnaissance, the borings performed for this study and other pertinent information presented herein. This report does not reflect any variations between, beyond, or below the borings. Should such variations become evident, it may be necessary to re-evaluate the recommendations of this report after performing on-site observation during the construction period and noting the characteristics of any such variation.

We appreciate this opportunity to be of service to you and would be pleased to discuss any aspect of this report with you at your convenience.

Sincerely,

Millennia Professional Services of Illinois, Ltd.

Jacob A. Schaeffer, P.E.
Project Manager

John S. Kottemann, P.E.
Senior Project Manager

LICENSED PROFESSIONAL ENGINEER
JACOB ALLEN SCHAEFFER
062.068397
10-1-19
STATE OF ILLINOIS

Appendix A

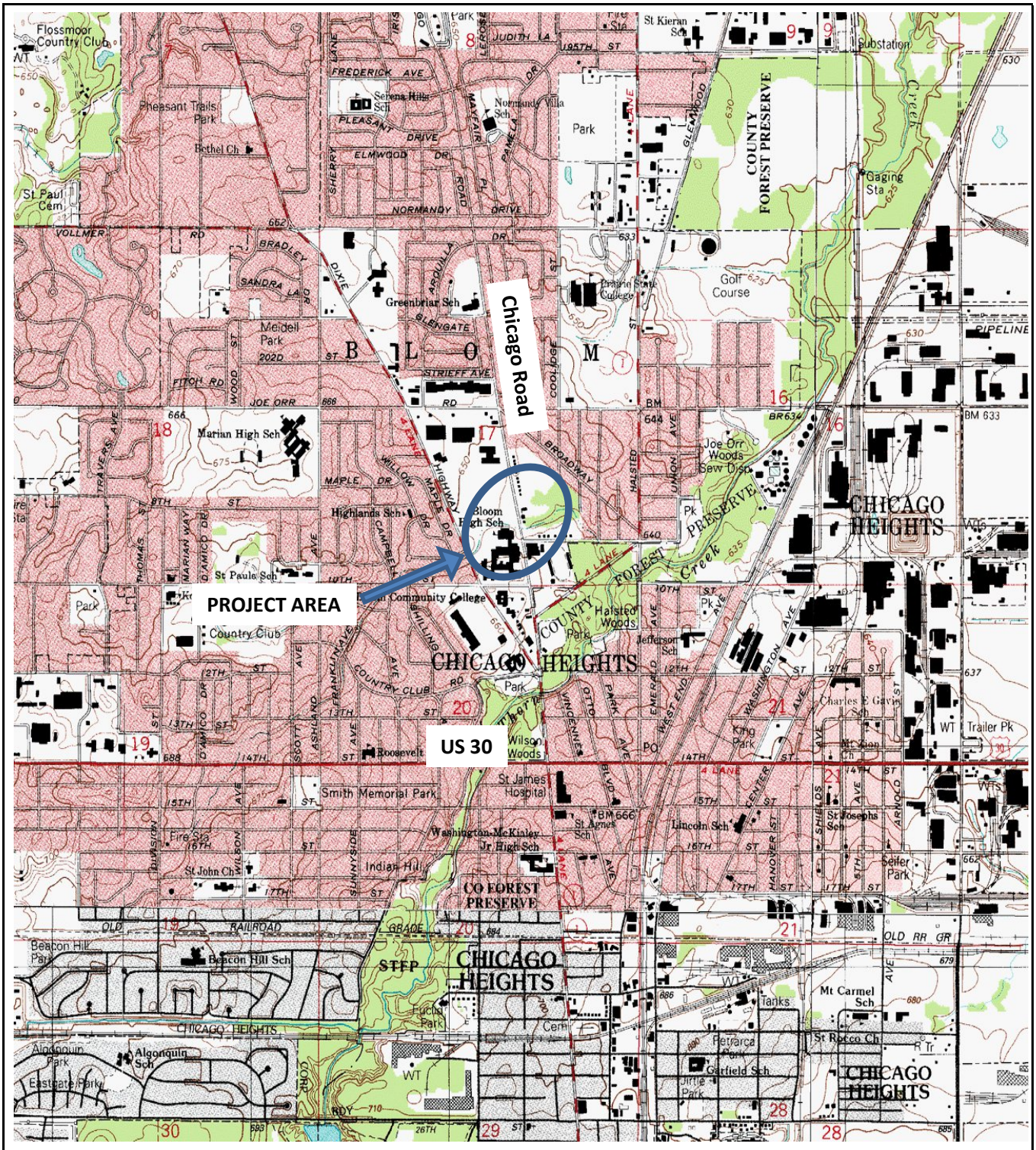
Report Figures:

Vicinity Map Figure 1

Boring Location Plan Figure 2

Subsurface Profile Figure 3

TS&L Plan (with approximate boring locations)



NOT TO SCALE

NOTE: IMAGE OBTAINED FROM TOPOQUEST 5-30-19.

VICINITY MAP		
Chicago Road Over Thorn Creek Tributary Culvert Replacement Chicago Heights, Illinois		
Drawn By: JAS	Checked By: JSK	
Project No.: ME18029.21	Date: 5/30/19	Figure 1

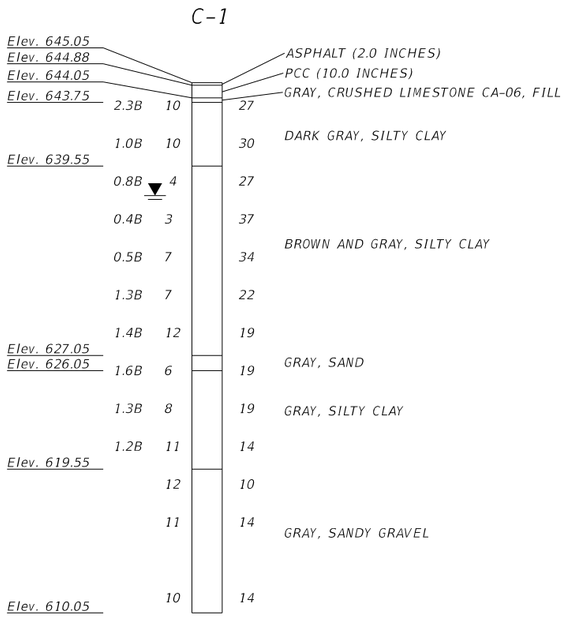
: APPROXIMATE BORING LOCATION

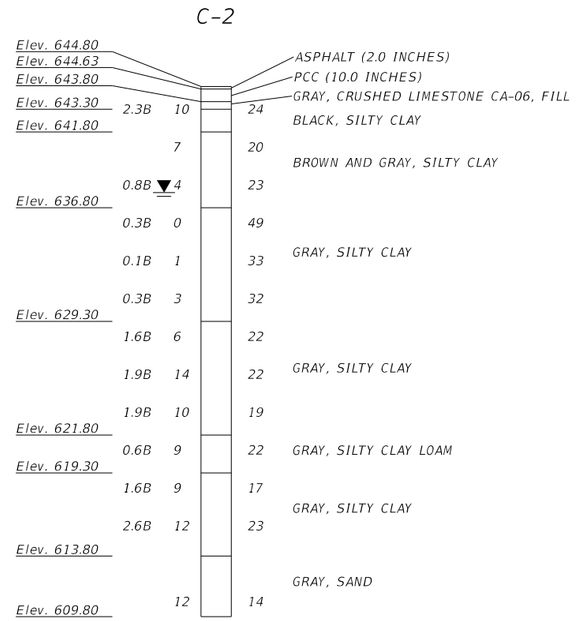
IMAGE OBTAINED FROM GOOGLE EARTH ON 05-30-2019

NOT TO SCALE

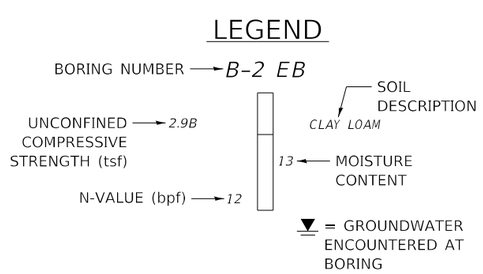
FIGURE 2: BORING LOCATION PLAN	
Chicago Road Over Thorn Creek Tributary Culvert Replacement Chicago Heights, IL	
Drawn by: JAS	Checked by: JSK
Project No.: ME18029.21	Date: 05-30-2019

SUBSURFACE PROFILE FIGURE 3





LEGEND



MILLENNIA PROFESSIONAL SERVICES
www.mps-il.com

USER NAME = tlopez	DESIGNED -	REVISED -
	DRAWN - T. LOPEZ	REVISED -
PLOT SCALE = 1.0000 ' / in.	CHECKED - J. SCHAEFFER	REVISED -
PLOT DATE = 5/30/2019	DATE - 05/30/2019	REVISED -

STRUCTURE NO. 016-1341

CHICAGO ROAD OVER THORN CREEK TRIBUTARY

SCALE: 1" = 10' | SHEET OF SHEETS | STA. | TO STA.

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
2860	059-0102 MFT	COOK		
	ILLINOIS PTB185-12			

Bench Mark: NGS Monument with PID#ME1606 N 1,760,564.961 E 1,148,917.748 Elevation 712.39'.

Existing Structure: S.N. 016-1341 was originally constructed at an unknown time before 1948 as a cast-in-place single box culvert 13'-6" wide and 4'-0" high and 27'-9" long. Extensions were added to each side of the culvert in 1948 making it a 69'-6" long structure. The existing structure to be removed and replaced with a cast-in-place triple box culvert 12'-0" wide by 6'-0" high and 80'-3¼" long. Traffic will be detoured during construction.

Salvage: No salvage.

Precast alternative is not allowed.

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Design Specifications, 8th edition.

HIGHWAY CLASSIFICATION

F.A.U. Rte. 2860 - Chicago Rd.
Functional Class: Major Collector
ADT: 6000 (2018); 8700 (2037)
ADTT: 180 (2018); 261 (2037)
Design Speed: 35 mph
Posted Speed: 35 mph

DESIGN STRESSES

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

LOADING HL-93

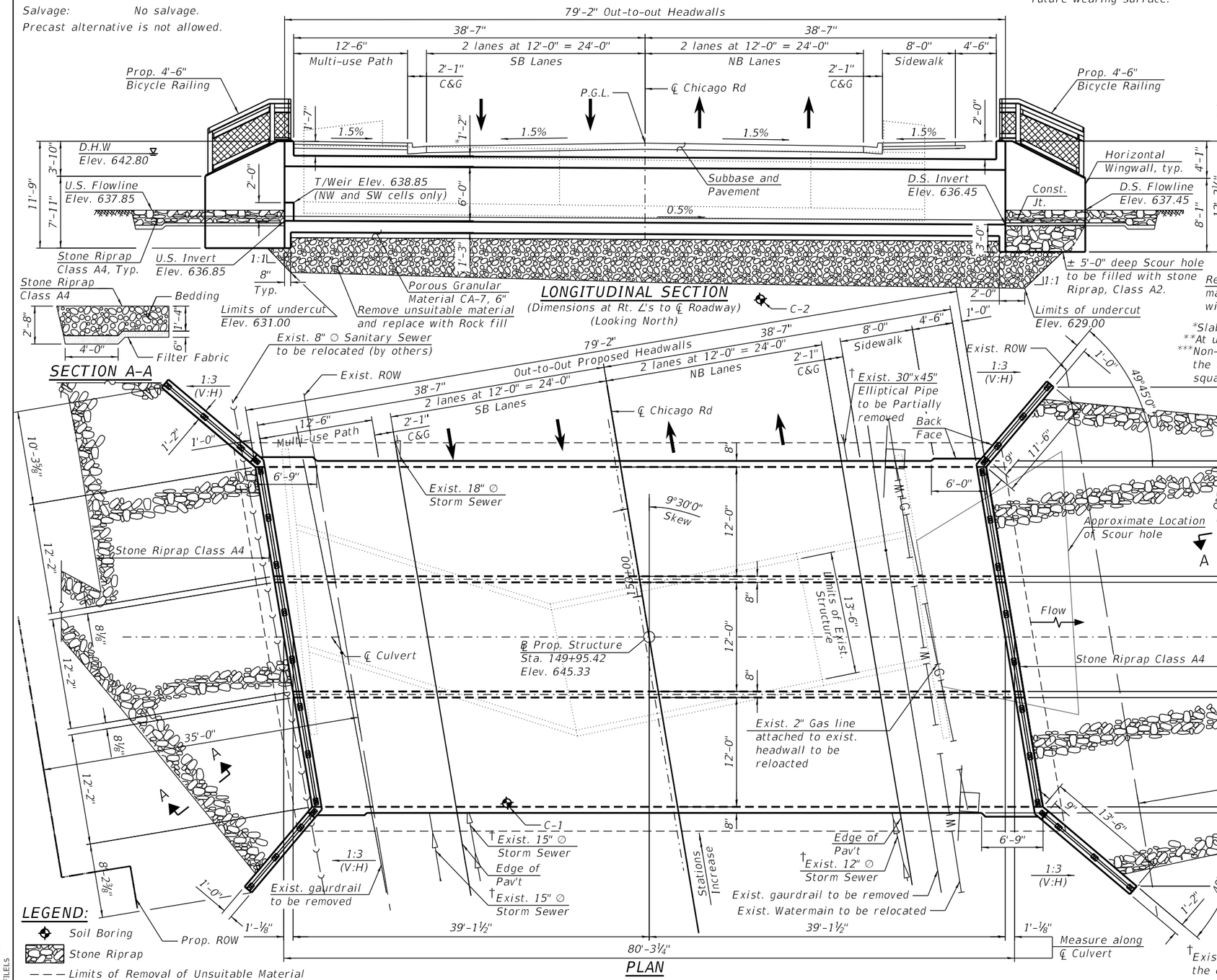
Allow 50 lb/sq. ft. for future wearing surface.

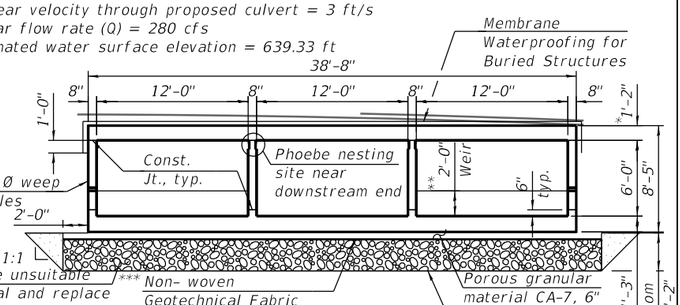
WATERWAY INFORMATION

Exist. Overtopping Elev. = 644.01 at Sta. 152+00
Drainage Area = 2.2 Square Miles Prop. Overtopping Elev. = 644.01 at Sta. 152+00

Flood Event	Freq. Yr.	Q C.F.S.	Opening - Sq. Ft. Exist.	Opening - Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater Elev. Exist.	Headwater Elev. Prop.
	10	375	50	156	642.8	1.0	0.0	643.8	642.8
Design	50	520	58	156	643.4	0.9	0.0	644.3	643.4
Base	100	590	61	156	643.7	0.8	0.1	644.5	643.8
Scour Design Check	200	640							
Overtop Exist.									
Overtop Prop.									
Max. Calc.	500	735	65	156	644.1	0.5	0.0	644.6	644.1

10-year velocity through the existing culvert = 7 ft/s
10-year velocity through proposed culvert = 3 ft/s
2 year flow rate (Q) = 280 cfs
Estimated water surface elevation = 639.33 ft

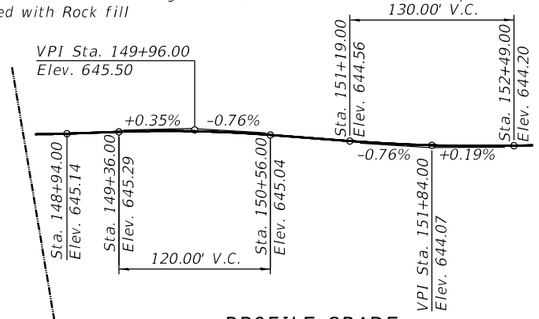




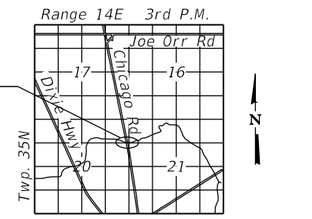
SECTION THRU BARREL

SECTION A-A

*Slab thickness may be refined in final design
**At upstream end, NW and SW cells only.
***Non- woven geotextile fabric shall conform to the requirement of Article 1080.01 of the Standard Specifications. The minimum weight of the fabric shall be 6 ounces per square yard. Cost included with Rock fill



PROFILE GRADE



LOCATION SKETCH

PLAN

LEGEND:
Soil Boring
Stone Riprap
— — — Limits of Removal of Unsuitable Material

GENERAL PLAN
CHICAGO ROAD OVER THORN CREEK TRIBUTARY
F.A.U. RTE 2860 - SEC. 2018-055-CR
COOK COUNTY
STATION 149+95.42
S.N. 016-2305

HBM ENGINEERING GROUP, LLC

USER NAME =	DESIGNED - MAA	REVISED -	
	CHECKED - MI, RTB	REVISED -	
PLOT SCALE =	DRAWN - MAA	REVISED -	
PLOT DATE =	DATE - 09/16/2019	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

STRUCTURE NO. 016-2305
SHEET 1 OF 1 SHEET

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
2860	2018-055-CR	COOK	1	1
		CONTRACT NO. 62G92		
	ILLINOIS	FED. AID PROJECT		

MODEL: $MODELNAME$
FILE NAME: $FILEIS
$DATE$ $TIME$

Appendix B

Boring Logs

Illinois Department of Transportation
Division of Highways
Millennia Professional Services of Illinois, Ltd.

SOIL BORING LOG

Date 5/22/19

ROUTE FAU Route 2860/Chicago Road **DESCRIPTION** Chicago Road Over Thorn Creek Tributary **LOGGED BY** E. Mueller

SECTION 059-0102 MFT **LOCATION** Over Thorn Creek Tributary, **SEC.** 20, **TWP.** 35N, **RNG.** 14E, 3rd **PM**,
Latitude , **Longitude**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Auto

STRUCT. NO. SN 016-1341
Station

BORING NO. C-1
Station 149+80
Offset 19.2 ft LT
Ground Surface Elev. 645.05 ft

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

Groundwater Elev.:
First Encounter 637.6 ft ▼
Upon Completion 638.1 ft ▽
After 0 **Hrs.** ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Asphalt (2.0 inches) 644.88
				PCC (10.0 inches) 644.05
				Gray, Crushed Limestone CA-06, FILL 643.75
	4			
	5 5 4	2.3 B	27	Dark Gray, Silty Clay
-5	4 6 2	1.0 B	30	
				639.55
				Brown and Gray, Silty Clay
	2 2 1	0.8 B	27	▽ ▼
-10	1 2 3	0.4 B	37	
	3 4 2	0.5 B	34	
-15	2 5 1	1.3 B	22	
	5 7 1	1.4 B	19	- Sand Seam at 17.0 ft.
				627.05
				Gray, Sand 626.05
-20	2 4	1.6 B	19	Gray, Silty Clay

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Gray, Silty Clay *(continued)*
	3			
	3 5 3	1.3 B	19	
-25	4 7	1.2 B	14	
				619.55
				Gray, Sandy Gravel
	3			
	4 8 5		10	
-30	5 6		14	
	4			
-35	4 6		14	- Silt Seam at 34.5 ft. 610.05
				End of Boring
-40				

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
Millennia Professional Services of Illinois, Ltd.

SOIL BORING LOG

Date 5/22/19

ROUTE FAU Route 2860/Chicago Road **DESCRIPTION** Chicago Road Over Thorn Creek Tributary **LOGGED BY** E. Mueller

SECTION 059-0102 MFT **LOCATION** Over Thorn Creek Tributary, **SEC.** 20, **TWP.** 35N, **RNG.** 14E, 3rd **PM**, **Latitude** , **Longitude**

COUNTY Cook **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Auto

STRUCT. NO. SN 016-1341
Station

BORING NO. C-2
Station 150+30
Offset 19.3 ft RT
Ground Surface Elev. 644.80 ft

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

Groundwater Elev.:
First Encounter 637.8 ft ▼
Upon Completion 638.8 ft ▽
After 0 **Hrs.** ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Asphalt (2.0 inches) 644.63				
PCC (10.0 inches) 643.80				
Gray, Crushed Limestone CA-06, FILL 643.30		10		
		5 5	2.3 B	24
Black, Silty Clay				
641.80				
Brown and Gray, Silty Clay		16		
		4 3		20
	-5			
▽		2		
▼		2 2	0.8 B	23
636.80				
Gray, Silty Clay		0		
		0 0	0.3 B	49
	-10			
		0		
		0 1	0.1 B	33
		2		
		2 1	0.3 B	32
	-15			
629.30				
Gray, Silty Clay		5		
		6 8	1.6 B	22
		4		
		5 9	1.9 B	22
	-20			
Gray, Silty Clay *(continued)*				
		4		
- Sand Seam at 21.5 ft.		4 6	1.9 B	19
621.80				
Gray, Silty Clay Loam		4		
		4 5	0.6 B	22
	-25			
619.30				
Gray, Silty Clay		4		
		4 5	1.6 B	17
		4		
		6 6	2.6 B	23
	-30			
613.80				
Gray, Sand		5		
		5 7		14
	-35			
609.80				
End of Boring				
	-40			

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)

GENERAL NOTES

The number of borings is based on topographic and geologic factors: the magnitude of loading; the size, shape, and value of the structure; consequences of failure; and other factors. The type and sequence of sampling is selected to reduce the possibility of undiscovered anomalies and increase drilling efficiency. Attempts are made to detect and/or identify occurrences during drilling and sampling such as encountering water, boulders, gas, zones of lost circulation, relative ease or resistance of drilling progress, unusual sample recovery, variation in driving resistance, unusual odors, etc. However, lack of mention of such variations does not preclude their presence.

Although attempts are made to obtain stabilized groundwater levels, the levels shown on the Boring Logs may not have stabilized, particularly in more permeable cohesive soils. Consequently, the indicated groundwater levels may not represent present or future levels. Groundwater levels may vary significantly over time due to effects of precipitation, infiltration, or other factors not evident at the times indicated.

Unless otherwise noted, soil classifications indicated on the Boring Logs are based on visual observations and are not the result of classification tests. Although visual classifications are performed by experienced technicians or engineers, classifications so made may not be conclusive.

Generally, variations in texture less than one foot in thickness will be described as seams while thicker strata will be logged as individual strata. However, minor anomalies and changes of questionable lateral extent may appear only in the verbal description. The lines indicating changes in strata on the Boring Logs are approximate boundaries only as the actual material change may be between samples or may be a gradual transition.

Samples chosen for laboratory testing are selected in such a manner so as to determine selected physical characteristics of each material encountered. However, as samples are recovered only intermittently and only representative samples are tested, the results of such tests may not conclusively represent the characteristics of all subsurface materials present.