GEOTECHNICAL REPORT FOR
PROPOSED CULVERT REPLACEMENT
ON U.S. ROUTE 20 OVER UNNAMED DITCH
(1.2 MILES SOUTH OF I-90) F.A.P. 345, SECTION 2009-089
KANE COUNTY, STATION 10+05.00
STRUCTURE NO. 045-0252 (Existing) / 045-2101 (Proposed)
IDOT JOB # P-91-363-13

For
Illinois Department of Transportation
Region One – District One

Through
Terra Engineering, Ltd.

SAM Job No.16017GT
January 11, 2017

Prepared by:

S.A.M. Consultants, Inc.
407 Eisenhower Lane South
Lombard, Illinois 60148

Revision Data Sheet

Date	Revision Number	Description	Reviewer Initials	Auditor Verification Initial/Date

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GEOTECHNICAL REPORT FOR PROPOSED CULVERT REPLACEMENT ON U.S. ROUTE 20 OVER UNNAMED DITCH (1.2 MILES SOUTH OF I-90) F.A.P. 345, SECTION 2009-089 KANE COUNTY, STATION 10+05.00 STRUCTURE NO. 045-0252 (Existing) / 045-2101 (Proposed) IDOT JOB # P-91-363-13

January 11, 2017

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation including laboratory testing, and geotechnical analyses for the proposed replacement of an existing culvert structure on U.S. Route 20, (Grant Highway) over an unnamed creek (aka Eakin Creek West), in Kane County, Illinois. A *Site Location Map* is presented in the Appendix showing the site of the structure.

These geotechnical services were performed in accordance with our revised cost estimate presented on IDOT CECS Form submitted by SAM on May 12, 2016 which was subsequently approved by Terra Engineering, Inc

2.0 LOCATION & DETAILS OF THE PROJECT

The following information was provided to us by our clients. The existing culvert at the site was originally constructed in 1920 with dimensions of 6 feet width, 2 feet height, and 32 feet – 5-inch length, cast in place box culvert. The culvert was later lengthened with 44 inch x 28-inch elliptical corrugated metal pipe (CMP). The out to out width of the structure is 42 feet – 5 inches, with a clear roadway width of 31 feet – 0 inches. Based on the Boring B-2 made recently through the existing roadway pavement consists of approximately 8 inches of hot-mix asphalt (HMA) underlain by a 4 inches of concrete pavement (PCC) which in turn is underlain by 4 -inch layer of Gravel base. The structure spans approximately north and south and carries a total of 2 lanes with one in each direction. Adjacent to each lane is a 2 feet aggregate shoulder. The ditch flows from southwest to the northeast, (or approximate south to the north).

Information related to the construction of the replacement culvert was obtained from a drawing titled General Plan prepared by HBM Engineering Group, LLC, made available to us by Terra Engineering on November, 4, 2016. The structural designers indicated to us in the e-mail accompanying the drawing that there are no plans to support the new culvert by piling or deep foundations. Per the plan provided to us, the proposed construction is expected to involve replacing the existing culvert with a new double 12 feet by 4 feet cast in place concrete culvert. The center line of new culvert will be at station 10+05.00, approximately 5 feet away from the center line of the existing culvert which is at station 10+00.00. The invert elevation of the new culvert is expected to be at elevation 939.40.

The plans provided to us also indicate the construction of wing walls at all four corners of the new culvert. Additionally, stone Rip-Rap will be provided at both entry and exit ends of the new culvert for 12 feet beyond the ends of the culvert for the entire widths between the wing walls.

The final surface grade of the new roadway is expected to be at elevation 947.02 at the culvert replacement location. Based on the proposed final grades of the new roadway, the base of the new culvert is expected to be approximately 8 feet below the final surface of the roadway.

3.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The project site is located on U.S. Highway #20, about 3,520 feet southeast of its intersection with Gast Road, and 1.2 miles south of Interstate 90, in Kane County, Illinois. The existing roadway is in poor condition with several longitudinal and transverse cracks in the pavement. The structure is located within a vertical sag curve and a horizontal curve. The ditch flows from the southwest to the northeast through the culvert.

In Kane County, the surficial cover is made up mostly of Quaternary glycogenic of unratified drift of the Wedron Group. Per the Illinois State Geological Survey's "Quaternary Deposits of Illinois" Map (1979), the project lies mostly within the surficial soil deposits of the *Tiskilwa Till Member of the Waldron Formation, (Wt and Wt-a)* These are mostly Silty and Sandy Clay deposits of glacial origin. Hard pan or rock formations were not encountered for the 45 feet depth to which our borings were taken.

Our subsurface investigation results generally agree with the local geologic contexts. The borings drilled in the project area revealed that below the embankment fills, the native sediments consisted of Sand and Gravel and below elevation 912.0 (30 feet below the road grade), stiff clays and Sandy Clays were encountered.

4.0 METHODS OF INVESTIGATION

The following section outlines the subsurface and laboratory investigations provided by SAM.

4.1 Field Work

The borings for the subsurface investigation for the U.S. Route #20 (Greg Highway) culvert site across the Unnamed Creek (aka Eakin Creek West), B-1 and B-2, were performed by SAM on September 29 and 30, 2016. Drill rig and crews from GEOCON companies were used to drill the borings under the direct surveillance and direction of SAM's field engineer who accompanied the drill rig, logged the borings and collected the soil samples. Boring B-1 was made outside the R.O.W. of US #20, at Station 9+85, 20 feet west of the road centerline in a grass covered area. Boring B-2 was made on the road drilled through pavement of U.S. #20, 6 feet east of the road centerline. As drilled, boring locations are shown on the *Boring Logs* and on the *Boring Location Plan* provided in the Appendix.

A truck mounted drilling rig equipped with hollow stem augurs, was used to complete the two borings for the proposed culvert replacement across the Unnamed Creek. Drilling was conducted with hollow stem augers to advance and maintain an open borehole. Soil sampling was performed per AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils.* All collected samples were transported to the laboratory in sealed moisture tight containers for analysis and testing. Physical tests including moisture content determination, visual classification, as well as an estimate of the shear strength of cohesive soils using a pocket penetrometer and "RIMAC" were performed. All tests were generally performed as per the current ASTM standards.

Field boring logs prepared and maintained by SAM's field engineer, included lithological descriptions, and visual-manual soil classifications (as per IDH textural classification system and ASTM 2487 and ASTM 2488). Results of Rimac unconfined compressive strength testing on cohesive soils, and Standard Penetration Test (SPT) per ASTM D6066, recorded as blows per 6 inches of penetration are provided on the boring logs. Groundwater observations were made during and at completion of drilling operations. The borings were backfilled with soil cuttings and bentonite chips, and the surface was restored as close as possible to its original condition.

4.2 Laboratory Testing

All soil samples were tested in the laboratory for moisture content (AASHTO T-265). Atterberg Limits (AASHTO T89/T90) and particle size analyses including hydrometer analysis (AASHTO T88) were also performed on selected samples. Densities of the soil samples were determined on some of the soil samples (ASTM D-2937). Field visual description of the soil samples were verified in the laboratory and classified per the IDH and the Unified Soil Classification Systems (ASTM 2487 and ASTM 2488).

Laboratory test results are shown in the *Boring Logs* and in the *Laboratory Test Results* both included in the Appendix.

Based on the results of the field drilling and laboratory testing, the sub-surface conditions encountered were analyzed for the appropriate support of the planned culvert project. Details of our analyses and geotechnical recommendations are provided in the following portions of this report.

4.3 Geotechnical Report

This report presents results of our subsurface investigation, laboratory testing and characterization of the site soil and groundwater conditions, geotechnical analyses, and provides recommendations for the design and construction of the new replacement culvert supports and approach slabs. Based on a plan and profile sheet provided by our clients, there will be a small fill height 1'-7" to 2'-1" below the new approach slabs outside of each end of the culvert. The analysis, recommendations and effects of this fill and related grading work are also included in this report.

5.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented in the *Boring Logs* included in the Appendix. Please note that strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical direction

5.1 Subsoil Conditions

Boring **B-1** was made close to the west/southwest corner of the proposed new culvert on U.S. Route #20 (Grant Highway) over Unnamed Creek. The boring was made outside of the existing guardrails in the weeded area. This boring indicated an 18" layer of a Topsoil at the surface.

Below the topsoil layer in B-1 and down to a depth of 6 feet, (or to elevation 936.2), a fill made with medium stiff to stiff silty clay soils, with traces of topsoil, sand and gravel was encountered. The moisture content of these soils varied between 12% and 13%. These soils were noted to have Standard Penetration Resistance "N" values of between 5 and 7 blows per foot.

In B-1, between elevations 936.2 and 932.2, a deposit of medium stiff to stiff lean clay (CL) was encountered. The moisture content of these soils varied between 10% and 13%, Standard Penetration Resistance "N" values of between 7 and 8 blows per foot, and shear strength measured in the field by a pocket penetrometer of 1.0 tsf.

Between elevation 932.2 and 924.2 (depths 10 feet to 18 feet) deposits of medium dense fine sand were encountered in B-1. This sand layer was noted to exist with a Standard Penetration Resistance "N" value of 8 to 14 blows per foot, and generally existed in a wet and saturated condition. These soils were classified as SP by the Unified system.

Deposits of stiff to very stiff lean clays to silty clay with traces of sand and gravel were generally encountered below 924.20 and continued to the bottom of B-1 (elevation 897.20 or 45 feet depth). These lower clay soils had the following in place properties; moisture content 12.8 to 17.4% and Standard Penetration Resistance "N" values between 9 and 16 blows per foot. These soils were classified as CL – Lean Clay to CL-ML Silty Clay by the Unified System.

Boring **B-2** was made close to the east/northeast corner of the proposed culvert n U.S. Route #20 (Grant Highway) over Unnamed Creek, through the road pavement. This boring indicated an 8-inch-thick asphalt paving at the surface underlain by a 4-inch concrete pavement, and a 4-inch thick layer of gravel fill (pavement base layer) that exists below the pavement section.

Below the pavement section in B-2 and down to a depth of 5 feet, (or to elevation 939.54), a fill made with dark brown lean clay soils was encountered. The moisture content of these soils varied between 31% and 32%. These soils were noted to have Standard Penetration Resistance "N" values of between 5 and 11 blows per foot.

In B-2, between depths of 5 feet and 16 feet (between elevations 939.5 and 928.5), a deposit of medium stiff to stiff brown to gray lean clay with traces of sand and gravel, was encountered. The moisture content of these soils varied between 8.9 and 15.0%, Standard Penetration Resistance "N" values of between 6 and 9 blows per foot, and shear strength measured in the field by a "Rimac" 1.0 to 2.7 tsf.

A thin layer of medium dense, fine to medium grained sand was encountered between the depths of 16' and 18' (between elevations 928.5 and 926.5) in B-2. This sand layer was noted to exist with a Standard Penetration Resistance "N" value of 12 blows per foot, and generally existed in a wet and saturated condition. These soils were classified as SP by the Unified system.

Deposits of stiff to very stiff lean clays with traces of fine sand and gravel were encountered between the depths of 18 feet and 40 feet (elevation 926.5 to 904.5) in B-2. The moisture content of these soils varied between 10.0 and 14.6%, Standard Penetration Resistance "N" values of between 8 and 15 blows per foot, and shear strength measured in the field by a "Rimac" 1.0 to 3.1 tsf.

Deposits of stiff sandy clay were encountered below 904.5 and continued to the bottom of B-2 at elevation 899.5 (or 45 feet depth). These lower sandy clay soils had the following in place properties; moisture content 13.1%, Standard Penetration Resistance "N" value of 7 blows per foot, and shear strength measured in the field by a pocket penetrometer of 2.0 tsf. These soils were classified as CL – Lean Clay by the Unified System.

5.2 Groundwater Conditions

Groundwater was encountered in the two borings, B-1 and B-2 at elevation 936.2 (depth of 6 feet) and 928.5 (depth of 16 feet) respectively during their drilling. The same was measured to be at elevations 938.2 (or at a depth of 4 feet) in B-1 at the completion of drilling of B-1.

The groundwater level observations provide an approximate indication of the groundwater at the time the borings were drilled. However, longer-term observations in cased holes or Piezometer can provide more accurate evaluation of the groundwater levels. Fluctuations in the groundwater level should be anticipated throughout the year depending on regional variations in the climate 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 fluctuations should be considered when developing the design and construction plans for the project.

6.0 GEOTECHNICAL EVALUATIONS & RECOMMENDATIONS

6.1 Excavations and Embankment Construction

Excavations will be needed to the proposed invert elevation of 939.90 from the existing ground surface, in two stages as per the Project General Plan, for the construction of the new cast-in-place reinforced concrete culvert. Since the General Plan indicates the thickening slab /

foundation for the invert slab which is typically 3 feet deep from the invert elevation, in addition to the excavations to the proposed invert elevation of 939.90 of the culvert, we recommend that the soils should be excavated 2'-10" depth from the bottom of the invert slab from elevation 939.90 to 935.90 due to the expected ground water level and / or wet soil condition. Backfill for the first 12-inch layer from elevation 935.90 to 936.90 is to be backfilled with granular material such as IDOT CA-01 crushed stone and densified, with geo-fabric underneath it, and a 3 feet layer of controlled compacted fill made with granular soils such as IDOT CA06 shall be placed and compacted in loose lifts of 6 inches and compacted to a dry density of 95% of ASTM D-1557. Construction of the thickening slab / foundation for the invert slab can be performed by trenching through the CA-06 granular fill material. Since the base of the excavations are expected to be wet with possible standing groundwater as seen in boring B-1 and B-2 we recommend continuous dewatering needs to be performed during the soils excavation, placement and compaction of granular materials. Similarly, the backfills on the sides of the new culvert shall also be made with compacted aggregate fill made with CA-6 material. The outside walls of the culvert should be backfilled with drainage material such as IDOT CA-07 and densified to allow drainage of any collected water. The excavation for the east and west wing walls is recommended to be performed to an elevation of 937.90 and backfill with the granular soils such as IDOT CA06 shall be placed and compacted as stated above.

For the construction of the culvert, excavations will be made safe side slopes. The excavations outside the culvert itself needs to be backfilled with a controlled compacted fill made with IDOT CA-06, placed in loose lifts of 6 inches and compacted to a dry density of 95% of ASTM D-1557.

The side slopes of any open cut construction excavations shall be constructed safe and in accordance with the OSHA requirements. The soils for all new fills and the backfill around the new culvert shall be granular materials. The compaction procedures and minimum density requirements shall be in accordance with Illinois Department of Transportation's "Standard Specifications for Road and Bridge Construction", 2016 Edition, Section 205.

6.2 Settlements under Culvert

Per the plans made available to us, earth fills of less than 3 feet (+/-) are planned to be placed on top of the existing roadway surface grade at the two approaches to the culvert. All the new fill on top of the culvert as well as on the sides of the culvert, shall be a controlled compacted fill made with granular soils.

The subsoils encountered in the two borings B-1 and B-2, generally indicated relatively stiff soils. In **B-1,** the upper lean clay layer between depths of 6 feet and 10 feet is saturated and compressible yet it is underlain by deposits of sand making the compressible layer to have double drainage. The lean clays and silty clay layers below 20 feet and down to 45 feet are less moist and are relatively stiff. In **B-2,** the upper lean clay layer between depths of 5 feet and 16 feet is not saturated and relatively less compressible and it is also underlain by a thin layer of sand below. The lean clay layer between 18 feet and 40 feet in B-2 is less moist and stiff to very stiff.

Based on the soil profile at B-1 and B-2, and the fact that all new fills and backfills will be made with compacted granular soils as indicated in the General Plan, we are estimating negligible settlements, either under the new culvert or under its approaches. Please refer the attached settlement calculations in the Appendix. Further, any nominal settlements realized will be completed within two weeks of time.

6.3 Seismic Considerations

Most subsurface soils encountered in the borings made at the proposed culvert structure at the unnamed creek site are cohesive in nature for the upper depths with granular soils interspersed in the clays generally at lower depths of below 30 feet. Ground water was observed to exist in the recently made borings B-1 and B-2 at depths of 6 feet and 16 feet respectively.

As per the Geotechnical Manual User (AGMU) Memo section 10.1 (January 2010) provided by IDOT, the liquefaction potential was determined. For the Seismic Site Class Determination, we have extended the soil column to 60 feet, extrapolating the soil properties at depths beyond the bottom of the borings to those that were encountered at the base of the two borings. The site soils within the top 45 feet have an average normalized undrained shear strength of 1.8 ksf, classifying the site in Seismic Site as Class D (AASHTO, 2008 Method C). The project location belongs to seismic performance zone 1, and the site soil class is D. The seismic spectral acceleration parameters recommended for design in accordance with the *2008 Interim Revisions of the AASHTO LRFD Design Specifications* are summarized in Table 6.1 below.

Table 6.1: Seismic Design Parameters

Spectral Acceleration Period (sec)	Site Factors	Design Spectrum for Site Class D** (%g)
	F_{pga}=1.6	As = 6.7
0.2	F_a=1.6	S_{DS}=15.2
1.0	F_v=2.4	S_{D1}=8.4

** Site Class D values to be presented on plans

6.4 Mining Activity

Per all available information for Kane / McHenry Counties the subject site does not have any record of any coal mining or other mining activities in the area.

6.5 Scour Considerations

The following waterway information was taken from the drawing provided to us.

- Flood High Water Elevations: 943.3 (10 year); 945.4 (100 years).
- Scour Elevations 936.9 (Upstream); 936.8 (downstream).
- Proposed elevation of the flow line: 940.9 (upstream); 940.8 (downstream)

The drawing provided to us by the designers indicate a layer of rip-rap is being provided at the base of the channel at both the entry and exit points of the new culvert for the entire widths between the wing walls and extending to 12 feet along the channel flow. With this, we feel that scour will not be of any consequence in the future

6.6 Culvert Foundation Evaluation and Design Recommendations

The plans provided to us indicate that the construction of the new culvert will be performed in two stages, the Stage I construction will be for the northern 20 feet (+/-) of the structure while the Stage II will involve 28 feet 3 inches of the southern portions of the culvert. Temporary arrangements should be made to divert the flow from the creek during the construction of the new culvert.

According to the structural design engineers, the new culvert will not be supported on pile foundations. Based on the results of the two borings, we estimate the following net allowable soil pressures are available for the foundation design:

Table 6.2: Net Allowable Bearing Pressure

Location	Net Allowable Soil pressure (psf) at elevation*	Remarks
B-1	2,000 at 934.00	GWL** 938.0
B-2	2,500 at 934.00	GWL** 928.5

* As long as all the wet soil under the culvert invert slab and the deepened ends of the slabs are removed and replaced by the granular fill material as mentioned in Section 6.1

**GWL – Ground Water Table

As noted earlier, below the base slab of the culvert, a 36-inch layer of compacted (at 95% ASTM D-1557) aggregate (such as IDOT CA-6) be created below which, a 12 inch layer of IDOT CA-1 be created. Since the culvert is to be constructed in two stages, for the Stage I construction, the north portion of the culvert shall be constructed independent of the Stage II construction. Since the culvert is recommended to be placed on the above said granular fill material, the required allowable bearing pressure against the vertical loads would be safe. Groundwater for this northern half of the construction may require temporary dewatering and diverting the stream flow through the southern half of the site. The foundation system for the wing walls will be spread footing with the allowable bearing pressures given in the Table 6.2 above.

The stage II construction shall be performed independent of the completed Stage I construction. Below the base slab of the culvert, similar granular soil fill layers as listed for Stage I shall be created for Stage II as well. Groundwater for this southern half of the construction will require temporary dewatering and diverting the stream flow through the northern half of the site.

6.7 Construction Considerations

Temporary excavations for the staged construction of the foundations of the two stages of the culvert construction is planned by implementing “Temporary Sheet Piling Wall” as indicated in the Project General Plan. The criterion for this shall be per IDOT Design Guide 3.1

7.0 QUALITY CONTROL DURING CONSTRUCTION

It is recommended that all undercuts, subgrade examinations and proof-rolling etc. shall be observed and documented by the geotechnical engineer during construction. The soils material for the backfill around the new culvert as well as all new embankment fill and the compaction procedures and minimum density requirements shall be in accordance with Illinois Department of Transportation's "Standard Specifications for Road and Bridge Construction", 2016 Edition, Section 205.

8.0 REPORT LIMITATIONS

The information, analyses and recommendations presented in this report are based on the design and construction related information supplied to S. A. M. Consultants Inc., by Terra Engineering Ltd. and their sub-consultants., the results of our field drilling, sampling and testing and the ensuing analyses performed by us. If any of the project information is different from our current understanding as presented in this report, or if any of the same changes, please inform us so that we can modify our recommendations if necessary.

The analyses and recommendations presented in this report conform to the current standards of the industry for similar projects. Beyond this, no warranty is provided or implied.

The recommendations provided in this report are for the exclusive use of Illinois Department of Transportation and their consultants Terra Engineering for the specific use in the design and construction of the proposed new culvert of U.S. 20 over Unnamed Creek in Kane County, Illinois.

Submitted by:
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Project Location Plan

Google Maps US-20

Imagery ©2016 Google, Map data ©2016 Google 500 ft

Project General Plan

Bench Mark: Bench tie spike in 1st PP north of culvert on west side of US 20 Sta 8+60.28 28.29'LT, Elevation 945.81

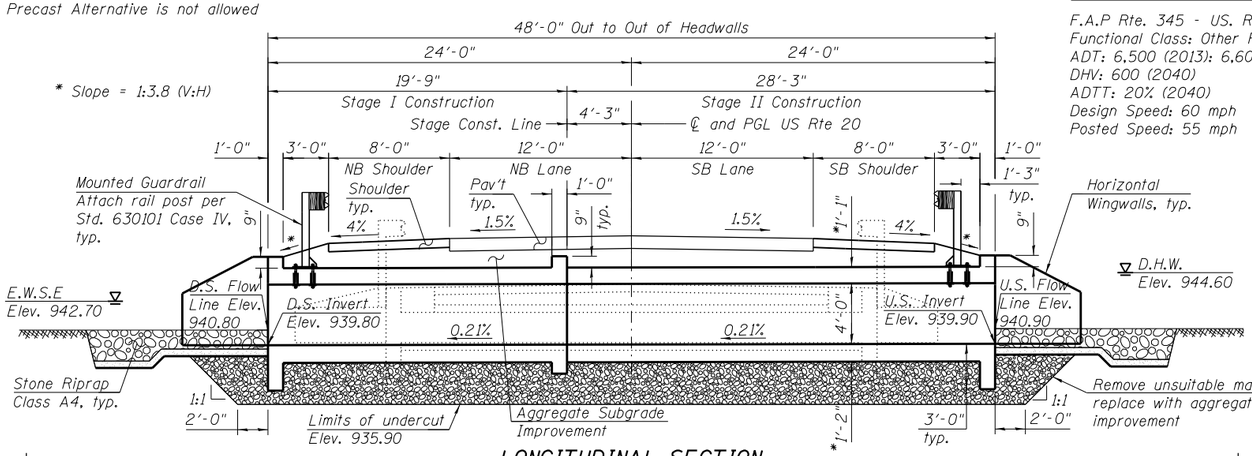
Existing Structure: SN 045-0252 originally constructed in 1920 as a single cast-in-place box culvert 6' wide and 2' high and 32'-5" long. The culvert was lengthened approximately by 6' on the east side and approximately 4' on the westside with 44"x28" elliptical corrugated metal pipe. Both bounds of traffic shall utilize one lane during each stage construction controlled by temporary traffic signal.

Salvage: None

Precast Alternative is not allowed

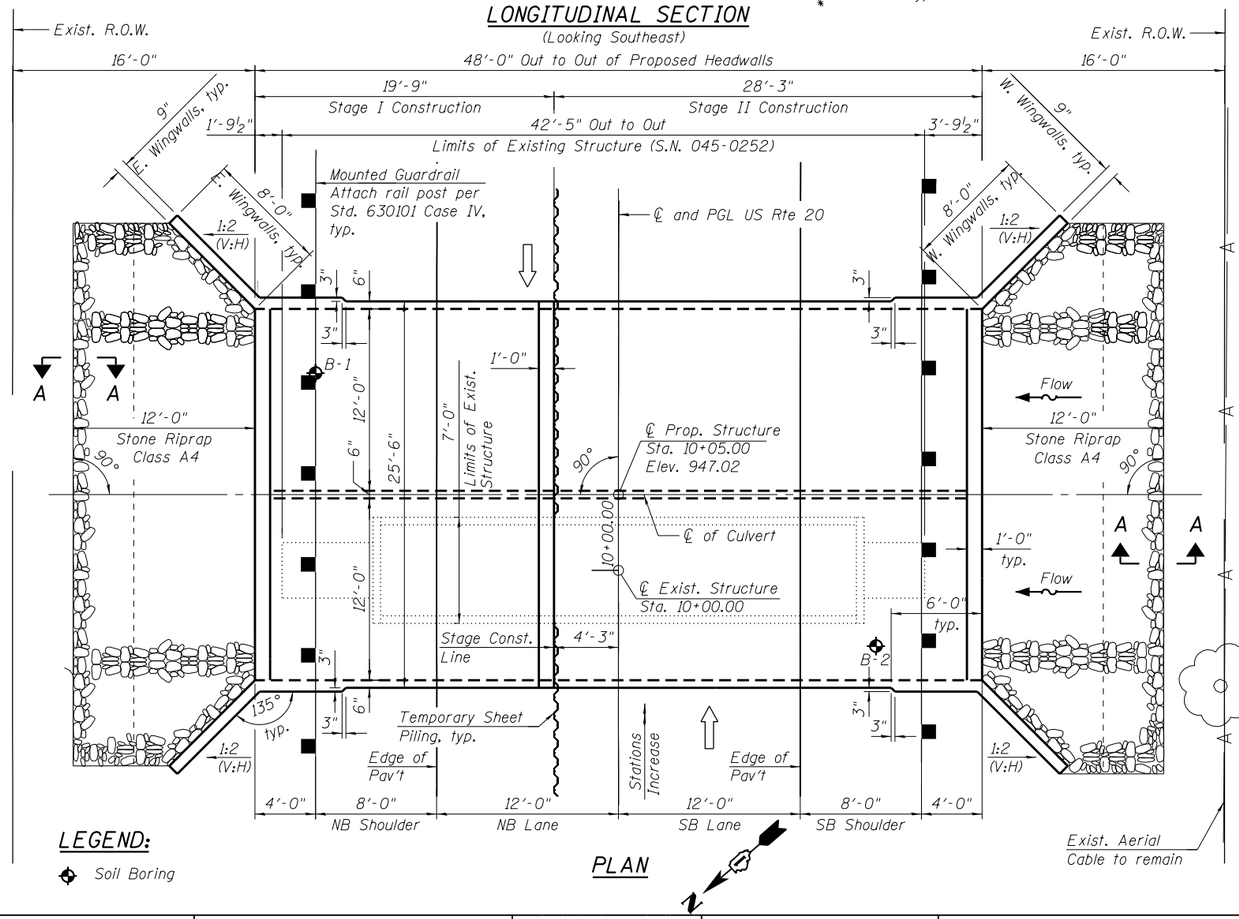
HIGHWAY CLASSIFICATION

F.A.P Rte. 345 - US. Rte. 20
Functional Class: Other Principal Arterial
ADT: 6,500 (2013): 6,600 (2040)
DHV: 600 (2040)
ADTT: 20% (2040)
Design Speed: 60 mph
Posted Speed: 55 mph



LONGITUDINAL SECTION

(Looking Southeast)



LEGEND:

Soil Boring

PLAN

WATERWAY INFORMATION

Drainage Area = 358 acres

Existing Overtopping Elev. = 944.5 at Sta. 9+00
Proposed Overtopping Elev. = 946.5 at Sta. 9+00

Flood	Freq. Yr.	Discharge 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	136	6.4	63.8	943.3	1.7	0.3	945.0	943.6
Design	50	269	6.4	72.0	944.0	1.3	0.6	945.3	944.6
Base	100	351	6.4	72.0	944.4	1.0	0.9	945.4	945.3
Overtop Existing		42	6.4					944.5	
Overtop Proposed		483		72.0					946.5
Max. Calc.	500	461	6.4	72.0	944.8	0.7	1.5	945.5	946.3

10-year velocity through the existing culvert = 7.4 fps.
10-year velocity through the proposed culvert = 2.6 fps.
2 Year Peak Flow (Q) = 60.70 cfs
Estimated Water Surface Elevation = 942.7 ft

DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	D.S. Invert	U.S. Invert
	936.8	936.9

NOTES:

1. For Stage Construction, see Sheet 2.
2. Low Flow weir is located at the Upstream (Southeast end) Southeast cell end elevation only.
3. For Section B-B, see Sheet 2.

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition. with 2015 and 2016 Interims

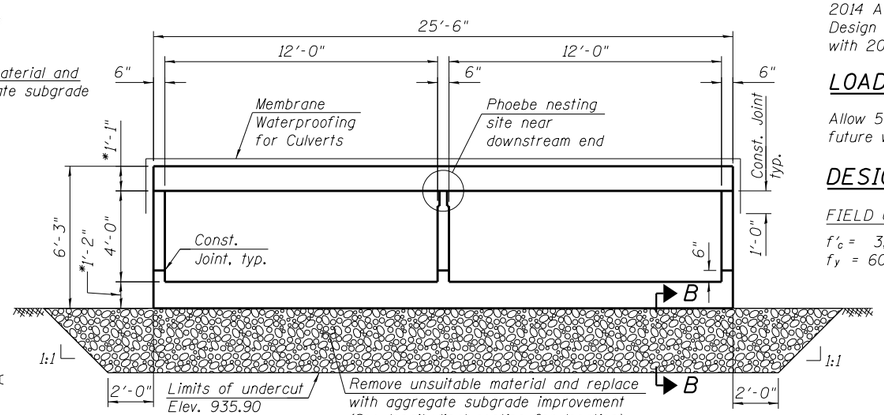
LOADING HL-93

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

DESIGN STRESSES

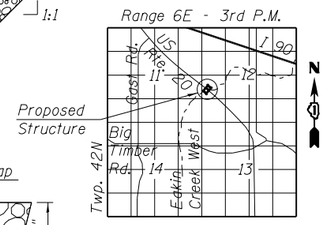
FIELD UNITS

f'_c = 3,500 psi (Concrete)
f_y = 60,000 psi (Reinforcement)

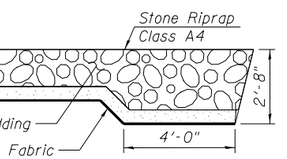


SECTION THRU BARREL

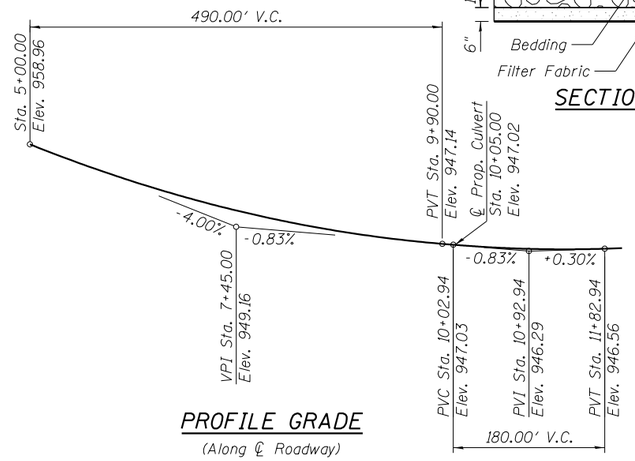
* Slab thickness may be refined in final design



LOCATION SKETCH



SECTION A-S



PROFILE GRADE

(Along ℄ Roadway)

GENERAL PLAN
U.S. RTE. 20 OVER UNNAMED DITCH
(1.2 MI SOUTH OF I-90)
F.A.P. 345 (US 20/ GRANT HWY)
SEC. 2015-063B
KANE COUNTY
STATION 10+05.00
STRUCTURE NO. 045-2101

FILE PATH = P:\1605-677 IDOT PTB163 Item 9 -Terra\Work Order #9 - US20 Over Unnamed Ditch\TSL Plans\GPE.dgn

HBM ENGINEERING GROUP, LLC

GPE.dgn	DESIGNED - MI, SK	REVISED -	
USER NAME = Stoyanka.Kotorokova	DRAWN - SK	REVISED -	
PLOT SCALE = 10.0 '/ in.	CHECKED - MI. LAB	REVISED -	
PLOT DATE = 1/9/2017	DATE - 01/09/2017	REVISED -	

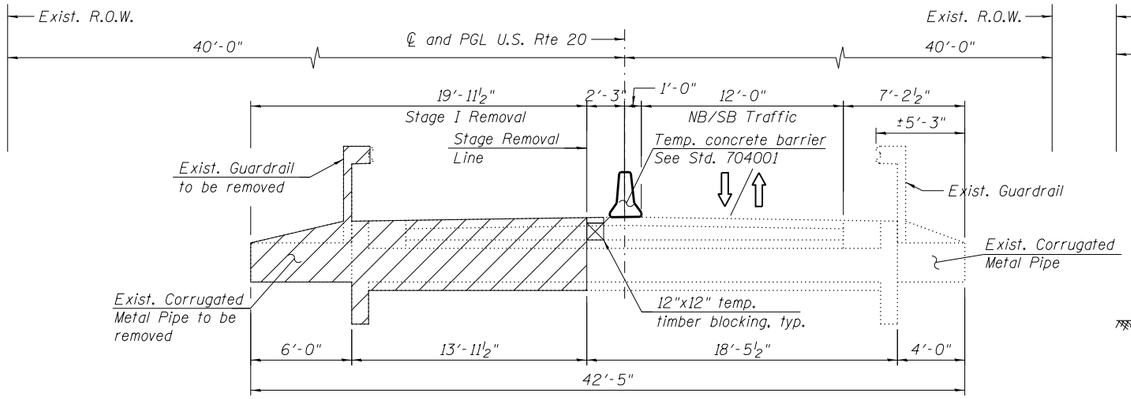
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SCALE: | SHEET 1 OF 2 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
345	2015-063B	KANE		

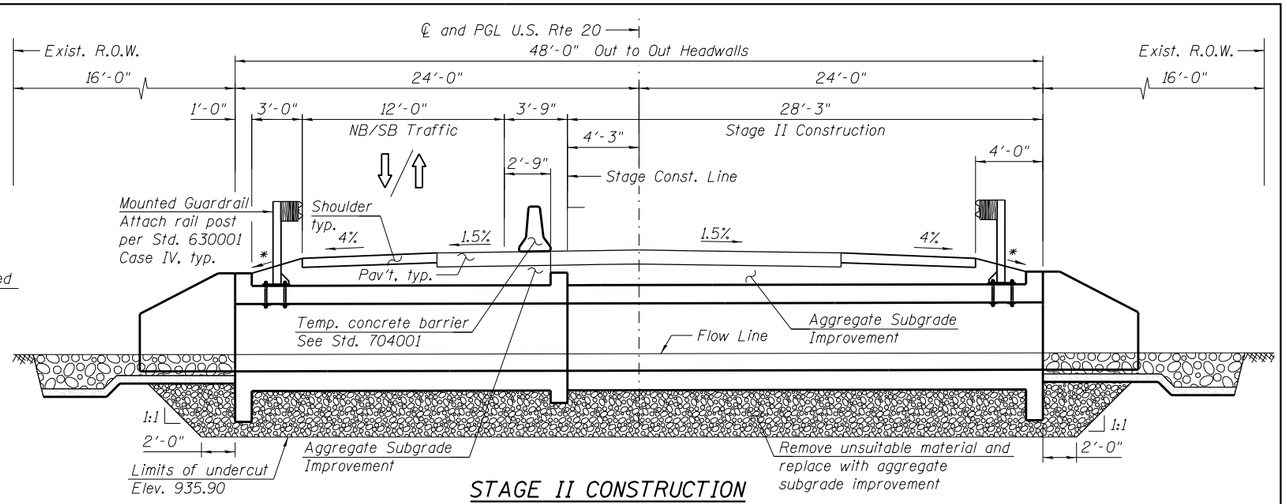
CONTRACT NO. 62B31

ILLINOIS FED. AID PROJECT



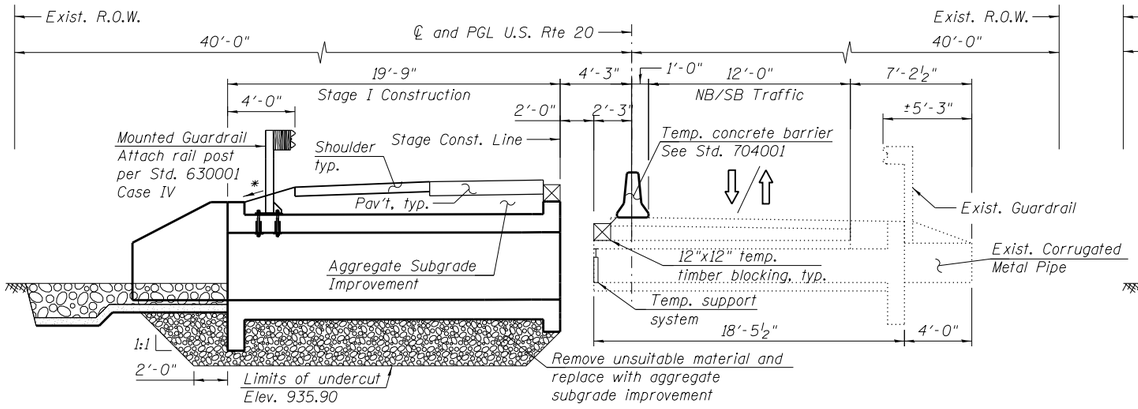
STAGE I REMOVAL

(Looking Southeast)



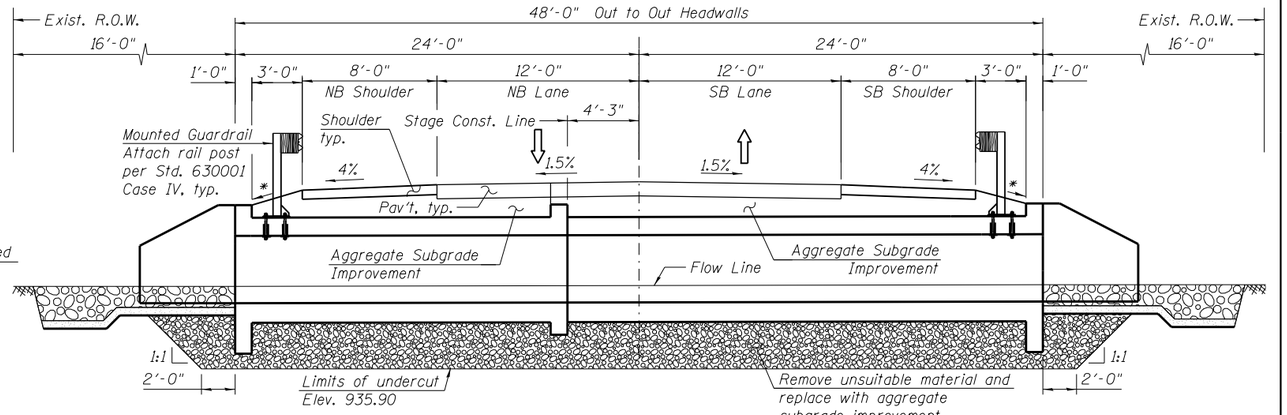
STAGE II CONSTRUCTION

(Looking Southeast)



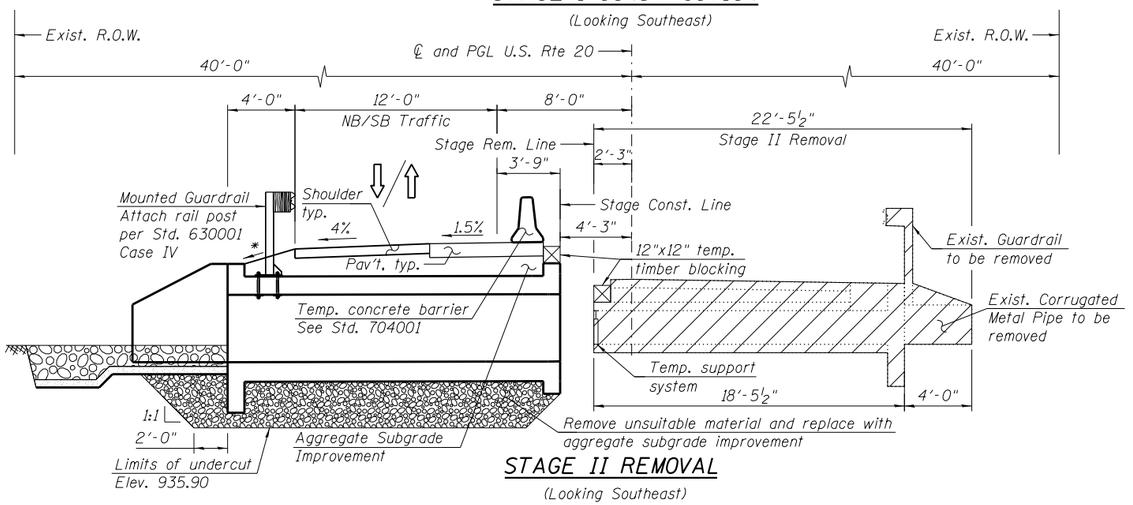
STAGE I CONSTRUCTION

(Looking Southeast)



FINAL CROSS SECTION

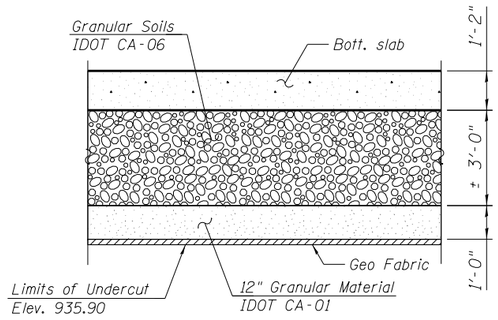
(Looking Southeast)



STAGE II REMOVAL

(Looking Southeast)

* Slope = 1:3.8 (V:H)



SECTION B-B

(Showing Aggregate Subgrade Improvement)

LEGEND:

Removal of existing structure

STAGE CONSTRUCTION
U.S. RTE. 20 OVER
UNNAMED DITCH
(1.2 MI SOUTH OF I-90)
F.A.P. 345 (US 20/GRANT HWY)
SEC. 2015-063B
KANE COUNTY
STATION 10+05.00
STRUCTURE NO. 045-2101

FILE PATH = P:\1605-617 IDOT PTB163 Item 9 -Terra\Work Order #9 - US20 Over Unnamed Ditch\TSL Plans\Stage.dgn

HBM ENGINEERING GROUP, LLC

Stage.dgn	DESIGNED - MI, SK	REVISED -	
USER NAME = Stoyanka.Kotorokova	DRAWN - SK	REVISED -	
PLOT SCALE = %0.0000 '' / in.	CHECKED - MI, LAB	REVISED -	
PLOT DATE = 1/9/2017	DATE - 01/09/2017	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SCALE: | SHEET 2 OF 2 SHEETS | STA. | TO STA.

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
345	2015-063B	KANE		

ILLINOIS FED. AID PROJECT

CONTRACT NO. 62B31

Soil Classification General Notes

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS: Split Spoon – 1 3/8" I.D., 2" O.D., unless otherwise noted
ST: Thin-Walled Tube – 3" O.D., Unless otherwise noted
PA: Power Auger
HA: Hand Auger
DB: Diamond Bit – 4", N, B
AU: Auger Sample
HS: Hollow Stem Auger
PS: Piston Sample
WS: Wash Sample
FT: Fish Tail Bit
RB: Rock Bit
BS: Bulk Sample
PM: Pressuremeter
DC: Dutch Cone
WB: Wash Bore

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon, except when noted.

WATER LEVEL MEASUREMENT SYMBOLS:

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short term observations.

DESCRIPTIVE SOIL CLASSIFICATIONS:

Soil Classification is based on the Unified Soil Classification System and ASTM Designations D-2487 and D-2488. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles; gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve: they are described as: clays, if they are plastic and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse grained soils are defined on the basis of their relative in place density and the fine grained soils on the basis of their consistency. Example: Lean Clay with sand, trace of gravel, stiff (CL); Silty sand, trace of gravel, medium dense (SM).

CONSISTENCY OF FINE GRAINED SOILS:

Unconfined Compressive Strength, Qu, tsf	N-Blows/ft	Consistency
< 0.25	Below 2	Very soft
0.25 - 0.50	2 – 4	Soft
0.50 - 1.0	4 – 8	Medium Stiff
1.0 - 2.0	8 - 15	Stiff
2.0 - 4.0	15 - 30	Very Stiff
4.0 - 8.0	30 – 50	Hard
> 8.0	> 50	Very Hard

RELATIVE PROPORTIONS OF SAND & GRAVEL

Descriptive Term(s) (of Components Also Present in Sample)	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) (of Components Also Present in Sample)	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

RELATIVE DENSITY OF COARSE GRAINED SOILS

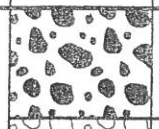
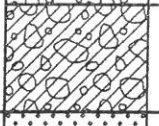
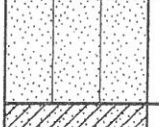
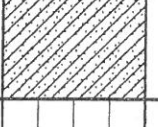
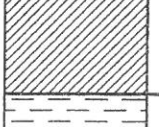
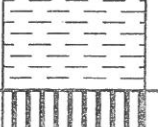
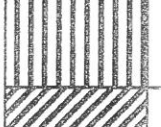
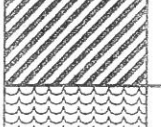
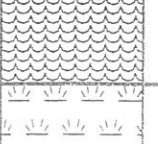
N-Blows/ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 - 29	Medium Dense
30 – 49	Dense
50 – 60	Very Dense
80+	Extremely Dense

GRAIN SIZE TERMINOLOGY

Major Component Of Sample	Size Range
Cobbles	12 in. to 3 in. (300 mm to 75 mm)
Gravel	3 in. to #4 sieve (75 mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75 mm to 0.75 mm)

S. A. M. Consultants, Inc.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Logs of Boring B-1 and B-2

S.A.M. CONSULTANTS, INC.
DBE/MBE Firm

SOIL BORING LOG

Date 9/30/16

ROUTE U.S. #20 (Grant Highway) / FAP 345 DESCRIPTION Job #16017GT First Encounter LOGGED BY Danish

SECTION _____ LOCATION On the Northwest of US #20 on Grass, SEC. , TWP. , RNG.

COUNTY Kane DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic

STRUCT. NO. 045-0252 (Exist.) / 045-2102 (Prop.)
Station _____

BORING NO. B-1
Station 10+13
Offset 20.00ft E
Ground Surface Elev. 942.20 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft
Groundwater Elev.:
936.2 ft ▼
Upon Completion 938.2 ft ▽
After _____ Hrs. _____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				TOPSOIL 18"
	1			940.70
	2	1.3	12.9	**FILL - made with Silty Clay traces of Sand, Gravel & Topsoil** Brownish Gray
	3	P		
	2			▽
	3	1.5	12.2	
-5	4	P		
				936.20 ▼
	2			**LEAN CLAY - traces of Sand & Gravel** Gray Medium Stiff CL
	3	1.0	10.4	
	4	P		
	3			
	3	1.0	13.1	
932.20 -10	5	P		
	6			**FINE SAND with trace of Gravel** Gray Medium Dense SP
	6		19.7	
	8			
	5			
	7		15.6	
-15	7			
	3			
	3		21.9	
	5			
924.20				
	8			
	6	2.0	12.5	
-20	6	P		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	4			**LEAN CLAY with trace of Sand & Gravel** Gray Stiff to Very Stiff CL *(continued)*
	5	2.3	12.8	
	6	P		
	6			
	6	3.5	13.2	
-25	8	P		
	5			
	5	2.5	13.3	
	8	P		
	6			
	6	2.5	12.9	
912.20 -30	10	P		
				SILTY CLAY - trace of Sand & Gravel Gray Medium Stiff to Stiff CL - ML
	3			
	6	1.0	13.4	
-35	4	P		
	4			
	4	0.8	17.4	
902.20 -40	5	P		

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)

S.A.M. CONSULTANTS, INC.
DBE/MBE Firm

SOIL BORING LOG

Date 9/30/16

ROUTE U.S. #20 (Grant Highway) / FAP 345 DESCRIPTION Job #16017GT LOGGED BY Danish

SECTION _____ LOCATION On the Northwest of US #20 on Grass, SEC. , TWP. , RNG.

COUNTY Kane DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic

STRUCT. NO. 045-0252 (Exist.) / 045-2102 (Prop.)
Station _____

BORING NO. B-1
Station 10+13
Offset 20.00ft E
Ground Surface Elev. 942.20 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 936.2 ft
Upon Completion 938.2 ft
After _____ Hrs. _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
LEAN CLAY - trace Sand & Gravel Gray Medium Stif to Stiff CL		4		
		4 7	1.0 P	14.2
897.20	-45			
End of Boring	-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)

S.A.M. CONSULTANTS, INC.
DBE/MBE Firm

SOIL BORING LOG

Date 9/29/16

ROUTE U.S. #20 (Grant Highway) / FAP 345 DESCRIPTION Job #16017GT First Encounter LOGGED BY Danish

SECTION _____ LOCATION On U.S. #20 Pavement, SEC. , TWP. , RNG.

COUNTY Kane DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic

STRUCT. NO. 045-0252 (Exist.) / 045-2102 (Prop.)
Station _____

BORING NO. B-2
Station 9+95
Offset 17.00ft W
Ground Surface Elev. 944.54 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
928.5 ft ▼
Upon Completion _____ ft
After _____ Hrs. _____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
943.87			
8" Asphalt			
943.54			
4" Concrete Pavement			
943.21	6		
FILL - 4" Gravel Pavement Base			
FILL - made with Lean Clay	6		32.4
Dark Brown	5		
	2		
	2	1.0	31.3
939.54 -5	3	P	
LEAN CLAY - trace of Sand and fine Gravel			
Brown to Gray	2		
Very Stiff to Stiff	4	2.7	13.4
CL	4	S	
	2		
	3	1.0	11.4
-10	3	S	
	3		
	4	1.7	8.9
	5	S	
	3		
	4	1.0	15.0
-15	5	S	
928.54 ▼			
FINE TO MEDIUM GRAINED SAND <B>>	6		
Gray	7		16.1
Medium Dense	5		
SP 926.54			
	2		
	3	1.7	12.2
-20	5	B	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
LEAN CLAY with traces of fine sand and gravel			
Gray	3		
Stiff to Very Stiff	4	1.7	12.9
CL *(continued)*	5	B	
	3		
	5	2.1	12.9
-25	6	B	
	4		
	6	1.0	14.6
	9	P	
	4		
	5	1.7	12.2
-30	8	B	
	4		
	5	2.6	10.3
-35	8	S	
	5		
	7	3.1	10.0
904.54 -40	8	S	

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)

S.A.M. CONSULTANTS, INC.
DBE/MBE Firm

SOIL BORING LOG

Date 9/29/16

ROUTE U.S. #20 (Grant Highway) / FAP 345 DESCRIPTION Job #16017GT LOGGED BY Danish

SECTION _____ LOCATION On U.S. #20 Pavement, SEC. , TWP. , RNG.

COUNTY Kane DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic

STRUCT. NO. 045-0252 (Exist.) / 045-2102 (Prop.)
Station _____

BORING NO. B-2
Station 9+95
Offset 17.00ft W
Ground Surface Elev. 944.54 ft

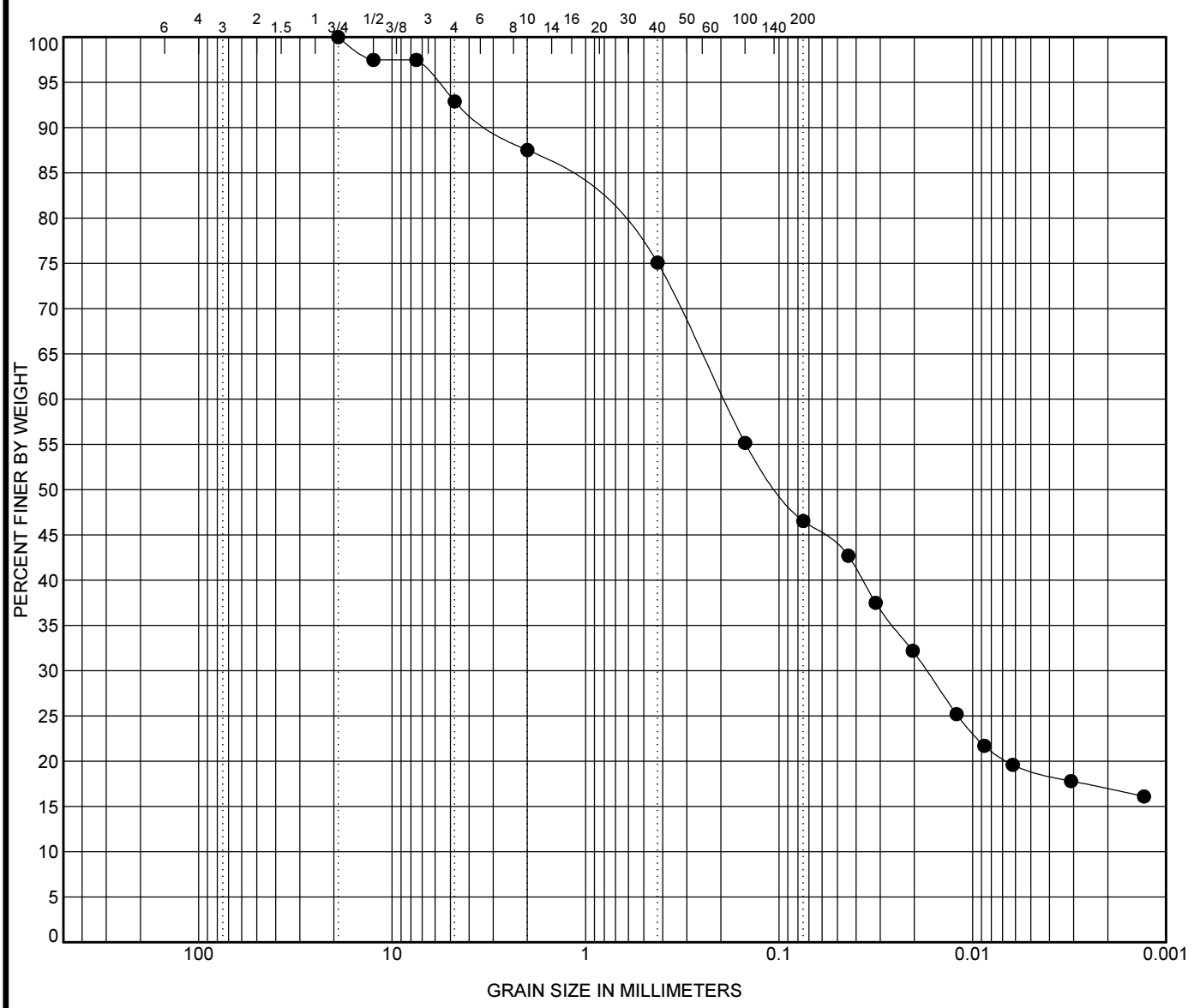
Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 928.5 ft ▼
Upon Completion _____ ft
After _____ Hrs. _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SANDY CLAY Gray Stiff CL		6		
		3 4	2.0 P	13.1
899.54	-45			
End of Boring	-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)

Laboratory Test Reports



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-1(6.0-7.5)**	**0.00**	**SANDY LOAM**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1(6.0-7.5)**	**0.00**	**19**	**0.193**	**0.017**		**7.1**	**46.4**	**29.6**	**16.9**

Illinois Department of Transportation
Division of Highways
SAM Consuntants, Inc.

GRAIN SIZE DISTRIBUTION

Route:
Section:
County:

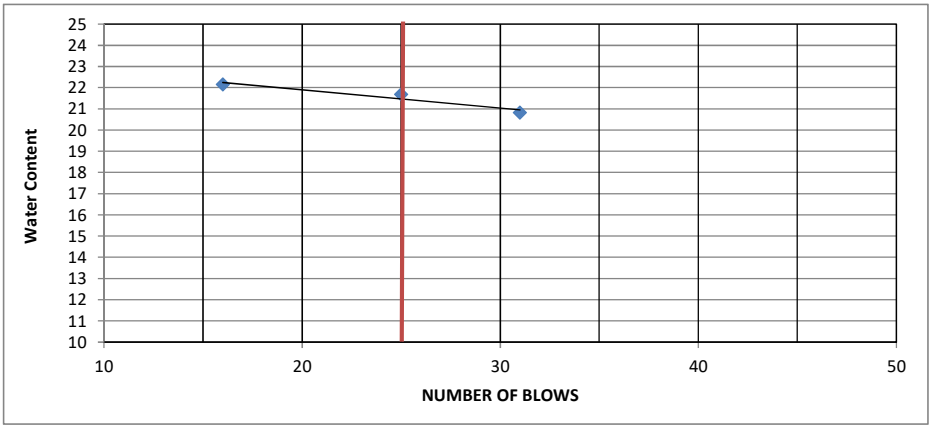
GRAIN_SIZE_16017GT-GRADATION.GPJ IL_DOT.GDT 10/27/16

ATTERBERG LIMITS (D4318 - T89 & T90)

Client Name:	Terra Engineering / IDOT	Project No.:	P-91-363-13
Project Name:	PROPOSED CULVERT REPLACEMENT ON U.S. ROUTE 20 (GRANT HIGHWAY) OVER UNNAMED	SAM Project No.:	16017GT
Location:	DITCH (Eakin Creek West)	Sampled on:	9/30/2016
Sample Description:	**Brown Sandy Silty Clay (CL)**	Tested on:	10/14/2016
Source / Placement:			
Location:	B-1 (3.5-5.0)		
Elevation:			
QC Sample No:	**B-1 (3.5-5.0)**		

LIQUID LIMIT:

No. of blows	31	25	16		
Wt. of Sample + Tare (wet)	34.42	33.41	38.43		
Wt. of Sample + Tare (dry)	31.83	31	35.02		
Wt. of Water	2.59	2.41	3.41		
Tare weight	19.39	19.89	19.63		
Weight of Dry Soil	12.44	11.11	15.39		
Water Content	20.82	21.69	22.16		



PLASTIC LIMIT: Hand Rolled

Wt. of Sample + Tare (wet)	28.12	26.84			
Wt. of Sample + Tare (dry)	27.17	25.98			
Wt. of Water	0.95	0.86			
Tare weight	19.87	19.22			
Weight of Dry Soil	7.30	6.76			
Water Content	13.01	12.72			

TEST RESULTS

Material Description	LL	PL	PI
Brown Sandy Silty Clay (CL)	21	13	8

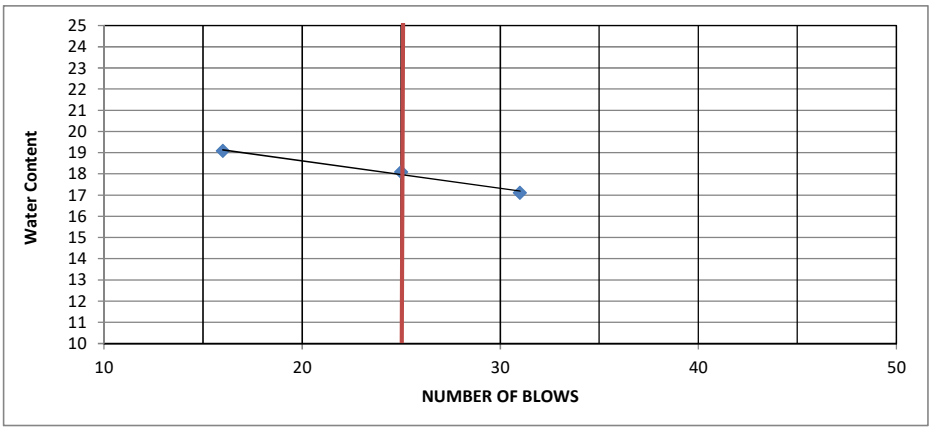
S.A.M. CONSULTANTS, INC.
DBE/MBE Firm
407 Eisenhower lane South, Lombard, IL 60148 Ph:(630)-424-1200 Fax:(630) 424-1245

ATTERBERG LIMITS (D4318 - T89 & T90)

Client Name:	Terra Engineering / IDOT	Project No.:	P-91-363-13
Project Name:	PROPOSED CULVERT REPLACEMENT ON U.S. ROUTE 20 (GRANT HIGHWAY)	SAM Project No.:	16017GT
Location:	OVER UNNAMED DITCH (Eakin Creek West)	Sampled on:	9/29/2016
Sample Description:	**Brown Sandy Clayey Silt (CL-ML)**	Tested on:	10/14/2016
Source / Placement:			
Location:	B-2 (8.5-10.0)		
Elevation:			
QC Sample No:	**B-2 (8.5-10.0)**		

LIQUID LIMIT:

No. of blows	31	25	16		
Wt. of Sample + Tare (wet)	32.23	34.69	36.13		
Wt. of Sample + Tare (dry)	30.38	32.3	33.47		
Wt. of Water	1.85	2.39	2.66		
Tare weight	19.57	19.09	19.53		
Weight of Dry Soil	10.81	13.21	13.94		
Water Content	17.11	18.09	19.08		



PLASTIC LIMIT: Hand Rolled

Wt. of Sample + Tare (wet)	28.20	27.36			
Wt. of Sample + Tare (dry)	27.27	26.52			
Wt. of Water	0.93	0.84			
Tare weight	19.60	19.51			
Weight of Dry Soil	7.67	7.01			
Water Content	12.13	11.98			

TEST RESULTS

Material Description	LL	PL	PI
Brown Sandy Clayey Silt (CL-ML)	18	12	6

S.A.M. CONSULTANTS, INC.
DBE/MBE Firm
407 Eisenhower lane South, Lombard, IL 60148 Ph:(630)-424-1200 Fax:(630) 424-1245

Settlement Calculations

Settlement Calculations at B-1 (Weaker Soil Profile Location)

1.0 Below the low area at the approaches and the sides of the culvert:

Δp = 125 x 8.12' = 1015 psf
Po at center of soft Clay layer = (4x115) + (2 x 60) + (2.0 x 58) = 696 psf
Cc = 0.18 (estimated); Initial void ratio at center of clay e_o = mxG = (10.4 x 2.65)/100 = 0.276

$(S)_{elevation\ 932.0'}$ = (Cc/1+ e_o) H log { (Po + Δp)/Po}
= (0.18/1.276) x 2.0 log {(696 + 1015)/ 1015} = 0.064' = **0.768"**

Final Grade top of Roadway 948.02'
New Fill – unit weight = 125 pcf

Grade top of Existing Roadway 944.54'

Existing Soil – Unit weight = 115 pcf

Existing Grade at toe of exist. Emb. 939.90'
Existing saturated soils
submerged unit weight = 60 pcf
Top of Soft Clay Layer 936.20'

Submerged Unit weight = 58 pcf

Bottom of Soft Clay Layer 932.20'
Sandy Soils

2.0 Settlement Calculations below the new culvert:

Weight of the RC culvert = (27 x 6' x 150) – (24 x 4' x150) = 9,900 pounds / foot or at the base of the culvert = 9900/27' = 366.67 psf
Weight of soil above the culvert = 27' x 2.12' x 140 = 8,015 pounds / foot or at the base of the culvert = 8015 / 27' = 297 psf
Weight of water in the culvert under a 100-year flood = 62.5 x 4.5' = 281.25 psf

Pf = Total Final pressure at elevation 939.9 = 366.67 + 297 + 281.25 = 1000 psf
Po = Initial pressure at elevation 939.9 was = 4.64 x 115 = 533.6 psf
Δp = 902.32 – 533.6 = 368.72
S (at elevation 937.90' ={(0.18/1.276) x 2) x (log (533.6+368.72)/533.6)}= 0.064' = 0.782"

Final Grade top of Roadway	948.02
New Fill – unit weight = 125 pcf	
Grade at top of new culvert	945.90
Grade top of Existing Roadway	944.54
Existing Soil– Unit weight = 115 pcf	
Existing saturated soils	
submerged unit weight = 60 pcf	
Elevation at base of culvert	939.9'
Elevation Top of Soft Clay Layer	936.20
Submerged unit weight of soil = 58 pcf	
Bottom of Clay Layer	932.20

Sandy Soils

Seismic Site Class Determination

SEISMIC SITE CLASS DETERMINATION

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified on 12/10/10

PROJECT TITLE=====U.S. HWY #20 (Grant Highway) over Un named Creek

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	937	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-1	
Top of Boring Elev.	942	ft.
Approximate Fixity Elev.	912	ft.

Individual Site Class Definition:

N (bar): 11 (Blows/ft.) Soil Site Class E

N_{ch} (bar): (Blows/ft.) NA

s_u (bar): 1.32 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
2.5	934.5	2.50	7	1.00	
5.0	932.0	2.50	8	1.00	B
7.5	929.5	2.50	14		
10.0	927.0	2.50	14	1.00	
12.5	924.5	2.50	14		
17.5	919.5	5.00	11	2.30	
22.5	914.5	5.00	13	2.50	B
27.5	909.5	5.00	10	1.00	
32.5	904.5	5.00	10	1.00	B
37.5	899.5	5.00	9	0.80	
42.5	894.5	5.00	11	1.00	
45.0	889.5	5.00	10	2.00	

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	937	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-2	
Top of Boring Elev.	944.5	ft.
Approximate Fixity Elev.	912	ft.

Individual Site Class Definition:

N (bar): 11 (Blows/ft.) Soil Site Class E

N_{ch} (bar): (Blows/ft.) NA

s_u (bar): 1.77 (ksf) Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
2.5	934.5	2.50	6	1.00	
5.0	932.0	2.50	9	1.70	B
7.5	929.5	2.50	9	1.00	B
10.0	927.0	2.50	12	1.70	
15.0	922.0	5.00	9	1.70	
20.0	917.0	5.00	15	1.00	B
25.0	912.0	5.00	13	1.70	B
30.0	907.0	5.00	13	2.60	B
35.0	902.0	5.00	15	3.10	B
40.0	897.0	5.00	7	2.00	B
45.0	892.0	5.00	11	3.00	B

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.
Approximate Fixity Elev.		ft.

Individual Site Class Definition:

N (bar): (Blows/ft.) NA

N_{ch} (bar): (Blows/ft.) NA

s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.
Approximate Fixity Elev.		ft.

Individual Site Class Definition:

N (bar): (Blows/ft.) NA

N_{ch} (bar): (Blows/ft.) NA

s_u (bar): (ksf) NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Global Site Class Definition: Substructures 1 through 2

N (bar): 11 (Blows/ft.) Soil Site Class E

N_{ch} (bar): (Blows/ft.) NA

s_u (bar): 1.54 (ksf) Soil Site Class D <----Controls