rubino
ENGINEERING INC.

SGR REPORT TRANSMITTAL

September 14, 2020

To: Steve Frerichs
Chastain & Associates, LLC.
120 Center Court
Schaumburg, IL 60195
Phone: 773.714.0050
Mobile: 847.287.6732
Fax: 773.714.0055

Re: **Geotechnical Engineering Services Report**
IL Route 1 over Deer Creek
Will County, Illinois

Rubino Report No. G17.174_Rev2

Via email: sfrerichs@hlcllp.com

Dear Mr. Frerichs,

Rubino Engineering, Inc. (Rubino) is pleased to submit our Geotechnical Engineering Services Report for the IL Route 1 over Deer Creek project in Will County, Illinois.

Report Description

Enclosed is the Geotechnical Services Report including results of field and laboratory testing, as well as recommendations for culvert design and general site development.

Authorization and Correspondence History

- Authorized Notice to Proceed by Steve Frerichs of Chastain & Associates, LLC. on January 18th, 2017 via Email.

Closing

Rubino appreciates the opportunity to provide geotechnical services for this project and we look forward to continued participation during the design and in future construction phases of this project.

If you have questions pertaining to this report, or if Rubino may be of further service, please contact our office at (847) 931-1555.

Respectfully submitted,
RUBINO ENGINEERING, INC.

Michelle A. Lipinski, PE
President

michelle.lipinski@rubinoeng.com

MAL/file/ Enclosures

IL ROUTE 1 OVER DEER CREEK

IL ROUTE 1
F.A.P. 876
WILL COUNTY, ILLINOIS

EXISTING SN#: 099-0076
PROPOSED SN#: 099-0917

RUBINO PROJECT NO. G17.174_REV2

Structure Geotechnical Report

{ *SGR* }

PREPARED BY:

rubino ENGINEERING INC.

Michelle A. Lipinski, PE
President
IL No. 062-061241, Exp. 11/30/17

PREPARED FOR:

CHASTAIN & ASSOCIATES, LLC.

120 CENTER COURT

SCHAUMBURG, ILLINOIS

SEPTEMBER 14, 2020

TABLE OF CONTENTS

PROJECT DESCRIPTION AND SCOPE

Rubino Engineering, Inc. (Rubino) understands that Chastain & Associates, LLC. (Chastain) is planning the replacement of the existing bridge along IL Route 1 located in Will County, Illinois approximately 1.0 miles north of W. Exchange St. in downtown Crete, Illinois. The existing bridge abutments are supported on timber piles. The current plan includes replacing the bridge with a double cell box culvert.

Documents received:

- "Exhibit C1 – Existing Drainage Plan Detail" – dated 3-5-2016 and provided by Chastain
- "Exhibit D1 – Proposed Drainage Plan Detail" – dated 3-5-2016 and provided by Chastain
- "Top of Deck Survey" provided by Chastain
- TS&L prepared by Chastain dated 01/07/2020
- Plan and Profile prepared by Chastain plotted 4/29/2020

Project Correspondence:

- RFP Email from Steve Frerichs of Chastain on May 19^{th}, 2017.

Culvert Details and Loading received: This report is based on the provided dimensions and the following assumptions:

Culvert Type:	Double Cell Box Culvert
Culvert Length:	56' - 4"
Culvert Width:	26' – 0"
Culvert Height:	9' - 3"
Culvert Loading:	HL-93

The geotechnical recommendations presented in this report are based on the available project information and the subsurface materials described in this report. If any of the information on which this report is based is incorrect, please inform Rubino in writing so that we may amend the recommendations presented in this report (if appropriate, and if desired by the client). Rubino will not be responsible for the implementation of our recommendations if we are not notified of changes in the project.

Purpose / Scope of Services

The purpose of this study was to explore the subsurface conditions at the site in order to prepare geotechnical recommendations for culvert design for proposed SN#: 099-0917 and general site development for the proposed construction.

Rubino's scope of services included the following drilling program:

Table 1: Drilling Scope

NUMBER OF BORINGS	DEPTH (FEET BEG*)	LOCATION
2	40 feet	Proposed IL Route 1 Culvert (See Boring Location Plan in Appendix for more details)

*BEG = below existing grade

Representative soil samples obtained during the field exploration program were transported to the laboratory for additional classification and laboratory testing.

This report briefly outlines the following:

- *Summary of client-provided project information and report basis*
- *Overview of encountered subsurface conditions*
- *Overview of field and laboratory tests performed including results*
- *Geotechnical recommendations pertaining to:*
  - *Site preparation and stability recommendations*
  - *Culvert Bearing and Wing Wall Shallow Foundations, including suitable foundation type(s), bearing pressure(s), and estimated settlement*
- *Construction considerations, including temporary excavation and construction control of water*

DRILLING, FIELD, AND LABORATORY TEST PROCEDURES

Chastain selected the number of borings and the boring depths. Rubino located the borings in the field using a Garmin GPSMap 64s and by measuring distances from known fixed site features. The borings were advanced utilizing 3 ¼ inch inside-diameter, hollow stem auger drilling methods and soil samples were routinely obtained during the drilling process.

Rubino encountered steel obstructions within the pavement section during the initial drilling attempt on October 4, 2017 which prohibited the advancement of the augers through the pavement. The nature of the obstructions were not fully understood and caused a project delay. Rubino received approval for supplemental investigation to attempt the use of a ground penetrating radar (GPR) system to delineate the extents of the obstruction and identify suitable locations to drill. After use of the GPR, drilling resumed on November 20, 2017. See the GPR Appendix for additional details.

Selected soil samples were tested in the laboratory to determine material properties for this report. Drilling, sampling, and laboratory tests were accomplished in general accordance with ASTM procedures. The following items are further described in the Appendix of this report.

- *Field Penetration Tests and Split-Barrel Sampling of Soils (ASTM D1586)*
- *Field Water Level Measurements*
- *Laboratory Determination of Water (Moisture) Content of Soil by Mass (ASTM D2216)*
- *Laboratory Determination of Atterberg Limits (ASTM D4318)*
- *Laboratory Determination of Particle Size (Hydrometer) Analysis of Soils (ASTM D422)*

The laboratory testing program was conducted in general accordance with applicable ASTM specifications. The results of these tests are to be found on the accompanying boring logs located in the Appendix.

EXECUTIVE SUMMARY OF GEOTECHNICAL CONSIDERATIONS

The main geotechnical design and construction considerations at this site are:

- **Subgrade soils** generally consisted of black, brown, and gray clay, silty clay, clay loam, or silty clay loams and black, brown, and gray gravelly, sandy loam. See *Subsurface Conditions* section for more detailed information.
  - **Soft, high moisture content soils** were observed within the borings at and below the proposed bearing elevation.
- **Shallow groundwater was observed** within the borings during drilling operations. See *Groundwater Conditions* section for more information.
- The culvert will need to be supported by **ground improvement** measures. See *Ground Improvement*, *Rigid Inclusions*, and *Culvert/Headwall Recommendations* sections for more information.
- **Horizontally cantilevered wingwalls or braced sheet pile wing walls** are options for this site. See *Wingwall Recommendations* section for more information.

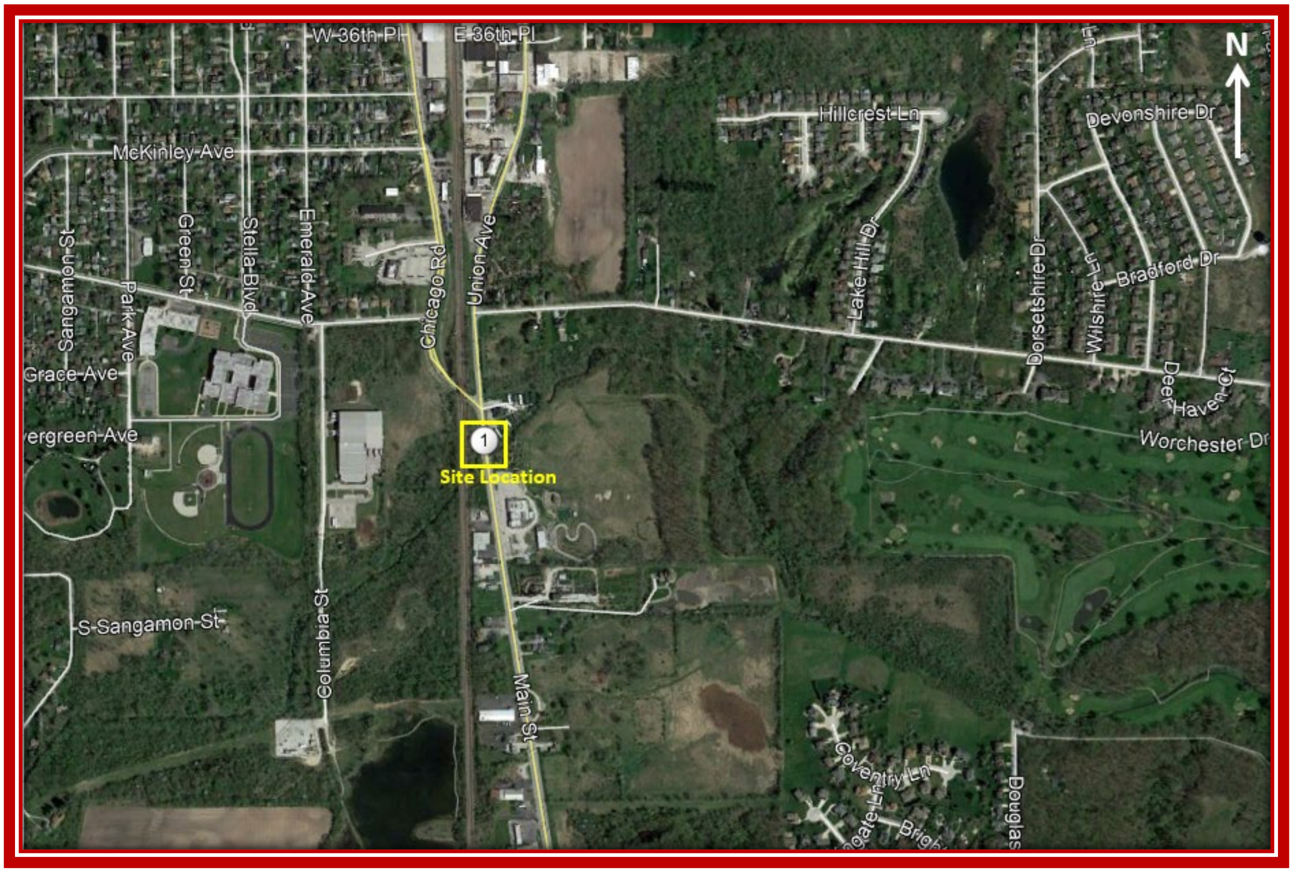
The geotechnical-related recommendations in this report are presented based on the subsurface conditions encountered and Rubino's understanding of the project. Should changes in the project criteria occur, a review must be made by Rubino to determine if modifications to our recommendations will be necessary.

FIELD EXPLORATION

Site Location and Description

The general site location of exploration is the existing IL Route 1 bridge running over Deer Creek in the village of Crete in Will County, Illinois. The site has an approximate latitude and longitude of 41°27'30.73"N and 87°38'1.60"W, respectively.

The map below shows the general site location of where the soil borings were taken:



Subsurface Conditions

Beneath the existing pavement, subsurface conditions generally consisted of black, brown, and gray clay, silty clay, clay loam, or silty clay loams and black, brown, and gray gravelly, sandy loam.

- The native **clay, silty clay, clay loam, or silty clay loam** soils were generally very soft to stiff in consistency.
- Granular soils were generally medium dense in apparent density.

Table 2: Subsurface Conditions Summary

Elevation Range (feet)	Soil Description	SPT N-Values (Blows per Foot)	Moisture Content (%)	Estimated Shear Strength
691 – 689 (B-02)	Medium dense, black, brown, and gray GRAVELLY, SANDY LOAM (possible fill)	23	6	ϕ = 33 – 34°
693 – 682	Medium stiff, brown, black and gray CLAY to CLAY LOAM	4 – 6	20 – 30	c = 600 – 900 psf

Elevation Range (feet)	Soil Description	SPT N-values (blows per foot)	Moisture Content (%)	Estimated Shear Strength
683 – 659	Very soft to soft, brown to dark gray CLAY to SILTY CLAY	0 – 3	31 – 72*	c = 0 – 450 psf
673 – 660 (B-01)	Stiff, brownish-gray CLAY to CLAY LOAM	9 – 14	15 – 19	c = 1,350 – 2,100 psf
660 – 653	Stiff, brown and gray SILTY CLAY LOAM	8 – 15	16 – 22	c = 1,200 – 3,300 psf

*Some outlying data points have been omitted from values shown in this table. See boring logs for all data collected.

The above table is a general summary of subsurface conditions. Please refer to the boring logs for more detailed information.

Estimated shear strength of clay soils is based on empirical correlations using N-values, moisture content, and unconfined compressive strength.

Groundwater Conditions

Groundwater was encountered in one of the borings during drilling operations. The moisture contents of the soils indicate that the soils are saturated. Based on the saturation of soils and the streambed conditions, Rubino anticipates that **groundwater will need to be controlled during construction.** The following table summarizes groundwater observations from the field:

Table 3: Groundwater Observation Summary

Boring Number	Groundwater Elevation During Drilling (feet)	Groundwater Elevation Upon Auger Removal (feet)
B-01	N/A	N/A
B-02	684.26 (8 ¾ feet *)	N/A (Boring caved in)

*Depth below existing grade

It should be noted that fluctuations in the groundwater level should be anticipated throughout the year depending on variations in climatological conditions and other factors not apparent at the time the borings were performed. Additionally, discontinuous zones of perched water may exist within the soils. The possibility of groundwater level fluctuation should be considered when developing the design and construction plans for the project.

GEOTECHNICAL EVALUATIONS AND RECOMMENDATIONS

The geotechnical-related evaluations and recommendations in this report are presented based on the subsurface conditions encountered and Rubino's understanding of the project. Should changes in the project criteria occur, a review must be made by Rubino to determine if modifications to our recommendations will be necessary.

Settlement

Based on the TS&L provided by Chastain and Associates dated 01/07/2020, Rubino anticipates that approximately 9 ½ feet of PGE fill will be placed along the length of the culvert on each side. Rubino calculates settlement from the weight of the fill on normally consolidated soils to be approximately 1 ½ to 2 inches. Rubino recommends that the fill areas be treated as part of the structure with the subgrade amended as recommended herein. Additionally, this report is based on the culvert itself being supported by ground improvement measures and wing walls being either cantilevered or supported by sheet piles.

Scour

Per the IDOT Geotechnical Manual dated December 2015, scour effects do not apply to closed bottom culverts.

Ground Improvement

Due to the presence of soft soils at the proposed bearing elevation, the culvert will need additional ground improvement to provide stability and mitigate settlement at this site. The following ground improvement options to support a closed-bottom culvert at this site are:

Removal and replacement / working platform – The IDOT Geotechnical Manual (2015) provides guidelines for working platforms at culverts and undercuts at foundations. However, traditional removal and replacement is not considered practical for this site due to the presence of deeper unsuitable soils and groundwater.

Geosynthetic reinforcement – Used to reinforce subgrade in layers to support structures, geosynthetic reinforcement is not considered practical at this site. Geosynthetic reinforcement is utilized mainly on surficial soils and suitable soils and provides stability but does not mitigate settlement without extensive removal and replacement.

Chemical modification/stabilization or Deep Mixing – Chemical modification or stabilization with cement or lime is not considered practical at this site since it is more of a surficial stabilization method and suitable soils were found deeper than practical to implement this method cost effectively.

Aggregate / Stone Columns – Intermediate foundation type used to transfer loads from a structure to a more competent soil stratum. Aggregate columns can be used to reduce settlement and increase soil strength. Stone columns may be an option at this site. Considerations include the presence of groundwater and the use of a well-graded stone to mitigate migration of fines into the stone columns. Stone column design is proprietary to the contractor.

Rigid Inclusions - Intermediate foundation type used to transfer loads from a structure to a more competent soil stratum. Rigid inclusions are concrete columns constructed in a specific design grid and capped with a stone mat to support structures such as closed-bottom culverts and are considered the favorable option for this site. Rigid inclusion design is proprietary to the contractor.

Rigid Inclusions

Rigid inclusions can be incorporated as ground improvement to support the proposed closed-bottom culvert.

- Rigid inclusions are recommended as ground improvement to support the proposed culvert
- The load transfer platform between the rigid inclusions and the closed-bottom culvert should consist of a compacted granular mattress with geogrid reinforcement.
- A non-woven geotextile fabric should be placed between fine-grained soils and open-graded stone to prevent the migration of fines into the stone.
- Treatment limits should extend at least 5 feet beyond the limits of the culvert as practical given site constraints to provide support to subgrade supporting new fill soils.

Table 4: Soil Strengths for Rigid Inclusion Design by Others

ELEVATION RANGE (FEET)	SOIL DESCRIPTION	ESTIMATED SOIL UNIT WEIGHT (PCF)	ESTIMATED SOIL UNDRAINED SHEAR STRENGTH
691 – 689 (B-02)	Medium dense, black, brown, and gray GRAVELLY, SANDY LOAM (possible fill)	120	26°
691 – 683	Medium stiff, brown / black / gray CLAY LOAM	120	c = 600 psf
683 – 659	Very soft brown to dark gray CLAY to SILTY CLAY	100	c = 50 psf
659 – 653	Stiff, brown and gray SILTY CLAY LOAM	125	c = 2,000 psf

FOUNDATION RECOMMENDATIONS

Culvert / Headwall Recommendations

The currently proposed culvert type includes a pre-cast closed bottom concrete 26-foot by 56.3-foot double cell box culvert. Because subgrade soils are not considered suitable for support of the culvert, Rubino has recommended ground improvement as part of this SGR.

Table 5: Box Culvert Recommendations

DESCRIPTION	RECOMMENDATIONS
Anticipated Bearing Elevation	684.50
Anticipated Soil Bearing	Ground Improvement: Rigid Inclusions
Recommended working platform:	Geogrid reinforced load transfer platform at least 2 feet thick

Wingwall Recommendations

Many soil dependent/box independent wings are feasible options for selection of wingwalls. The wall type selection should be performed considering but not limited to soil conditions, length, and economy.

In most cases, **horizontal cantilever wingwalls** are the most economical and preferred wall type. They are supported by the box rather than the foundation soils, and their feasibility evaluation is therefore structural rather than geotechnical.

When the bearing pressures are not adequate, or the structural limits shown in the Culvert Manual are exceeded, or if precast boxes are used, soil dependent/box independent wings, such as MSE, T-type, gabion, sheet piling, soldier piling, or apron supported should be used.

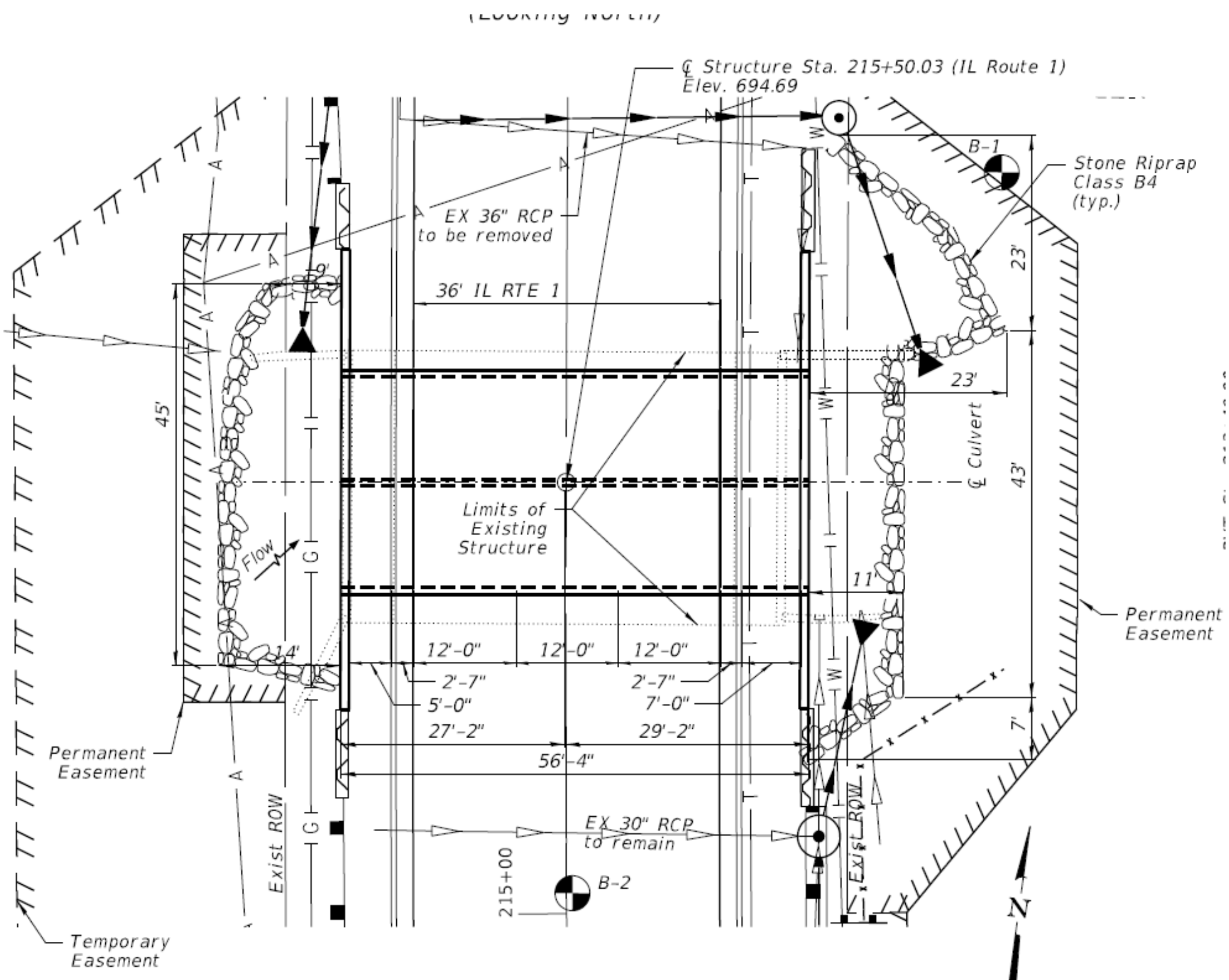
- **MSE** is normally not economical due to the small quantity and raises concerns in some hydraulic applications about loss of granular backfill or foundation soils.
- **L-type or T-type wings** are fairly common as their aesthetics, alignment and foundation design can be modified to accommodate most any application. However, the resulting foundation expense, particularly when either a cofferdam or piles are required, may suggest that another wing type may be more appropriate.
- **Gabion wings** can be specified to follow a wide range of curved alignments and face batters. They can be placed through limited depths of water but should be supported on reasonably good foundation soils to resist overturning and bearing pressures.

- **Sheet pile walls** also allow installation through open water and at locations where bearing capacity may not be adequate for gravity walls.

- **Soldier piles** are used where sheeting cannot be driven because H-piles can penetrate farther or can be drilled when required. However, they require either a cast-in-place or other facing system.

- **Cast-in-place aprons** are often used with precast boxes and should be analyzed like a "reverse L" wall design as the apron and cutoff wall provides the foundation. The apron's lack of embedment and soil weight makes them difficult to design and should be used where proper foundation soils (sliding and bearing pressure) are present and where the skew angle is not excessive. Various precast modular wingwall systems have also been used, most commonly with precast boxes and three-sided structures to make the entire structure precast.

Based on the TS&L, the project will include a permanent sheet pile wingwall to retain soils on each side of the culvert parallel to the roadway:



PLAN

Lateral Earth Pressures for a sheet pile wingwall design are as follows:

Table 6: "K-Factor" Lateral Earth Pressures

ELEVATION RANGE (FEET)	SOIL DESCRIPTION	ESTIMATED TOTAL UNIT WEIGHT (PCF)	DRAINED FRICTION ANGLE (DEG)	K_O	K_A	K_P
691 – 689 (B-02)	Medium dense, black, brown, and gray GRAVELLY, SANDY LOAM (possible fill)	120	26°	0.56	0.39	2.56
691 – 683	Medium stiff, brown / black / gray CLAY LOAM	120	28°	0.53	0.36	2.77
683 – 659	Very soft brown to dark gray CLAY to SILTY CLAY	100	20°	0.66	0.49	2.04
659 – 653	Stiff, brown and gray SILTY CLAY LOAM	125	28°	0.53	0.36	2.77

CONSTRUCTION CONSIDERATIONS

Dewatering

Due to the nature of culvert construction within a flowing creek, water diversion measures are anticipated to be required to maintain dry foundation conditions during placement of culvert and construction of headwall on clay soils. It is the responsibility of the design engineer and/contractor to determine the appropriate method of site dewatering and associated details. Temporary diversion methods may include diversion channels, pumping system(s), piped diversions, coffer dams, or similar practices.

CLOSING

The recommendations submitted are based on the available subsurface information obtained by Rubino Engineering, Inc. and design details furnished by Chastain & Associates, LLC. for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, Rubino should be notified immediately to determine if changes in the foundation recommendations are required. If Rubino is not retained to perform these functions, we will not be responsible for the impact of those conditions on the project.

The scope of services did not include an environmental assessment to determine the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater or air, on, or below or around this site. Any statements in this report and/or on the boring logs regarding odors, colors, and/or unusual or suspicious items or conditions are strictly for informational purposes.

After the plans and specifications are more complete, the geotechnical engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At this time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of Chastain & Associates, LLC. and their consultants for the specific application to the IL Route 1 Culvert Replacement over Deer Creek in Will County, Illinois.

Appendix A - Drilling, Field, and Laboratory Test Procedures

AASHTO T 206 Penetration Tests and Split-Barrel Sampling of Soils

During the sampling procedure, Standard Penetration Tests (SPT's) were performed at regular intervals to obtain the standard penetration (N-value) of the soil. The results of the standard penetration test are used to estimate the relative strength and compressibility of the soil profile components through empirical correlations to the soils' relative density and consistency. The split-barrel sampler obtains a soil sample for classification purposes and laboratory testing, as appropriate for the type of soil obtained.

Water Level Measurements

Water level observations were attempted during and upon completion of the drilling operation using a 100-foot tape measure. The depths of observed water levels in the boreholes are noted on the boring logs presented in the appendix of this report. In the borings where water is unable to be observed during the field activities, in relatively impervious soils, the accurate determination of the groundwater elevation may not be possible even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the groundwater table and volumes of water will depend on the permeability of the soils.

Ground Surface Elevations

Elevations of the soil borings were provided by Quigg Engineering, Inc. The depths indicated on the attached boring logs are relative to the existing ground surface for each individual boring at the time of the exploration. Copies of the boring logs are located in the Appendix of this report.

AASHTO T 265-15 Water (Moisture) Content of Soil by Mass (Laboratory)

The water content is an important index property used in expressing the phase relationship of solids, water, and air in a given volume of material and can be used to correlate soil behavior with its index properties. In fine grained cohesive soils, the behavior of a given soil type often depends on its natural water content. The water content of a cohesive soil along with its liquid and plastic limits as determined by Atterberg Limit testing are used to express the soil's relative consistency or liquidity index.

AASHTO T 267-86 Standard Test Method for Organic Soils using Loss on Ignition (Laboratory)

These test methods cover the measurement of moisture content, ash content, and organic matter in peats and other organic soils, such as organic clays, silts, and mucks. Ash content of a peat or organic soil sample is determined by igniting the oven-dried sample from the moisture content determination in a muffle furnace at 440°C (Method C) or 750°C (Method D). The substance remaining after ignition is the ash. The ash content is expressed as a percentage of the mass of the oven-dried sample. 2.4 Organic matter is determined by subtracting percent ash content from 100.

Appendix B - Report Limitations

Subsurface Conditions:

The subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the appendix should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, penetration resistances, locations of the samples and laboratory test data as well as water level information. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition between layers may be gradual. The samples, which were not altered by laboratory testing, will be retained for up to 60 days from the date of this report and then will be discarded.

Geotechnical Risk:

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools that geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free, and more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations, presented in the preceding section, constitute Rubino’s professional estimate of the necessary measures for the proposed structure to perform according to the proposed design based on the information generated and reference during this evaluation, and Rubino’s experience in working with these conditions.

Warranty:

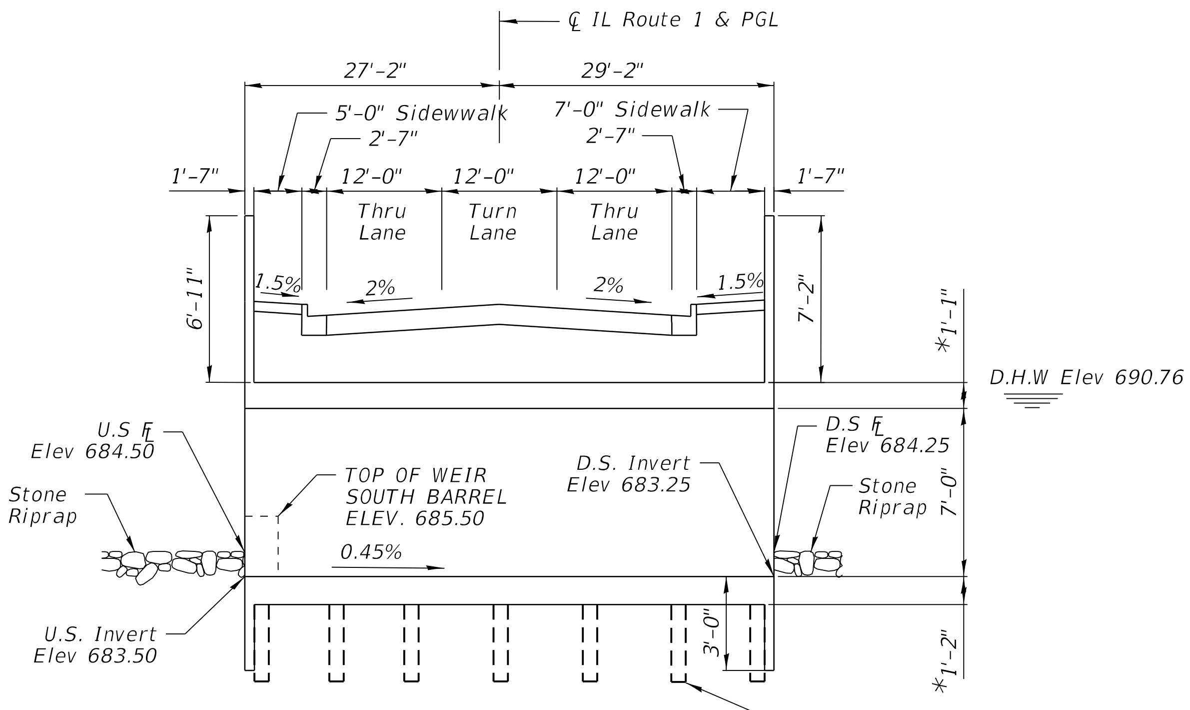
The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

Federal Excavation Regulations:

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better ensure the safety of workmen entering trenches or excavations. This federal regulation mandates that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person," as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. Rubino is providing this information solely as a service to our client. Rubino is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

Appendix C – Draft TSL



LONGITUDINAL SECTION
(Looking North)

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th Edition with 2018 Interims

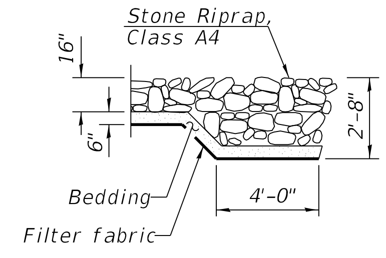
LOADING HL-93

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

DESIGN STRESSES

FIELD UNITS

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



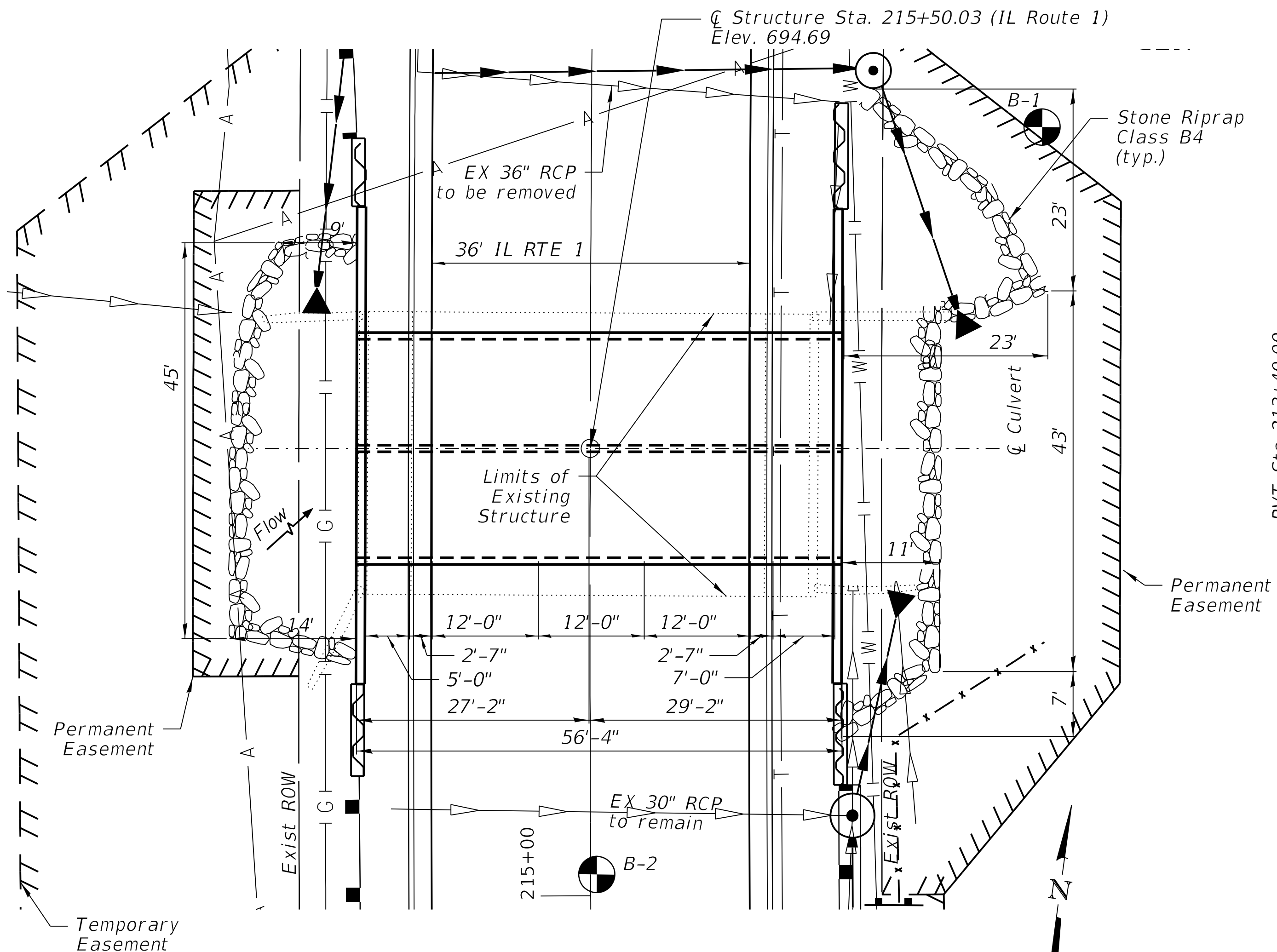
SECTION A-A

STATION 215+50.03
BUILT BY
STATE OF ILLINOIS
LOADING HL-93
STRUCTURE NO.
099-0917

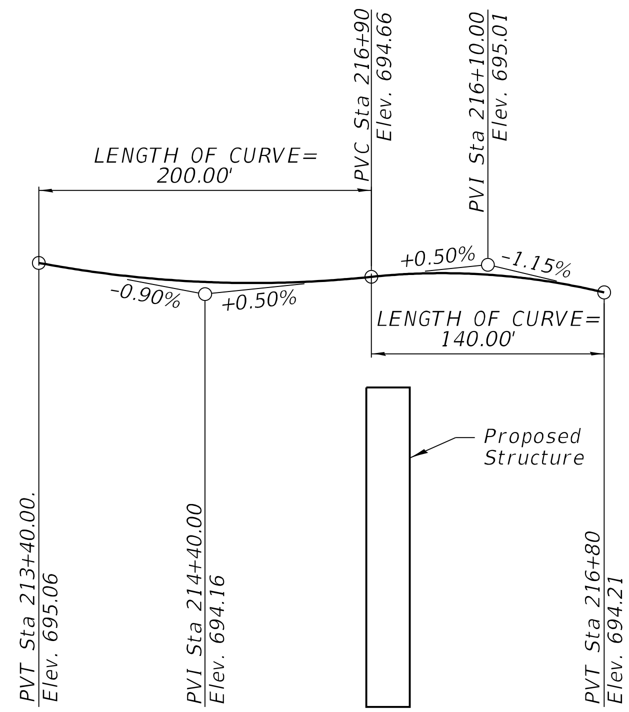
NAME PLATE
See Std. 515001

BILL OF MATERIALS

ITEM	UNIT	QUANTITY
REMOVAL OF EXISTING STRUCTURE	EACH	1
CONCRETE STRUCTURES	CU YD	14.4
REINFORCEMENT BARS	POUND	46,010
PERMANENT SHEET PILING	SQ FT	1,230
CONCRETE BOX CULVERTS	CU YD	236
MEMBRANE WATERPROOFING SYSTEM FOR BURIED STRUCTURES	SQ YD	178.8
CONTROLLED STIFFNESS COLUMN GROUND IMPROVEMENT	L SUM	1



PLAN



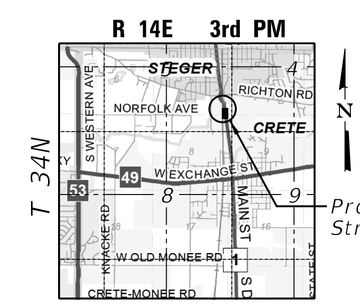
PROFILE GRADE - IL RTE 1
(Along ℄ IL Rte 1)

WATERWAY INFORMATION

Drainage Area = 7.17 sq. mi.
Exist Overtopping Elev. = 693.37 (Inlet Rim) at Sta. 214+47
Prop Overtopping Elev. = 694.00 (Inlet Rim) at Sta. 214+69

Flood	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 El. Exist.	Headwater El. Prop.
	10	284.1	70.9	115.2	689.80	0.04	0.00	689.84	689.80
Design	50	427.1	99.4	132.0	690.76	0.06	0.00	691.82	690.76
Base	100	493.9	111.1	132.0	691.15	0.08	0.00	691.23	691.15
Overtop exist	>500								
Overtop prop									
Max Calc	500	632.1	127.6	132.0	691.70	0.14	0.15	691.84	691.85

10 Year Velocity through Existing Structure = 3.18 ft/s
10 Year Velocity through Proposed Structure = 2.41 ft/s



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
IL RTE. 1
OVER DEER CREEK
F.A.P. RTE. 876 SEC. 10WB-B
WILL COUNTY
STATION 215+50.03
S.N. 099-0917

CHASTAIN & ASSOCIATES LLC CONSULTING ENGINEERS	USER NAME = jpang	DESIGNED - BCG	REVISED -
		DRAWN - DMW	REVISED -
	PLOT SCALE = 20.0000 ' / in.	CHECKED - JMB	REVISED -
	PLOT DATE = 4/29/2020	DATE - 01/07/2020	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL ROUTE 1 OVER DEER CREEK
GENERAL PLAN AND ELEVATION

SCALE: N/A | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
876	10WB-B	WILL	34	18

CONTRACT NO. 62D49
ILLINOIS | FED. AID PROJECT

Appendix D – Boring Logs

rubino ENGINEERING INC.

SOIL BORING LOG

Date 11/20/17

ROUTE IL-1 **DESCRIPTION** IL Route 1 over Deer Creek , Crete, Illinois **LOGGED BY** M.W.

SECTION FAP 876 **LOCATION** Crete, Illinois (19' N of Bridge Abutment)

COUNTY Will **DRILLING METHOD** 3 ¼" Hollow Stem Auger **HAMMER TYPE** Automatic

STRUCT. NO. 099-0076
Station

BORING NO. B-01
Station
Offset 46' East of CL
Ground Surface Elev. 694.13 ft

Surface Water Elev. 685.70 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter N/A ft
Upon Completion N/A ft
After Hrs. N/A ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Approximately 10 inches of TOPSOIL: Brown and black clay with sand and gravel	693.30				
Medium stiff, black CLAY, organics present (A-7-6)			2 1 3		21
		-5	2 2 4	0.9 B	23
	688.13				
Medium stiff, brown and gray CLAY, organics present (A-7-6)			2 2 3	1.2 B	30
		-10	1 2 3	0.8 B	28
	683.13				
Soft, gray CLAY, organics present (A-7-6)			0 0 1	0.6 B	62
		-15		0.4 B	31
	677.13		0 0 0	0.0 B	53
Very soft, dark gray SILTY CLAY (A-7-6)		-20	0 0 2	0.0 P	18
Very soft, dark gray SILTY CLAY (A-7-6) *(continued)*	673.13				
Stiff, brownish-gray CLAY (A-7-6)			3 3 6	1.7 B	19
	670.63				
Stiff, brownish-gray SILTY CLAY LOAM (A-7-6)		-25	3 4 7	2.5 B	18
			4 4 7	1.4 B	19
	665.63				
Stiff, brownish-gray CLAY (A-7-6)		-30	4 6 8	4.6 B	15
	660.63				
Stiff, brownish-gray silty CLAY LOAM (A-7-6)		-35	3 4 6	2.1 B	16
	654.13	-40	3 6 8	2.5 B	22

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)

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Date 11/20/17

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SECTION FAP 876 **LOCATION** Crete, Illinois (19' N of Bridge Abutment)

COUNTY Will **DRILLING METHOD** 3 ¼" Hollow Stem Auger **HAMMER TYPE** Automatic

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
STRUCT. NO. 099-0076 **Station** **BORING NO.** B-01 **Station** **Offset** 46' East of CL **Ground Surface Elev.** 694.13 ft					**Surface Water Elev.** 685.70 ft **Stream Bed Elev.** ft **Groundwater Elev.:** **First Encounter** N/A ft **Upon Completion** N/A ft **After** ___ **Hrs.** N/A ft
End of boring at approximately 40 feet below existing grade. No free groundwater encountered during drilling operations.	-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)

rubino ENGINEERING INC.

SOIL BORING LOG

Date 11/20/17

ROUTE	IL-1	DESCRIPTION	IL Route 1 over Deer Creek , Crete, Illinois	LOGGED BY	M.W.
SECTION	FAP 876	LOCATION	Crete, Illinois (30.5' S of Bridge Abutment)		
COUNTY	Will	DRILLING METHOD	3 ¼" Hollow Stem Auger	HAMMER TYPE	Automatic

STRUCT. NO.	099-0076		Surface Water Elev.	685.70 ft
Station			Stream Bed Elev.	ft
BORING NO.	B-02		Groundwater Elev.:	
Station			First Encounter	8' 9" ft
Offset	4.5' West of CL		Upon Completion	CAVE IN ft
Ground Surface Elev.	693.01 ft		After ___ Hrs.	N/A ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Approximately 11 inches of ASPHALT	692.09				
Approximately 10 inches of CONCRETE	691.26				
Medium dense, black, brown and gray GRAVELLY, SANDY LOAM Possible fill (A-2-7)	689.51		13 / 17 / 6		6
Medium stiff, brown CLAY LOAM (A-6)	687.01	-5	2 / 1 / 3	1.5 P	20
Medium stiff, dark gray CLAY (A-7-5)	684.51		2 / 2 / 3	0.5 B	29
Medium stiff, brown and gray CLAY LOAM (A-6) 8" of black SANDY CLAY starting near 9' 8"	682.01	-10	2 / 2 / 3	1.8 P	25
Soft, brown and dark gray CLAY, organics present (A-6)				0.2 B	38
	677.01	-15	0 / 1 / 2	1.6 B	40
Very soft, dark gray SILTY CLAY (A-7-5)			0 / 0 / 0	0.7 B	72
		-20	0 / 0 / 0	0.7 B	57
Very soft, dark gray SILTY CLAY (A-7-5) *(continued)*			0 / 0 / 0	0.4 B	60
		-25	0 / 0 / 0	0.6 B	58
			0 / 0 / 0	0.6 B	61
	659.51	-30	0 / 0 / 0	0.5 B	52
Stiff, brown and gray SILTY CLAY LOAM (A-6)		-35	3 / 3 / 5	1.7 B	20
	653.01	-40	6 / 6 / 9	5.6 B	16

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, from 137 (Rev. 8-99)

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ROUTE IL-1 **DESCRIPTION** IL Route 1 over Deer Creek , Crete, Illinois **LOGGED BY** M.W.

SECTION FAP 876 **LOCATION** Crete, Illinois (30.5' S of Bridge Abutment)

COUNTY Will **DRILLING METHOD** 3 ¼" Hollow Stem Auger **HAMMER TYPE** Automatic

STRUCT. NO. 099-0076
Station

BORING NO. B-02
Station
Offset 4.5' West of CL
Ground Surface Elev. 693.01 ft

Surface Water Elev. 685.70 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 8' 9" ft
Upon Completion CAVE IN ft
After Hrs. N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
End of boring at approximately 40 feet below existing grade.				
	-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)

BBS, from 137 (Rev. 8-99)

Appendix E – Ground Penetrating Radar

Ground Penetrating Radar (GPR)

Rubino mobilized to the site for drilling on October 4th, 2017. In effort to drill B-01 near the proposed culvert location, Rubino attempted drilling at four locations in the southbound lane including north and south of the bridge. The drilling attempts, labeled as #1 through #4 in Exhibit 1 below, hit a steel obstruction between 16 and 22 inches. After these unsuccessful attempts, it was too late in the day to begin a 40-foot boring at proposed location B-02 and Rubino demobilized the drill rig without collecting any subsurface data. Rubino attempted to obtain construction history of the pavement by contacting various parties, but was unsuccessful in obtaining any useful information.

Rubino proposed to perform ground penetrating radar (GPR) in effort to delineate the obstruction(s) and identify a location to drill near the proposed culvert. Rubino submitted a supplemental scope on November 3rd, 2017 to perform the GPR and complete the drilling program. The supplemental CECS (Work Order 7a) was approved by Chastain on November 4th.

Rubino re-mobilized with the GPR unit on November 14th and performed a grid pattern of scans spaced 18" in both directions of the southbound lane extending 30 feet south of the existing bridge. The scans were difficult to interpret with a high level of accuracy, though the obstructions were interpreted to be steel bars in both directions on fixed spacing, fairly typical of concrete pavement re-reinforcement. Rubino re-mobilized to the site with the drill rig site on November 20th. Using the GPR to pin-point drill locations, Rubino attempted to drill near the proposed culvert and again hit refusal against a steel bar on two attempts, #5 and #6 in Exhibit #1.

After a phone conversation with Chastain, it was agreed to move the boring location 30 feet off the bridge outside of the GPR identified obstructions. Boring locations B-02 is also shown below in Exhibit 1.

Exhibit #1) Plan view showing attempted drill locations (#1 to #6) and final boring location B-02.

Additional photos are provided below showing the GPR grid pattern and obstructions encountered.

Photo 1) Performing GPR scan on 18” x18” grid pattern. (November 14, 2017)

Photo 2) Overview of attempts #5 and #6 utilizing GPR data. Both holes encountered shallow obstructions. (November 20, 2017)

Photo 3) Steel obstruction encountered in attempt #5. (November 20, 2017)

Photo 4) Steel obstruction encountered in attempt #6. (November 20, 2017)