STRUCTURE GEOTECHNICAL REPORT
US ROUTE 6 (FAU 0297) BRIDGE OVER MARLEY CREEK (WEST), STATION 380+41.37
PR SN 099-0543, SECTION 33B (B-R)
IDOT D-91-130-12, PTB 162/ITEM 010
WILL COUNTY, ILLINOIS

for

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11. Abstract

The existing, single-span bridge carrying US Route 6 over Marley Creek will be removed and lengthened with a new, three-span structure with integral abutments and solid wall piers. The new back-to-back length will be 203.5 feet and the out-to-out width will be 54.2 feet. The centerline of US 6 will be raised by 5 feet, while the widening areas will be raised by a maximum of 12 feet. This report provides geotechnical recommendations for the design of proposed bridge foundations and embankments.

The existing embankments consist of soft to medium stiff silty clay fill underlain by soft silty loam floodplain deposits. Deeper soils include loose to dense sandy outwash overlying loose to dense silt and strong, poor to fair quality dolostone. The bedrock was encountered approximately 40 to 50 feet below the existing roadway grade. We recommend no reduction to the scour depths at the piers. The site classifies in the Seismic Class D and is in Seismic Performance Zone 1.

The centerline profile grade will be increased over soft and compressible floodplain soils. We estimate the new embankments will undergo approximately 3.0 inches of long-term consolidation settlement. The fill sections will have side slopes graded at 1:2 (V:H) and the FOS against global instability is 2.5 to 1.6.

The proposed abutments and piers should be supported on driven piles. At the abutments, losses are required for downdrag. We estimate the abutments could be designed on steel H-piles driven 42 to 49 total feet to the top of bedrock to achieve 160 to 380 kips of factored axial resistance. The piers should also be supported on steel H-piles driven to the top of bedrock with lengths of 36 to 40 feet providing 320 to 390 kips of factored resistance.

The bridge will include stage construction, with temporary sheet piling required along the stage line with a *Temporary Soil Retention System* required for culvert removal. The temporary sheet piling should be designed according to IDOT *Design Guide 3.13.1*. The pier construction will require the use of Type 2 Cofferdams and Seal Coat at each location to control groundwater.

12. Path to archived file

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TABLE OF CONTENTS

LIST OF TABLES

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STRUCTURE GEOTECHNICAL REPORT
US ROUTE 6 (FAU 0297) BRIDGE OVER
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FOR
CIVILTECH ENGINEERING, INC.

1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluations for the reconstruction of the US Route 6 (FAU 0297) West Bridge over Marley Creek in Mokena, Will County, Illinois. A *Site Location Map* is presented as Exhibit 1.

1.1 Proposed Structure

Wang Engineering, Inc. (Wang) understands Civiltech Engineering, Inc. envision a new, three-span structure with pile-supported integral abutments and pile-supported solid wall piers replacing the existing single-span bridge at Station 380+27.20 and a 6.5-foot by 6.5-foot, single box culvert. The General Plan and Elevation (GPE) provided by Civiltech shows a back-to-back length of 203.5 feet with two end spans of 53 feet and the main span of 92 feet. The out-to-out width will measure 54.2 feet to accommodate two 12-foot wide traffic lanes, two 8-foot wide shoulders, and two parapets. The bridge will be at 45° skew to the centerline. As part of the bridge reconstruction, the centerline of US 6 will be raised by approximately 5 feet behind both abutments with the fill materials to be placed in the widening area adding about 12 feet of material above the existing grade. The slopes along the approach slab will be sloped at 1:2 (V:H), but quickly grade down to 1:4 behind the slab. Extensive cuts are planned into the creek-bank material between the existing and proposed abutments. These cuts will provide increased streambed and floodplain area needed to compensate for the floodplain loss resulting from the proposed grade increase.

The purpose of our investigation was to characterize the site soil and groundwater conditions, perform geotechnical analyses, and provide recommendations for the design and construction of the bridge foundations and approach embankments.

1.2 Existing Structure

Existing bridge plans provided by Civiltech indicate the structure was constructed in 1930. The bridge has a single span supported on closed-wall abutments with a total back-to-back length of 53.8 feet and an out-to-out width of 42.0 feet. The foundations consist of spread footings.

Approximately 25 feet behind the existing west abutment is a 6.5-foot by 6.5-foot box culvert with horizontal wingwalls. This structure provides drainage from a detention pond northwest of the US 6 and Haas Road intersection to Marley Creek, which outlets immediately south of US 6. The TSL plan does not indicate the foundation type for this structure, but we assume the foundations are shallow and the culvert will require complete removal due to the placement of the proposed west pier.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The project area is located in northwest Mokena, which spans New Lenox and Homer Townships in northeast Will County. On the USGS *Mokena Quadrangle 7.5 Minute Series* map, the bridge is located in the NE ¼ of Section 2, Tier 35N, Range 11E of the Third Principal Meridian.

The following review of the published geologic data, with emphasis on factors that might influence the design and construction of the proposed engineering works, is meant to place the project area within a geological framework and confirm the dependability and consistency of the subsurface investigation results. For the study of the regional geologic framework, Wang considered the northern Illinois area in general and northeast Will County in particular. Exhibit 2 illustrates the *Site and Regional Geology*.

2.1 Physiography

In northeastern Will County, the Marley Creek runs southwest, cutting a valley through the Westmont and Keeneyville Moraines before it outlets to Hickory Creek and subsequently, the Des Plaines River. This section of US 6 also runs to the southwest along the Marley Creek Valley and within the floodplain. The meandering creek crosses the road twice prior to the Hickory Creek outlet approximately one mile south of the proposed bridge replacement. Marley Creek runs through a 20-foot wide, well defined channel cut near the north edge of its floodplain.

Across the half-mile wide floodplain, surface elevations range from 674 feet (NAVD88) on the northwest side of the creek to as high as 680 feet on the southeast side. Along the creek valley, elevations vary from 655 feet downstream to 670 feet upstream. At the west bridge, the elevations

of the roadway are about 660 to 665 feet.

2.2 Surficial Cover

The surficial cover is mainly the result of Wisconsin-age glacial activity (Hansel and Johnson, 1996). The glacigenic deposits were emplaced during pulsating advances and retreats of an icesheet lobe responsible for the formation of end moraines and associated low-relief till and lake plains and valley. Outwash valleys and other low-lying areas that scar the Westmont and Keeneyville Moraines are filled with post-glacial and glacial deposits. Located along Marley Creek that runs through a former outwash valley, the site is underlain by post-glacial fine, sorted sediment of the Cahokia Alluvium and discontinuous presence of peat and marl of the Grayslake Peat. Glacial clayey deposits of the Equality Formation over the coarser sandy and gravelly outwash of the Henry Formation fill the outwash valley that cuts into the silty clayey diamictons of the Wadsworth Formation that make the Westmont and Keeneyville Moraines. Older diamictons underlain the Wadsworth Formation and rest unconformably over the bedrock (Willman and Lineback 1970). An approximately 50-foot thick drift covers the bedrock.

2.3 Bedrock

The surficial cover rests unconformably on top of Silurian-age dolostone. In the project area the bedrock may be encountered at elevations of approximately 600 feet, or approximately 50 feet below ground surface (bgs).

Our subsurface investigation results fit into the local geologic context. The soil borings reveal the native sediments consist of silty and loamy floodplain deposits with organic debris of the Cahokia Alluvium, overlying gravelly sand and sand of the Henry Formation. The borings encountered bedrock at 621 to 627 feet.

3.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations performed by Wang.

3.1 Subsurface Investigation

The subsurface investigation consisted of four structure borings, designated as BSB-01 through BSB-04, drilled in May 2014. The borings were drilled from elevations of 663.6 to 664.1 feet to depths of 51.0 to 63.0 feet bgs. Northings, eastings, and elevations were surveyed by Wang with a mapping-

grade GPS unit; stations and offsets were taken from design drawings provided by Civiltech. The boring location data are shown in the *Boring Logs* (Appendix A), and the as-drilled locations are shown in the *Boring Location Plan* (Exhibit 3).

A truck-mounted drill rig, equipped with hollow stem augers, was used to advance and maintain an open borehole. Soil sampling was performed according to AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils*." The soil was sampled at 2.5-foot intervals to 30 feet bgs and at 5.0-foot intervals to the top of bedrock. The bedrock was cored in each boring with a NWD4-sized barrel in 5- and 10-foot runs. Soil samples from each interval were placed in sealed jars for further laboratory testing.

Field boring logs, prepared and maintained by a Wang geologist, include lithological descriptions, visual-manual soil classifications (IDH Textural Classification), results of Rimac and pocket penetrometer unconfined compressive strength tests, and results of Standard Penetration Tests (SPT), recorded as blows per 6 inches of penetration.

Groundwater observations were made during and after drilling operations. The borings were backfilled with soil cuttings and bentonite after completion. The surface along US 6 was restored as close as possible to the original condition.

3.2 Laboratory Testing

The soil samples were tested in the laboratory for moisture content (AASHTO T 265). Selected soils were also chosen for Atterberg limits (AASHTO T 89/90) and particle size (AASHTO T 88) analyses. The soils were classified according to the IDH Textural Classification system and field visual-manual descriptions were verified in the laboratory. The laboratory results are shown in the *Boring Logs* (Appendix A) and in the *Laboratory Test Results* (Appendix B).

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 4). 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 directions.

4.1 Soil Conditions

The existing pavement section along US 6 includes 15 to 18 inches of asphalt pavement. In descending order, the general lithologic succession includes: 1) man-made ground (fill); 2) soft to medium stiff silty loam to loam; 3) loose to dense sand; 4) loose to dense silt; and 5) strong, poor to fair quality dolostone.

(1) Man-made ground (Fill)

Immediately beneath the pavement section, the borings encountered 3 to 6 feet of very soft to very stiff, brown silty clay and silty clay loam fill. The fill has unconfined compressive strength (Q_u) values of 0.3 to 2.5 tsf with an average of 0.5 tsf and moisture content values of 12 to 28%.

(2) Soft to medium stiff silty loam to loam

At elevations of 660 to 656 feet, the borings encountered 4 to 9 feet of soft to medium stiff, black silty loam and loam with traces of gravel and organic debris; these soils are likely floodplain deposits from the Marley Creek channel. The loamy soils have Qu values of 0.3 to 1.0 tsf with an average of 0.6 tsf and moisture content values of 31 to 50% with an average of 40%. Laboratory index testing on two samples of this layer shows liquid limit (L_L) values of 34 to 46% and plastic limit (P_L) values of 18 to 28%; the liquidity indices of these samples indicate materials close to the L_L that will be prone to deformation under additional embankment loading.

(3) Loose to dense sand

Below the soft floodplain soils, the borings advanced through 5 to 18 feet of loose to dense, brown, fine to coarse, well-graded sand with trace to little gravel. The sand, which represents to primary soil type along the existing Marley Creek streambed, has an N-value of 8 to 47 blows/foot, with the values in the 8 to 18 blows/foot range along the west side of the bridge and 20 to 41 blows/foot along the east side. This layer was encountered wet in each of the borings.

(4) Loose to dense silt

At elevations of 648 to 636 feet, the borings encountered loose to dense, gray silty with trace to some gravel extending to the top of weathered bedrock at elevations of 627 to 621 feet. The silt has N-values ranging from 3 to 47 blows/foot and was generally recovered dry.

(5) Strong, poor to fair quality dolostone

The top of sound bedrock was encountered at elevations of 616 to 623 feet, rising slightly in elevation

from west to east. The bedrock cores revealed strong, gray dolostone with Rock Quality Designations (RQD) from 25 to 70% and horizontal jointing.

4.2 Groundwater Conditions

Groundwater was encountered at a high elevation of 658 feet in Boring BSB-04 and a low elevation of 649 feet, near the west bank of the creek. The water surface elevation of the creek is at about 655 to 660 feet, which corresponds well to the levels recorded in the borings. The evaluations for stability and settlement along the abutments account for a groundwater elevation at 658 feet.

4.3 Scour Considerations

Results of the hydraulic study have been provided by Civiltech and the TSL plan provides scour estimates for the 100- and 500-year flood events. The abutment end slopes, as well as the piers and channel bottom, will be armored with rip rap. The D_{50} value of the streambed soil is approximately 0.2 mm and we do not recommend any reductions to the design pier scour depths. At the abutments, the design scour elevations should be taken at the base of the abutment, per IDOT policy for abutments protected by rip rap (IDOT 2012). The design high water elevation (DHWE) is 662.00 feet and the Estimated Water Surface Elevation (EWSE) is 655.59 feet. The proposed streambed elevation will be established at elevations of 656.8 to 653.4 feet.

Table 1: Design Scour Elevations

Event / Limit State	West Abut.	Pier 1	Pier 2	East Abut.	Item 113
Q100 (feet)	660.86	651.51	650.33	661.47	
Q200 (feet)	660.86	651.16	650.67	661.47	
Design (feet)	660.86	650.90	650.33	661.47	5
Check (feet)	660.86	650.90	650.67	661.47	

4.4 Seismic Design Considerations

The soils within the top 100 feet have a weighted average N-value of 40 blows/foot (AASHTO 2012; Method B controlling). These results classify the site in Seismic Site Class D in accordance with IDOT *All Geotechnical Manual Users (AGMU) 9.1* (2010); the project location belongs to Seismic Performance Zone 1. The seismic spectral acceleration parameters recommended for design in accordance with the 2012 AASHTO *LRFD Design Specifications* are summarized in Table 1

(AASHTO 2012). The factor of safety (FOS) against liquifacton for the saturated sandy soils along the bridge site is greater than the AASHTO-required value of 1.1 (AASHTO 2012).

Table 2: Seismic Design Parameters

Spectral Acceleration Period (sec)	Spectral Acceleration Coefficient[1)] (% g)	Site Factors	Design Spectrum for Site Class D[2)] (% g)
0.0	PGA= 4.8	F_{pga}= 1.6	**A_s= 7.6**
0.2	S_S= 10.2	F_a= 1.6	**S_{DS}= 16.3**
1.0	S_1= 3.9	F_v= 2.4	**S_{D1}= 9.4**

1) Base spectral acceleration coefficients from AASHTO (2012)

2) Site Class D values to be presented on plans (A_s = PGA*F_{pga}; S_{DS}= S_S*F_a; S_{D1}= S_1*F_v)

5.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

Geotechnical evaluations and recommendations for the approach embankment, approach slab, and structure foundations are included in the following sections. We estimate the global stability of the structure and foundations is adequate; however, the long-term consolidation settlement of the embankment will result in downdrag allowances along the abutment foundations. Wang recommends supporting the proposed abutments and piers on driven piles.

The GPE shows the proposed west abutment constructed 70 feet behind the existing and the east abutment constructed about 80 feet behind the existing to facilitate the large excavations into the existing creek banks on both sides. These excavations are necessary to provide additional floodplain compensation due to the proposed raise in profile grade along US 6. The centerline profile grade will be raised by about 5 feet behind both abutments and the grade will be increased by about 12 feet along the north side widening area. We assume the existing abutment footings will remain in place and will be cut off below the ground surface; however, to construct Pier 1, the existing 6.5-foot by 6.5-foot box culvert will require complete removal.

5.1 Approach Embankments and Slabs

Wang has performed evaluations of the settlement and global stability for the approach embankments and slabs based on the soil conditions encountered in the borings. The global stability meets the IDOT-required FOS; however, we do anticipate the new embankment fill will induce long-term settlements large enough to require downdrag allowances on the foundation piles.

5.1.1 Settlement

We understand the profile grade will be raised by approximately 5 feet behind the abutments. The maximum total height of the embankments, measured from the toe of the new embankments to the top of pavement, will be increased by about 12 feet. The centerline grade change will result in additional embankment loads of about 750 psf while the north side widening area will apply an additional 1,500 psf of load on the foundation soils.

The foundation soil within the zone of influence beneath the embankment is the soft and compressible floodplain soils overlying granular outwash material. The loamy soils will be subjected to long-term consolidation settlement. The consolidation properties of these soils have been estimated by correlation to the measured index properties. We estimate approximately 1.5 inches of total long-term settlement along the outside shoulders and 3.5 inches of settlement beneath the widening. Under the anticipated one-way drainage down into the sandy soils, the time to 50% of total primary settlement will be about 30 days, with 90% of primary consolidation occurring in 120 days. With estimates greater than 0.4 inch occurring at the abutments, the piles will require downdrag allowances. For the approach slab construction and ensure that there is no separation between the slab and adjacent roadway section, we recommend staging the construction of the bridge such that a 30 day period is allowed between the completion of the embankment fill placement and placement of the HMA pavement. Settlement monitoring plates should be placed at the outside edges of the roadway pavement behind each abutment, at Stations 379+25 (west abutment) and 381+55 (east abutment) to measure the progress of the settlement. The plates should be monitored bi-weekly and when the monitoring indicates that the settlement has reached 1-inch of residual movement, the pavement can be placed.

5.1.2 Global Stability

We have analyzed the global stability of the east embankment at Station 379+40. The embankment has a total estimated height of about 12 feet and side slopes graded at 1:2 (V:H). The analysis reflects the 6-foot increase in centerline grade. The global stability was analyzed using *Slide 6.0* for both short-term (undrained) and long-term (drained) soil conditions and the results of the analyses

are shown in Appendix C. We estimate the embankment has a short-term FOS of 2.1 (Appendix C-1) and a long-term FOS of 1.6 (Appendix C-2). Both FOS meet the IDOT requirement of 1.5.

5.2 Structure Foundations

Wang recommends supporting the abutments and piers on driven piles. The soil conditions include relatively thick deposits of granular soils, primarily below the groundwater level; therefore, we do not recommend drilled shaft foundations. The bedrock elevation at the site is relatively shallow and steel H-Piles will most economical if driven to refusal. We estimate concrete-filled metal shell piles can also be designed at the abutments. The estimated service and factored loads provided by Civiltech are summarized in Table 3.

Table 3: Summary of Foundation Loads

Substructure ID	Boring ID	Service I Load (kips)	Factored Strength I Load (kips)
West Abutment	BSB-01	1,130	1,545
Pier 1	BSB-02	1,679	2,333
Pier 2	BSB-03	1,679	2,333
East Abutment	BSB-04	1,130	1,545

5.2.1 Driven Piles

IDOT specifies the maximum nominal required bearing (R_{NMAX}) for each pile and states the factored resistance available (R_F) should be based on a geotechnical resistance factor (Φ_G) of 0.55 (IDOT, 2012a). Nominal tip and side resistance were estimated using the methods and empirical equations presented in *AGMU Memorandum 10.2 – Geotechnical Pile Design* (IDOT, 2011). The TSL plan details show the superstructure supported by eight PCC I-beams. Information provided by Civiltech indicates the preliminary factored abutment load per pile is 141 kips and the factored pier load per pile is 212 kips. Based on ABD Memo 12.3 (2012), the effective expansion length and skew combination indicates 12-inch diameter MSP and HP8 piles are not feasible options for integral abutments. In addition, due to the hard driving conditions near the shallow bedrock and weathered dolostone, MSP in general are not recommended.

The R_F, R_N, estimated pile tip elevations, and pile lengths for HP10x42 (abutments), HP12x53 (abutments), HP12x74 (abutments and piers), and HP14x73 (abutments and piers) are summarized in Table 5.

The R_F estimates are governed by the relationship $R_F = \phi_G R_N - \phi_G(DD_R+S_C+L_{iq})I_G - (\gamma_p)(\lambda_{IS})DD_L$ (IDOT, 2012a). The changes to the proposed profile grade are over soft and deformable loamy soils that will result in long-term settlements greater than 0.4 inches; we estimate that downdrag losses should be considered at the abutment piles (IDOT 2012a). The steel H-Pile sections should have the downdrag reductions applied and should be driven to larger R_N values as required to compensate for the losses. The factored capacity evaluations along the piers account for the scour effects between the cap base elevations and the Q100 scour elevations summarized in the hydraulic analysis.

Table 4: Estimated Pile Lengths and Tip Elevations for Steel H-Piles Driven to Bedrock

Structure Unit	Pile Cutoff Elevation (feet)	Pile Size	Max. Nom. Required Bearing, R_{NMAX} (kips)	Factored DD and Sc Losses (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
West Abutment (BSB-01)	662.86	HP10x42	335	18	166	49	614
		HP12x53	418	21	209	49	614
		HP12x74	589	22	302	49	614
		HP14x73	578	26	292	49	614
		HP14x89	705	26	362	50	613
Pier 1 (BSB-02)	663.47	HP12x74	589	0	324	47	616
		HP14x73	578	0	318	47	616
		HP14x89	705	0	388	47	615
Pier 2 (BSB-03)	663.72	HP12x74	589	0	324	44	620
		HP14x73	578	0	318	44	620

		HP14x89	705	0	388	44	619
East Abutment (BSB-04)	663.47	HP10x42	335	12	172	42	621
		HP12x53	418	15	215	42	621
		HP12x74	589	15	309	42	621
		HP14x73	578	18	300	42	621
		HP14x89	705	18	370	43	620

5.2.2 Lateral Loading

Lateral loads on piles should be analyzed for maximum moments and lateral deflections. Recommended lateral soil modulus and strain parameters required for analysis via the p-y curve method are included in Table 5.

Table 5: Recommended Soil Parameters for Lateral Load Analysis

Soil Type (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength, c_u (psf)	Estimated Friction Angle, Φ (°)	Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50} (%)
V Soft to M Stiff SILTY CLAY FILL (1)	115	500	0	500	1.0
Soft to M Stiff SILTY LOAM (2)	115	500	0	500	1.5
Loose to Dense SAND (3)	63	0	34	60	--
Loose to Dense SILT (4)	63	0	32	50	--

5.3 Stage Construction Design Recommendations

The bridge construction will be performed in three stages. According to the GPE, Stage One will include the removal of the northern 38.6 feet of existing bridge and construction of the northern 34.1 feet. There will be a 4.5-foot offset between the stage removal and stage construction lines; we anticipate *Temporary Sheet Piling* will be required along the stage construction line to support the embankments behind the proposed east abutment, as well as the excavations proposed through the

existing embankments. To facilitate the removal of the existing box culvert behind the existing west abutment, we anticipate the pay item *Temporary Soil Retention System* will be required. The *Temporary Sheet Piling* should be designed in accordance with the IDOT *Design Guide 3.13.1* (2012a); preliminary design evaluations show the sheeting is feasible at the east abutment. The *Temporary Soil Retention System* should be designed by the Contractor and approved by IDOT prior to construction.

The preliminary construction plan includes installing the piers prior to excavating the new channel to 656.8 feet at the piers. With the EWSE at 655.6 feet the excavations will extend into saturated granular material and groundwater encountered in the borings at elevations as high as 656 feet. We anticipate the excavations will encounter significant groundwater infiltration that may rise to the EWSE of the creek and will require a sealcoat to control. Therefore, we recommend the contract should include the pay item *Type 2 Cofferdam* and the plans and specifications should indicate the need for a seal coat at each pier location. The absence of the seal coat will cause significant difficulties is construction of the piers. The cofferdam and seal coat should be designed by the Contractor prior to construction and approved by IDOT or the design engineer. The design of a seal coat should be in accordance with Design Guide 3.13.3- *Cofferdam Seal Coat Design (2006).*

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

Vegetation, topsoil, existing pavement, and debris should be cleared and stripped where foundations and structural fills will be placed. The existing slopes, where new fill materials are to be placed, should be benched or deeply plowed prior to fill placement. The benching should follow the dimensions shown in the IDOT standard detail for benching. During excavation, the engineer should check for any unstable or unsuitable materials within the existing embankments. Unstable soils should be removed and replaced with compacted structural fill as described in Section 6.3.

6.2 Excavation and Dewatering

Foundation excavations should be performed in accordance with local, state, and federal regulations. The potential effect of ground movements upon nearby utilities should be considered during construction.

Groundwater was encountered very close to the base elevation of the proposed piers and the EWSE is

above the base elevation of the pier caps. The material at the base of the excavation will be sandy with gravel and the *Type 2 Cofferdam* and seal coat will be required. The cofferdam and seal coat are designed by the Contractor and approved by IDOT prior to construction. The piers should not be constructed within an open-cut excavation.

Any precipitation allowed to enter excavations should be immediately removed via sump pump. Any soil allowed to soften under standing water should be removed and replaced with structural fill as described below in Section 6.3.

6.3 Filling and Backfilling

Fill material required to attain the final design elevations should be structural fill material and should be pre-approved prior to placement. Compacted cohesive or granular soil conforming to IDOT Section 204 would be acceptable as structural fill (2012b). The fill material should be free of organic matter and debris. Structural fill should be placed in lifts and compacted according to IDOT Section 205, *Embankment* (2012b). The onsite fill materials (**Layer 1**) within the existing embankments should not be considered as new fill material, as they may contain organic debris from the floodplain soils beneath.

Backfill materials must be pre-approved by the Resident Engineer. To backfill the abutment and piers we recommend the porous granular material conforming to the requirements specified in the IDOT Special Provision, *Granular Backfill for Structures* (2013). Backfill material should be placed and compacted in accordance with the Special Provision.

6.4 Earthwork Operations

The required earthwork can be accomplished with conventional construction equipment. Moisture and traffic will cause deterioration of exposed subgrade soils. Precautions should be taken by the Contractor to prevent water erosion of the exposed subgrade. A compacted subgrade will minimize water runoff erosion.

Earth moving operations should be scheduled to not coincide with excessive cold or wet weather (early spring, late fall or winter). Any soil allowed to freeze or soften due to the standing water should be removed. Wet weather can cause problems with subgrade compaction.

6.5 Pile Installation

The driven piles shall be furnished and installed according to the requirements of IDOT Section 512, *Piling* (IDOT 2012b). Due to the slight variability in bedrock depth from the west to east of the structure we recommend including one test pile at each abutment prior to ordering production piles for any of the substructures. The test piles shall be driven to 110 percent of the nominal required bearing indicated in Section 5.2.1, Table 5. Assuming the piles are driven to refusal at the top of bedrock, they should be driven with metal shoes. The H-piles shall be according to AASHTO M270M, Grade 50.

7.0 QUALIFICATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from the borings drilled at the locations shown on the boring logs and in Exhibit 3. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of the bridge are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist Civiltech Engineering, Inc. and the Illinois Department of Transportation on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

WANG ENGINEERING, INC.

Mickey L. Snider, P.E.
Senior Geotechnical Engineer

Corina T. Farez, P.E., P.G.
QA/QC Reviewer

REFERENCES

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HANSEL, A.K. AND JOHNSON, W.H. (1996) *Wedron and Mason Groups: Lithostratigraphic Reclassification of the Wisconsin Episode, Lake Michigan Lobe Area*. ISGS Bulletin 104. Illinois State Geological Survey, Champaign, 116 pp.

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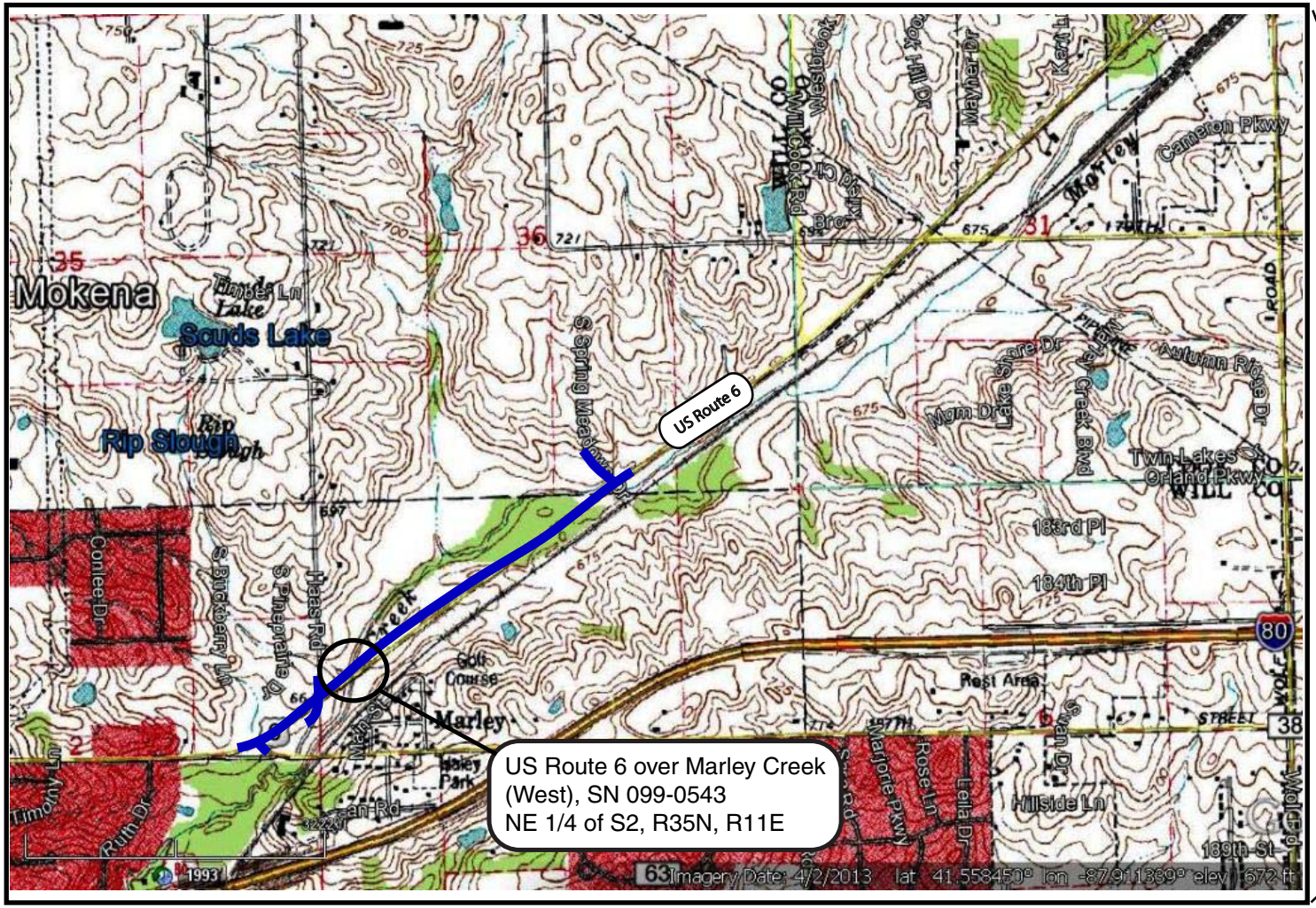
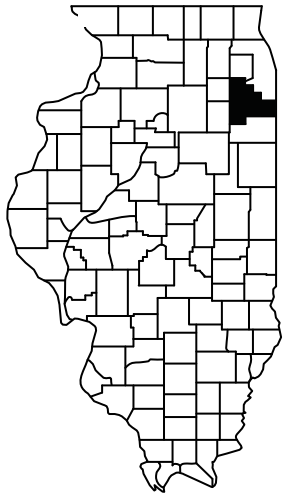
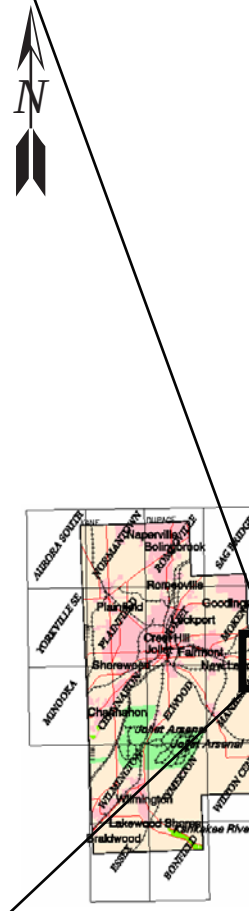
WILLMAN, H.B., AND LINEBACK, J.A. (1970) *Surficial Geology the Chicago Region*. Illinois State Geological Survey, Sc. 1:250,000.

EXHIBITS







0 0.25 0.50 0.75 1.0 Miles

SITE LOCATION MAP: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: END CHECKED BY: MLS

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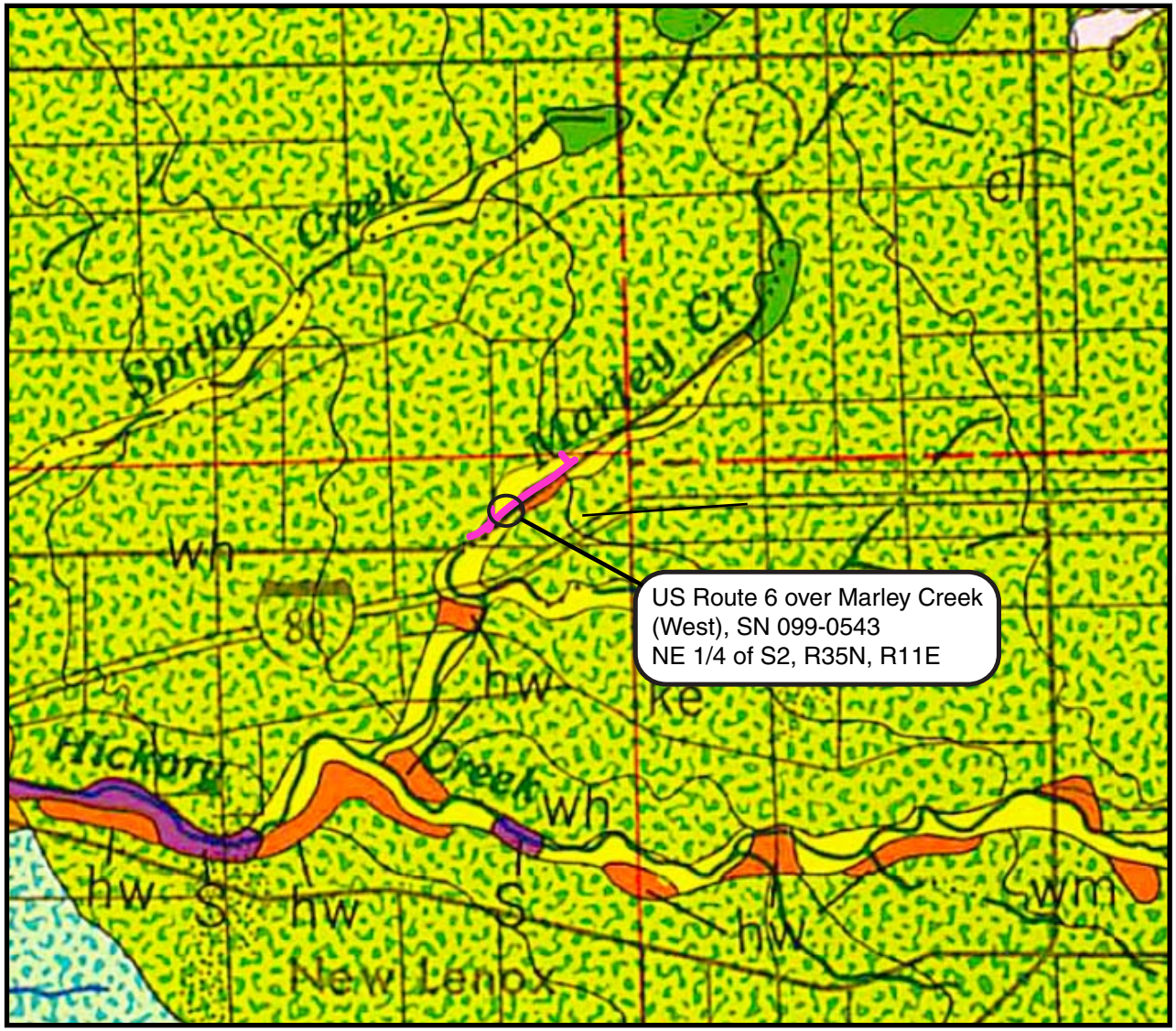
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR CIVILTECH ENGINEERING, INC. 401-05-01

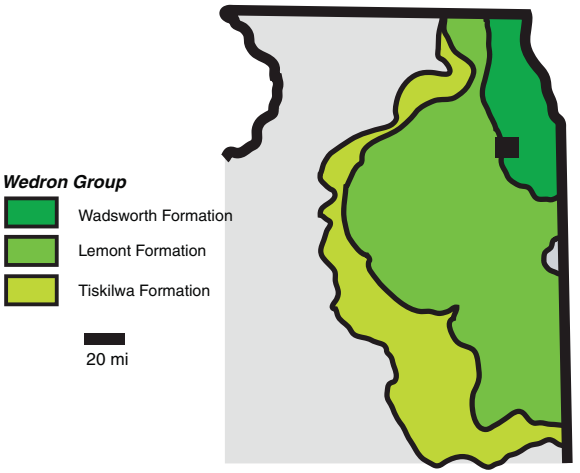


Modif ed after Willman and Lineback (1970)

0 1.0 2.0 3.0 4.0 5.0 Miles

N

REGIONAL GEOLOGY



Modified after Hansel and Johnson (1996)

LEGEND

Postglacial Cover

c — **Cahokia Alluvium**
Deposits in floodplains and channels of modern rivers and streams; mosly poorly sorted silt and sand containing local deposits of sandy gravel;

Glacial Cover

Mason Group

Henry Formation
Sand and gravel, generally well sortedand evenly bedded; Glacial outwash deposits;

hm — **Mackinaw facies**
Sand and gravel, generally well sorted and evenly bedded, deposits in valley.

hw — **Wasco facies**
Sand and gravel, unevenly sorted, irregularly bedded, with various grain size; glacial ice-contact deposits in kames, eskers, and kame terraces

Wedron Group

Wadsworth Formation
Mostly gray pebbly silty clayey till; contains local lenses of silt laminae and sand.

Valparaiso Morainic System

cl — **Clarendon Moraine**
wm — **Westmont Moraine**
ke — **Keeneyville Moraine**
wh — **Wheaton Moraine**
wc — **West Chicago Moraine**

Bedrock

S — **Silurian**
Largely Dolomite, slightly to moderately argillaceous with scattered chert nodules

Modifed after Willman and Lineback (1970)

SITE AND REGIONAL GEOLOGY: US ROUTE 6 BRIDGE OVER MARLEY CREEK, SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: C. Marin CHECKED BY: L. Iordache

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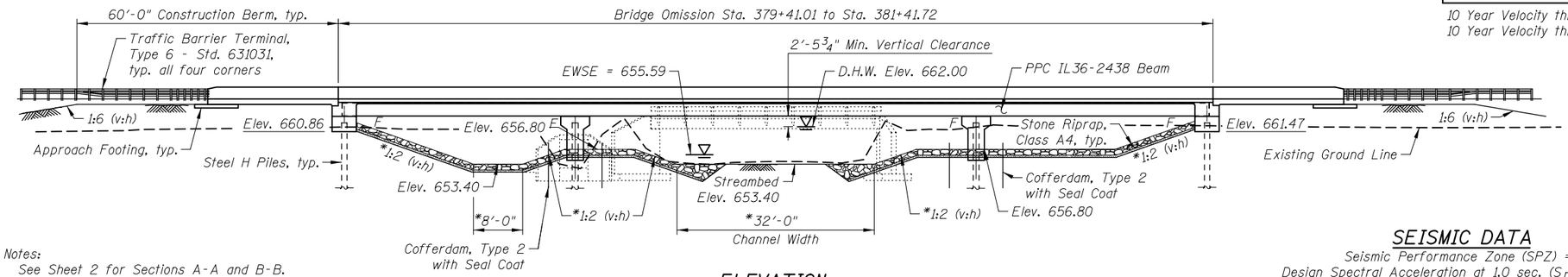
FOR CIVILTECH ENGINEERING, INC

401-05-01

Benchmark: Box "□" cut at the northwest wingwall of the existing US Route 6 over Marley Creek bridge (Existing SN 099-0149); Station 380+39.68, Offset 22.27' Lt., Elevation 664.41

Existing Structure: SN 099-0149 was originally built in 1930 under SAR 38, Section 33B-15D. It was a single span reinforced concrete tee beam superstructure on closed wall abutments supported on spread footings. In 1980, the structure was reconstructed as FAS 1294, Section 33-B1. Precast Prestressed Concrete Deck Beams (27"x36") replaced the concrete tee beam superstructure, and part of the substructure was removed and replaced. The out-to-out width of the superstructure is 42'-0", and the structure length is 53'-9" measured back-to-back of abutments.
One lane of traffic in alternating directions will be maintained utilizing temporary traffic signals and staged construction.

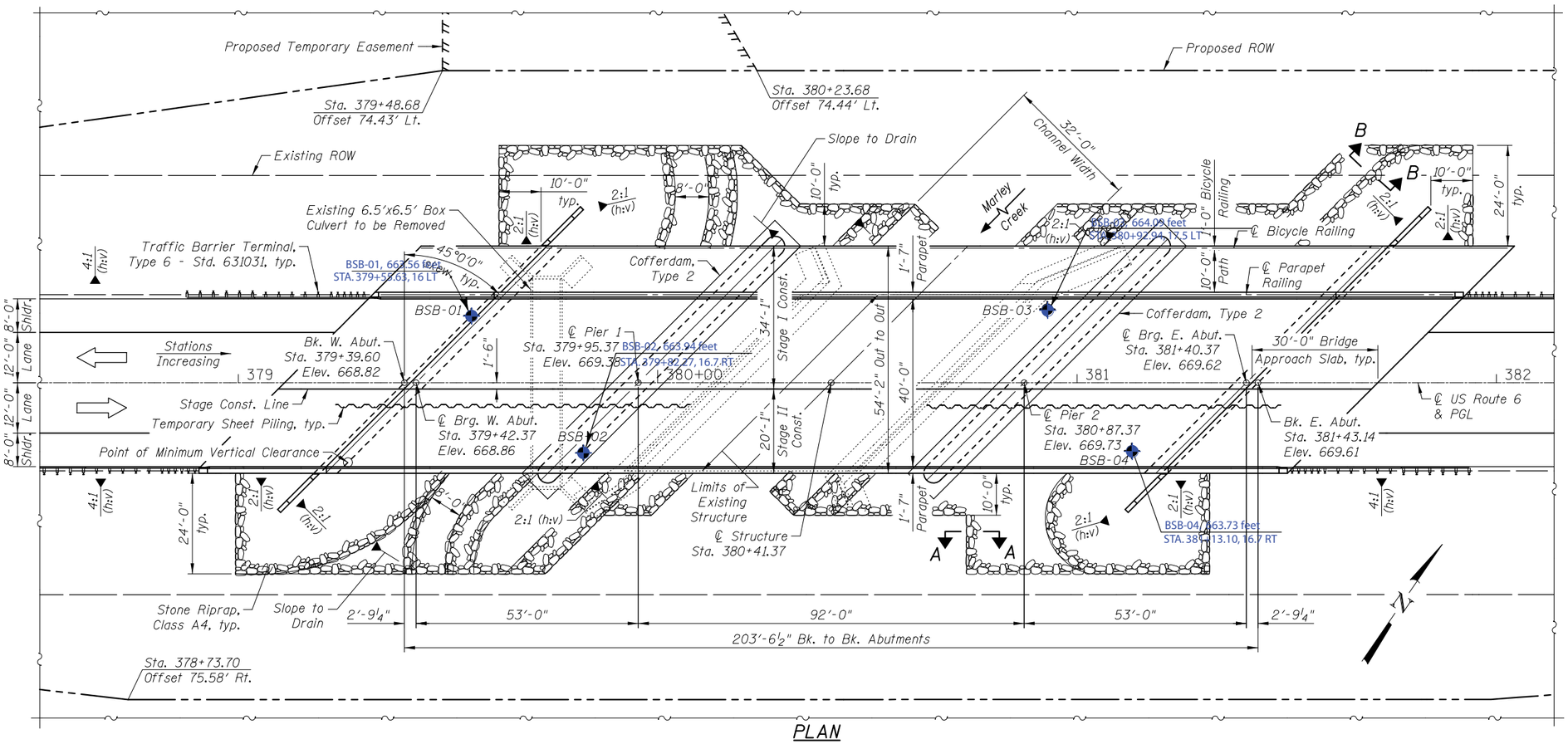
Salvage: None.



Notes:
See Sheet 2 for Sections A-A and B-B.
Const. = Construction

ELEVATION

* At Right L's to Abutment



PLAN

WATERWAY INFORMATION

Drainage Area = 12.4 sq. mi. Low Grade Elev. 663.2 @ Sta. 376+73

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	1238	236	544	660.2	0.7	0.5	660.9	660.7
Design	50	2342	285	771	662.0	1.0	0.3	663.0	662.3
Base	100	2928	285	877	662.8	0.8	0.3	663.6	663.1
Scour Design Check	200	3187	285	918	663.1	0.7	0.4	663.8	663.5
Overtopping (Ex.)	20	1490	250	-	660.6	0.8	-	661.4	-
Overtopping (Pr.)	125	3000	-	891	662.9	-	0.3	-	663.2
Max. Calc.	500	3963	285	1039	664.1	0.3	0.4	664.4	664.5

10 Year Velocity through Existing Bridge = 5.2 ft/sec
10 Year Velocity through Proposed Bridge = 2.3 ft/sec

DESIGN SCOUR ELEVATION TABLE

Event/Limit State	Design Scour Elevations (ft.) W. Abut.	W. Pier	E. Pier	E. Abut.
Q100	660.86	651.51	650.33	661.47
Q200	660.86	651.16	650.67	661.47
Design	660.86	651.51	650.33	661.47
Check	660.86	651.16	650.67	661.47
Item 113	8	8	5	8

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.094g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.163g
Soil Site Class = D

HIGHWAY CLASSIFICATION

F.A.U. Route 0297 - US Route 6
Functional Class: Minor Arterial (Urban)
ADT: 11,700 (2009); 14,000 (2040)
ADTT: 250 (2009); 300 (2040)
DHV: 1,120 (2040)
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic Directional Distribution: 50:50

LOADING HL-93

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

DESIGN SPECIFICATIONS

AASHTO LRFD Bridge Design Specifications, 7th Edition

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Superstructure Concrete)
fy = 60,000 psi (Reinforcement)

PRECAST PRESTRESSED UNITS

f'c = 8,500 psi
f'ci = 7,000 psi
fpu = 270,000 psi (0.6" ϕ low relax strands)
fpbt = 202,300 psi (0.6" ϕ low relax strands)

BORING LOCATION PLAN: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL | EXHIBIT 3 | DRAWN BY: END CHECKED BY: MLS

Wang Engineering
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FOR CIVILTECH ENGINEERING, INC. | 401-05-01

GENERAL PLAN & ELEVATION
US ROUTE 6 OVER MARLEY CREEK (WEST)
FAU ROUTE 0297 - SECTION 33B (B-R)
WILL COUNTY
STA. 380+41.37
STRUCTURE NO. 099-0543

CIVILTECH
450 E Devon Ave, Suite 300
Itasca, Illinois 60143
Tel: 630.773.3900 Fax: 630.773.3975
www.civiltechinc.com

DRAWN	-	K. KOMPARE
DESIGNED	-	M. LANGE
CHECKED	-	G. HATLESTAD
DATE	-	JANUARY 6, 2016

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

US ROUTE 6 OVER MARLEY CREEK

SHEET NO. 1 OF 2 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
0297	33B (B-R)	WILL	126	88
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

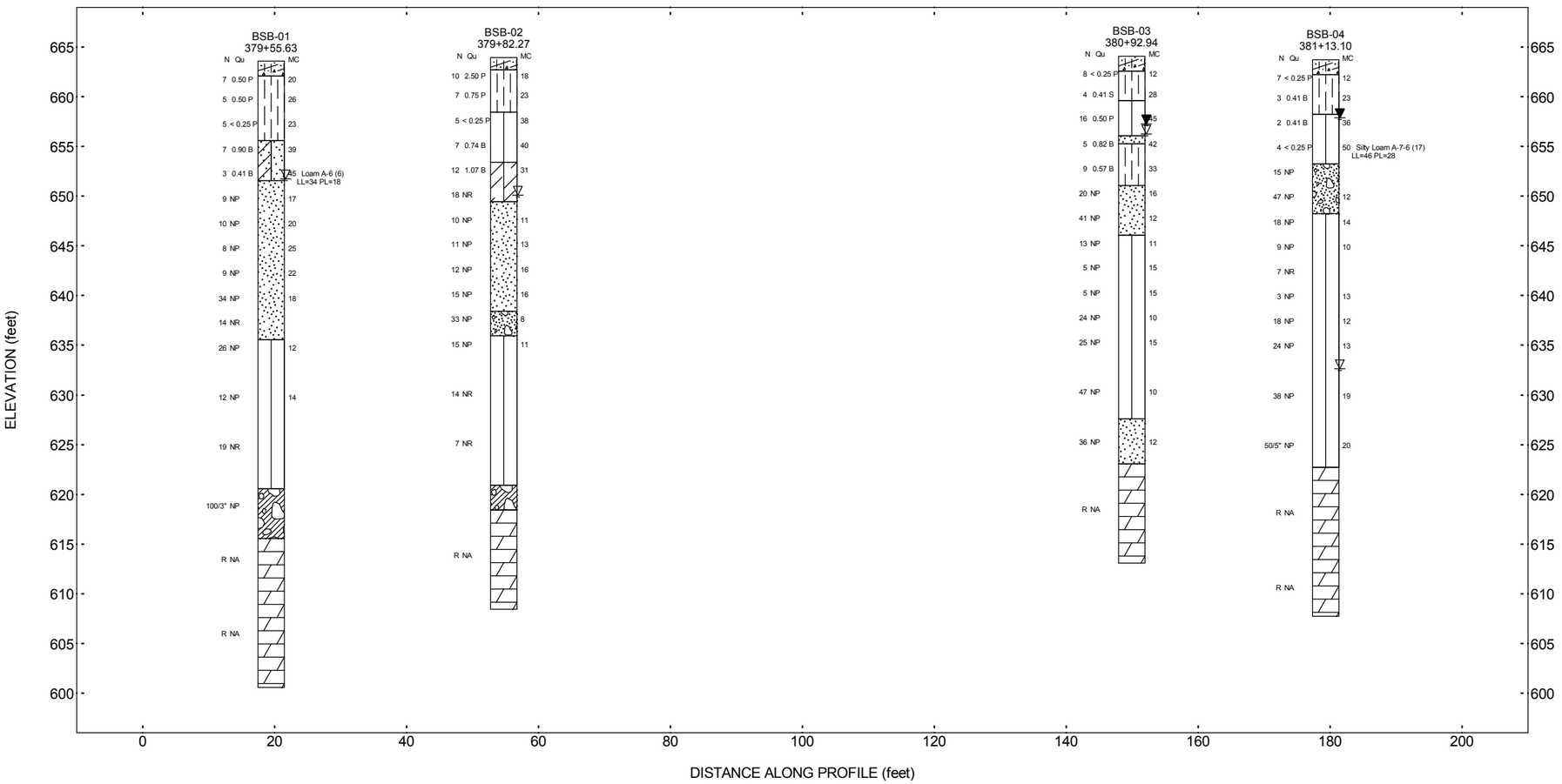
W

A

A'

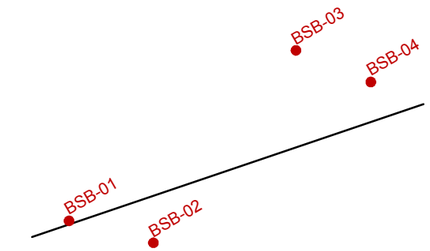
E

N



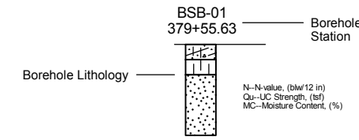
Lithology Graphics

- Pavement
- IDH Silty Clay, Silty Clay Loam
- IDH Loam
- IDH Sand, Sandy Loam
- IDH Silt, Silty Loam
- Weathered bedrock
- Dolomite or Dolomitic Limestone
- IDH Clay Loam
- Gravelly sand, sandy gravel



Site Map Scale 1 inch equals 75 feet

Explanation:



Water Level Reading at time of drilling.

Water Level Reading 24-hr after drilling or at end of drilling

0 20

Horizontal Scale (feet)

Vertical Exaggeration: 1.5x

Wang Engineering, Inc.
1145 N Main Street
Lombard, IL 60148

Soil Profile A-A'
SN 099-0543, West Bridge over Marley Creek

WEI SINCE 1982

US Route 6 over Marley Creek
New Lenox, Will County, IL

JOB NUMBER	PLATE NUMBER
401-05-01	EXHIBIT 4

WEI 11X17 4010501.GPJ WANGENG.GDT 10/17/14

APPENDIX A

Wang Engineering
wangeng@wangeng.com
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Fax: 630 953-9938

BORING LOG BSB-01

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 663.56 ft
North: 1779224.27 ft
East: 1095326.41 ft
Station: 379+55.63
Offset: 15.98 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	662.1	18-inch thick ASPHALT --PAVEMENT--						
		Very soft to medium stiff, brown SILTY CLAY to SILTY CLAY LOAM, trace gravel --FILL--			1	2 2 5	0.50 P	20
			5		2	1 2 3	0.50 P	26
					3	1 2 3	< 0.25 P	23
	655.6							
		Soft to medium stiff, black LOAM, trace organic matter			4	1 3 4	0.90 B	39
			10					
		--L_L(%) = 34, P_L(%) = 18-- --%Gravel = 6.8%-- --%Sand = 37.8%-- --%Silt = 41.9%-- --%Clay = 13.5%--			5	1 1 2	0.41 B	45
	651.6							
		Very loose to dense, brown, fine to coarse SAND, trace to little gravel --wet--	15		6	7 4 5	NP	17
		--wet--			7	6 6 4	NP	20
		--wet--	20		8	4 4 4	NP	25
		--wet--	25		9	4 5 4	NP	22
		--wet--			10	6 14 20	NP	18
					11	10 6 8	NR	
	635.6							
		Medium dense, gray SILT, trace to little gravel and cobbles --dry--	30		12	7 15 11	NP	12
			35		13	5 6 6	NP	14
			40		14	11 8 11	NR	

GENERAL NOTES

Begin Drilling: **05-23-2014** Complete Drilling: **05-26-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **12.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

WANGENGINC 4010501.GPJ WANGENG.GDT 10/17/14

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Fax: 630 953-9938

BORING LOG BSB-01

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 663.56 ft
North: 1779224.27 ft
East: 1095326.41 ft
Station: 379+55.63
Offset: 15.98 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	620.6							
		Very dense weathered DOLOSTONE	45		15	100/3"	NP	
	615.6							
		Strong, greenish and gray, very poor to fair quality DOLOSTONE, 2 inch horizontal joint spacing with slicken joint wall surface, slightly weathered joints, soft and greenish infill with thickness < 0.2 in, dry	50		16	CORE		
		--Run #1: 48 to 53 feet-- --Recovery = 53%-- --RQD = 28%--						
		--Run #2: 53 to 63 feet-- --Recovery = 85%-- --RQD = 61%--	55		17	CORE		
			60					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	600.6	Boring terminated at 63.00 ft	65					
			70					
			75					
			80					

GENERAL NOTES

Begin Drilling: **05-23-2014** Complete Drilling: **05-26-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **12.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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Fax: 630 953-9938

BORING LOG BSB-02

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 663.94 ft
North: 1779213.66 ft
East: 1095367.24 ft
Station: 379+82.27
Offset: 16.74 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	662.7	15-inch thick ASPHALT --PAVEMENT--						
		Medium stiff to very stiff, brown SILTY CLAY LOAM to SILTY CLAY, trace gravel --FILL--			1	3 4 6	2.50 P	18
			5		2	2 2 5	0.75 P	23
	658.4	Very soft to medium stiff, black SILTY LOAM, trace gravel and organic matter			3	1 2 3	< 0.25 P	38
			10		4	1 3 4	0.74 B	40
	653.4	Stiff, black CLAY LOAM, some gravel and trace organic matter			5	1 4 8	1.07 B	31
	649.4			▽	6	10 10 8	NR	
		Medium dense, brown, fine to medium SAND, trace gravel	15					
		--moist--			7	9 6 4	NP	11
		--moist--			8	7 6 5	NP	13
			20					
		--moist--			9	5 5 7	NP	16
		--moist--	25		10	8 8 7	NP	16
	638.4	Dense, brown, fine SANDY GRAVEL --moist--			11	20 15 18	NP	8
	635.9	Medium dense, gray SILT, trace gravel --dry--	30		12	12 7 8	NP	11
			35		13	4 7 7	NR	
			40		14	6 4 3	NR	

GENERAL NOTES

Begin Drilling: **05-15-2014** Complete Drilling: **05-15-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **14.00 ft**
At Completion of Drilling ▼ **NA**
Time After Drilling **NA**
Depth to Water ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

WANGENGINC 4010501.GPJ WANGENG.GDT 10/17/14

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Telephone: 630 953-9928
Fax: 630 953-9938

BORING LOG BSB-02

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 663.94 ft
North: 1779213.66 ft
East: 1095367.24 ft
Station: 379+82.27
Offset: 16.74 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	620.9							
		Weathered DOLOSTONE	45					
	618.4	Strong, grayish, poor quality DOLOSTONE, <0.05 inch horizontal joint spacing, slightly rough joint wall surface --Run #1: 45.5 to 55.5 feet-- --Recovery = 70%-- --RQD = 40%-- --Q_u =12,070 psi-- --6-inch thick shale--	50		15	CORE		
			55					
	608.4	Boring terminated at 55.50 ft	60					

GENERAL NOTES

Begin Drilling: **05-15-2014** Complete Drilling: **05-15-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **14.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG BSB-03

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 664.09 ft
North: 1779306.75 ft
East: 1095436.20 ft
Station: 380+92.94
Offset: 17.52 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	662.6	18-inch thick ASPHALT --PAVEMENT--						
		Very soft to medium stiff, brown and black SILTY CLAY to SILTY CLAY LOAM --FILL--			1	10 4 4	< 0.25 P	12
	659.6	Soft, black SILTY LOAM, trace organic matter	5		2	1 1 3	0.41 S	28
					3	2 8 8	0.50 P	45
	656.1	Loose, brown, fine SAND						
	655.3	--wet--						
		Medium stiff, black SILTY CLAY, trace gravel	10		4	1 2 3	0.82 B	42
					5	1 2 7	0.57 B	33
	651.1	Medium dense to dense, brown, medium to coarse SAND, trace gravel --wet--	15		6	11 8 12	NP	16
		--wet--			7	21 25 16	NP	12
	646.1	Loose to dense, gray SILT, trace gravel --moist--	20		8	6 6 7	NP	11
		--saturated--			9	2 2 3	NP	15
		--saturated--	25		10	4 2 3	NP	15
		--dry--			11	8 9 15	NP	10
		--dry--	30		12	9 12 13	NP	15
		--dry--	35		13	27 22 25	NP	10
	627.6	Dense, brown, fine to medium SAND, trace gravel --dry--						
			40		14	18 21 15	NP	12

GENERAL NOTES

Begin Drilling: **05-20-2014** Complete Drilling: **05-20-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **8.00 ft**
At Completion of Drilling: **7.00 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG BSB-03

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 664.09 ft
North: 1779306.75 ft
East: 1095436.20 ft
Station: 380+92.94
Offset: 17.52 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	623.1							
		Strong, gray, very poor quality DOLOSTONE, 2 inch horizontal joint spacing, infill thickness <0.2 inches, soft, green infill, hard and slightly rough joint wall surface				C O R E		
		--Run #1: 41 to 51 feet--						
		--Recovery = 100%--						
		--RQD = 25%--	45		15			
			50					
		--Q_u =12,470 psi--						
	613.1							
		Boring terminated at 51.00 ft						
			55					
			60					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

GENERAL NOTES

Begin Drilling: **05-20-2014** Complete Drilling: **05-20-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **8.00 ft**
At Completion of Drilling: **7.00 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG BSB-04

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 663.73 ft
North: 1779291.44 ft
East: 1095472.44 ft
Station: 381+13.10
Offset: 16.72 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		18-inch thick ASPHALT --PAVEMENT--						
	662.2							
		Very soft to soft, black and brown SILTY CLAY, trace gravel --FILL--			1	3 3 4	< 0.25 P	12
			5		2	1 1 2	0.41 B	23
	658.2							
		Very soft to soft, black SILTY LOAM, trace gravel and organic matter --L_L(%) = 46, P_L(%) = 28-- --%Gravel = 0.3%-- --%Sand = 16.1%-- --%Silt = 69.3%-- --%Clay = 14.3%--			3	0 1 1	0.41 B	36
			10		4	1 1 3	< 0.25 P	50
	653.2							
		Medium dense to dense, brown GRAVEL and SANDY GRAVEL			5	3 5 10	NP	
		--moist--	15		6	19 18 29	NP	12
	648.2							
		Very loose to very dense, tan and gray SILTY LOAM, trace gravel --moist--			7	6 7 11	NP	14
		--moist--	20		8	6 6 3	NP	10
					9	5 3 4	NR	
		--moist--	25		10	3 1 2	NP	13
		--dry--			11	5 9 9	NP	12
		--dry--	30		12	13 14 10	NP	13
		--wet--	35		13	11 15 23	NP	19
		--dry-- --cobbles--	40		14	10 6 50/5"	NP	20

GENERAL NOTES

Begin Drilling: **05-16-2014** Complete Drilling: **05-19-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **31.25 ft**
At Completion of Drilling: **6.00 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG BSB-04

WEI Job No.: 401-05-01

Client: **Civiltech Engineering, Inc.**
Project: **US Route 6 over Marley Creek**
Location: **New Lenox, Will County, IL**

Datum: NAVD88
Elevation: 663.73 ft
North: 1779291.44 ft
East: 1095472.44 ft
Station: 381+13.10
Offset: 16.72 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	622.7							
		Strong, gray, poor to fair quality DOLOSTONE with approximately 2-inch horizontal joint spacing, <0.2-inches of soft greenish infilling, hard and slightly rough joint wall				CORE		
		--Run #1: 41 to 51 feet-- --Recovery = 100%-- --RQD = 38%--	45		15			
			50					
		--Run #2: 51 to 56 feet-- --Recovery = 98%-- --RQD = 70%--				CORE		
					16			
			55					
	607.7							
		Boring terminated at 56.00 ft						
			60					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

GENERAL NOTES

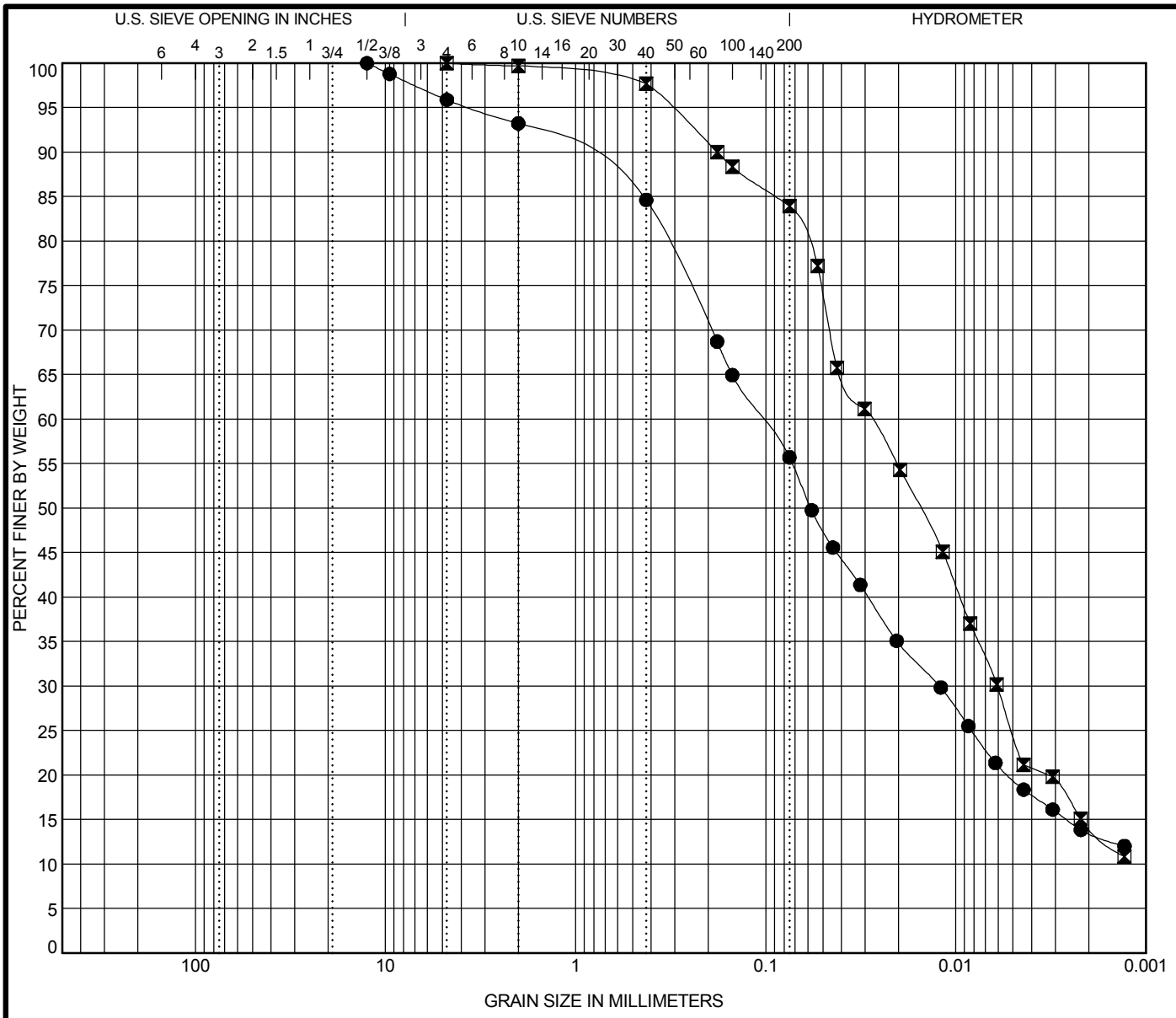
Begin Drilling: **05-16-2014** Complete Drilling: **05-19-2014**
Drilling Contractor: **Wang Testing Service** Drill Rig: **D50 TMR**
Driller: **R&J** Logger: **S. Woods** Checked by: **M. Snider**
Drilling Method: **2.25 SSA to 10 feet, mud rotary below 10 feet; 140 lb auto hammer; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: ▽ **31.25 ft**
At Completion of Drilling: ▼ **6.00 ft**
Time After Drilling: **NA**
Depth to Water: ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

APPENDIX B



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	BSB-01#5	11.0 ft	**Loam**	**34**	**18**	**16**		
⊠	BSB-04#4	8.5 ft	**Silty Loam**	**46**	**28**	**18**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BSB-01#5	11.0 ft	**12.5**	**0.103**	**0.012**		**6.8**	**37.8**	**41.9**	**13.5**
⊠	BSB-04#4	8.5 ft	**4.75**	**0.028**	**0.006**		**0.3**	**16.1**	**69.3**	**14.3**

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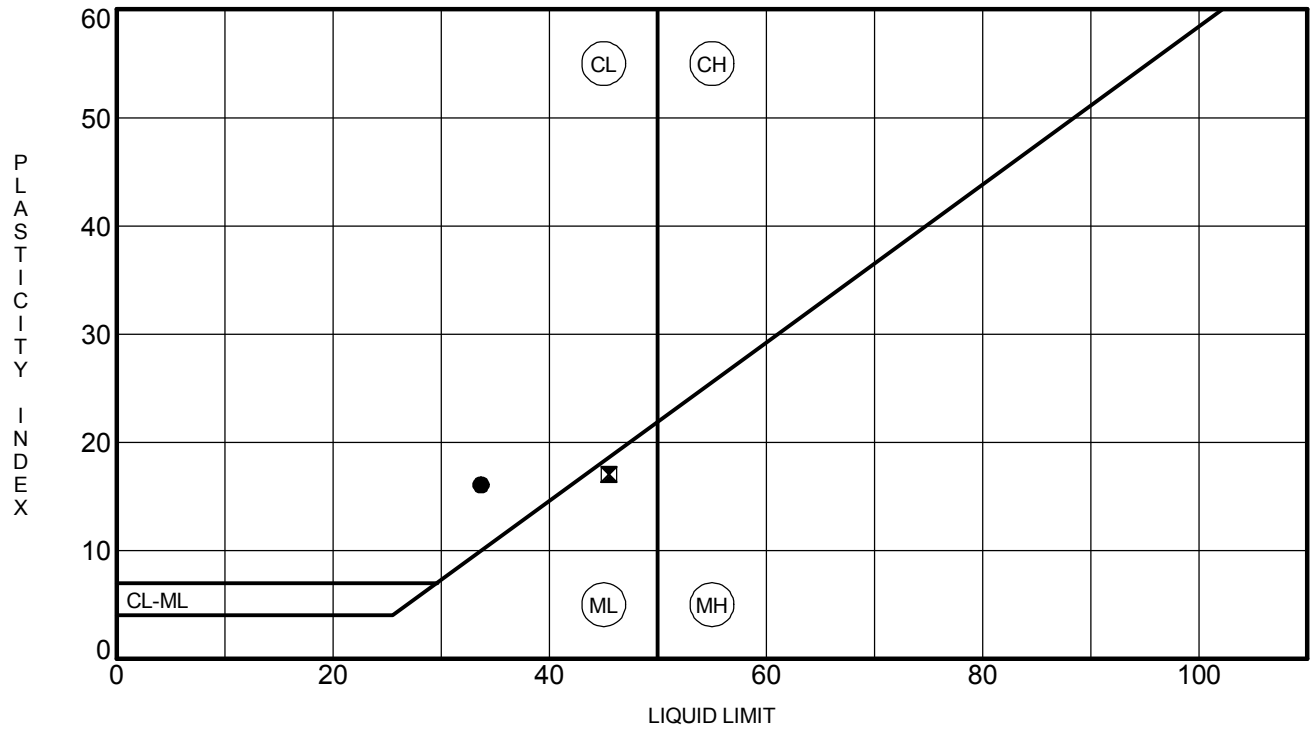
GRAIN SIZE DISTRIBUTION

Project: US Route 6 over Marley Creek

Location: New Lenox, Will County, IL

Number: 401-05-01



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	**BSB-01#5**	**11.0 ft**	**34**	**18**	**16**	**56**	**Loam**
⊠	**BSB-04#4**	**8.5 ft**	**46**	**28**	**18**	**84**	**Silty Loam**

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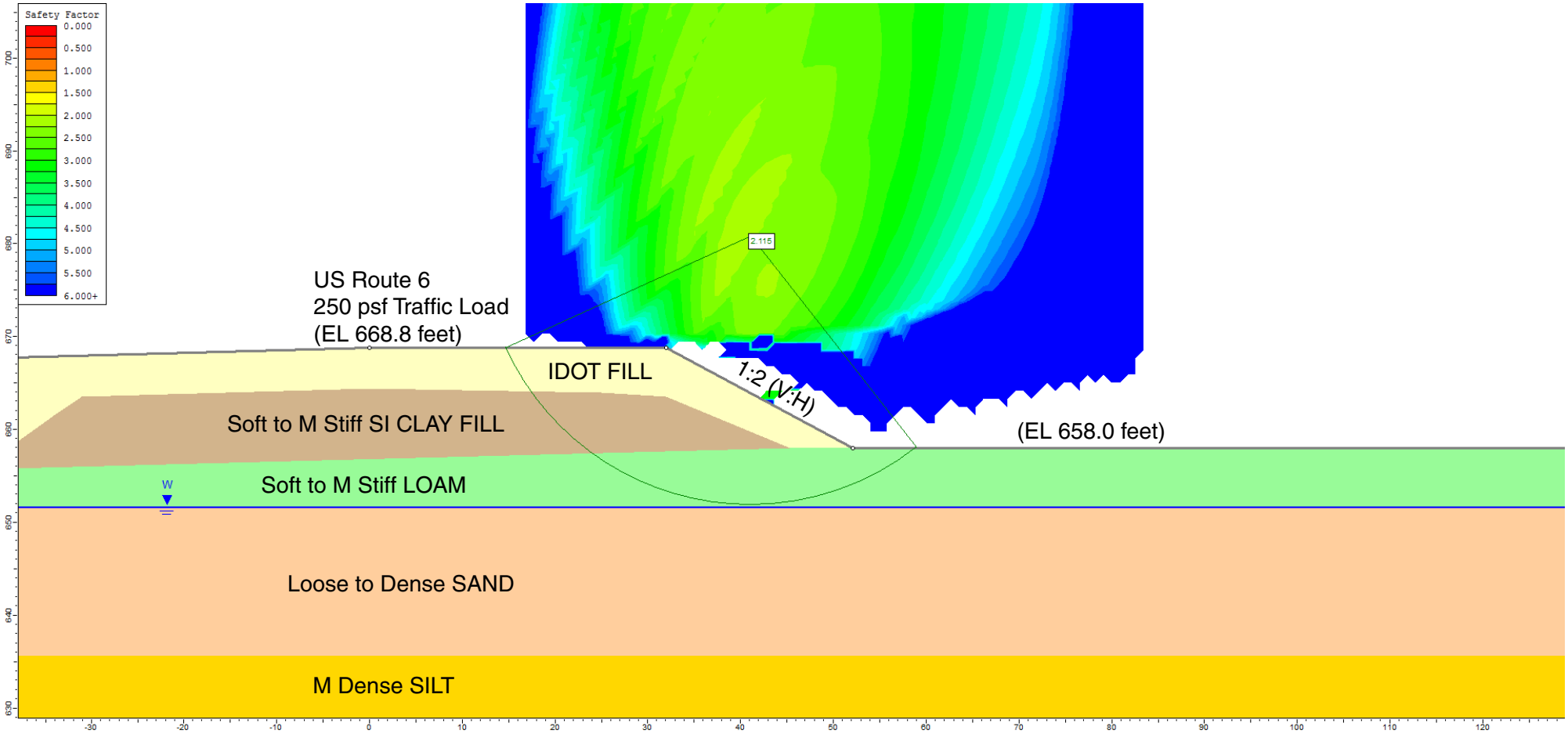
ATTERBERG LIMITS' RESULTS

Project: US Route 6 over Marley Creek

Location: New Lenox, Will County, IL

Number: 401-05-01

APPENDIX C



Undrained Analysis for Side Slopes, Station 379+40, Ref Boring BSB-01

Layer ID	Description	Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	IDOT FILL	125	1000	0
2	Soft to M Stiff SI CLAY FILL	115	500	0
3	Soft SI LOAM	115	500	0
4	Loose to Dense SAND	125	0	32
5	M Dense SILT	125	0	30

GLOBAL STABILITY: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-1 | DRAWN BY: HKB, CHECKED BY: MLS

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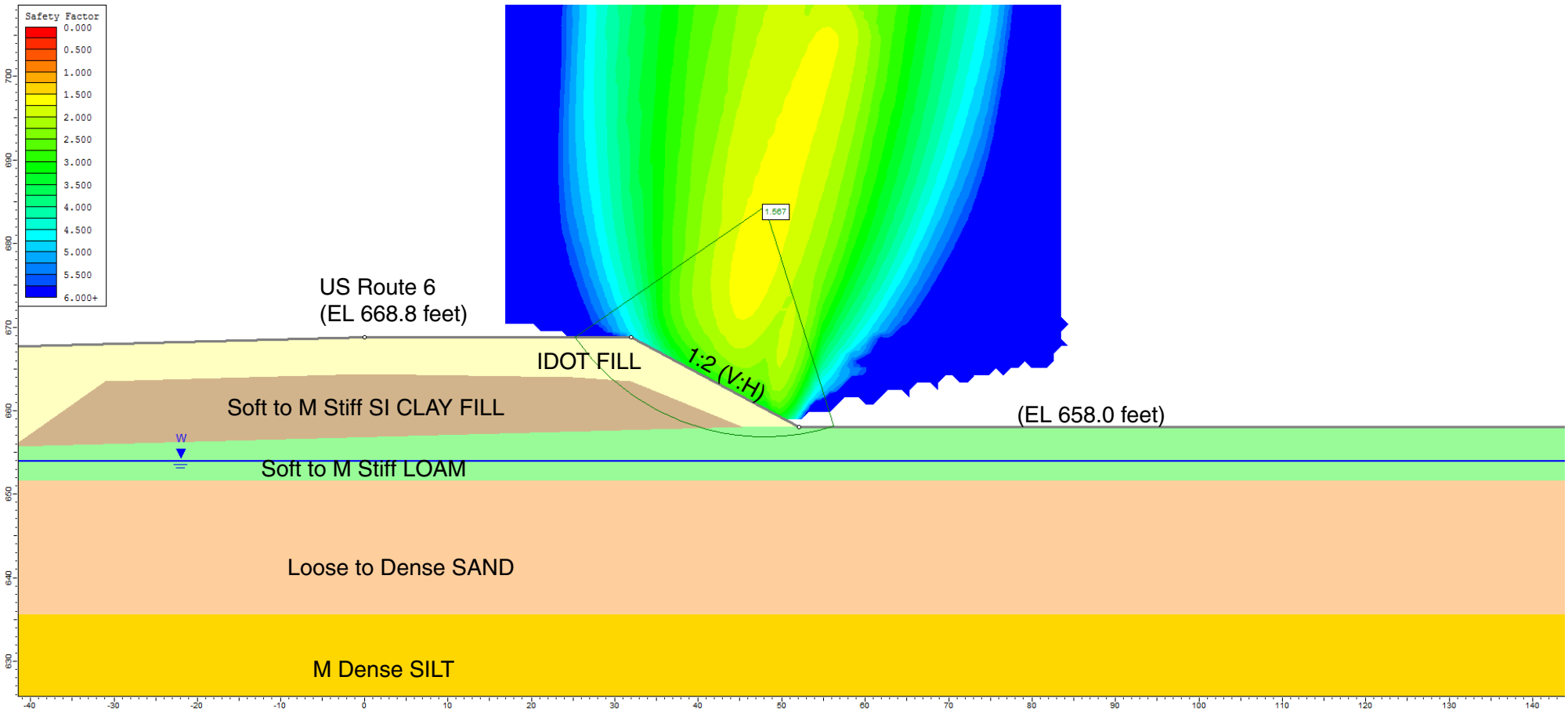

Drained Analysis for Side Slopes, Station 379+40, Ref Boring BSB-01

Layer ID	Description	Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	IDOT FILL	125	100	0
2	Soft to M Stiff SI CLAY FILL	115	0	28
3	Soft SI LOAM	115	0	28
4	Loose to Dense SAND	125	0	32
5	M Dense SILT	125	0	30

GLOBAL STABILITY: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-2 | DRAWN BY: HKB, CHECKED BY: MLS

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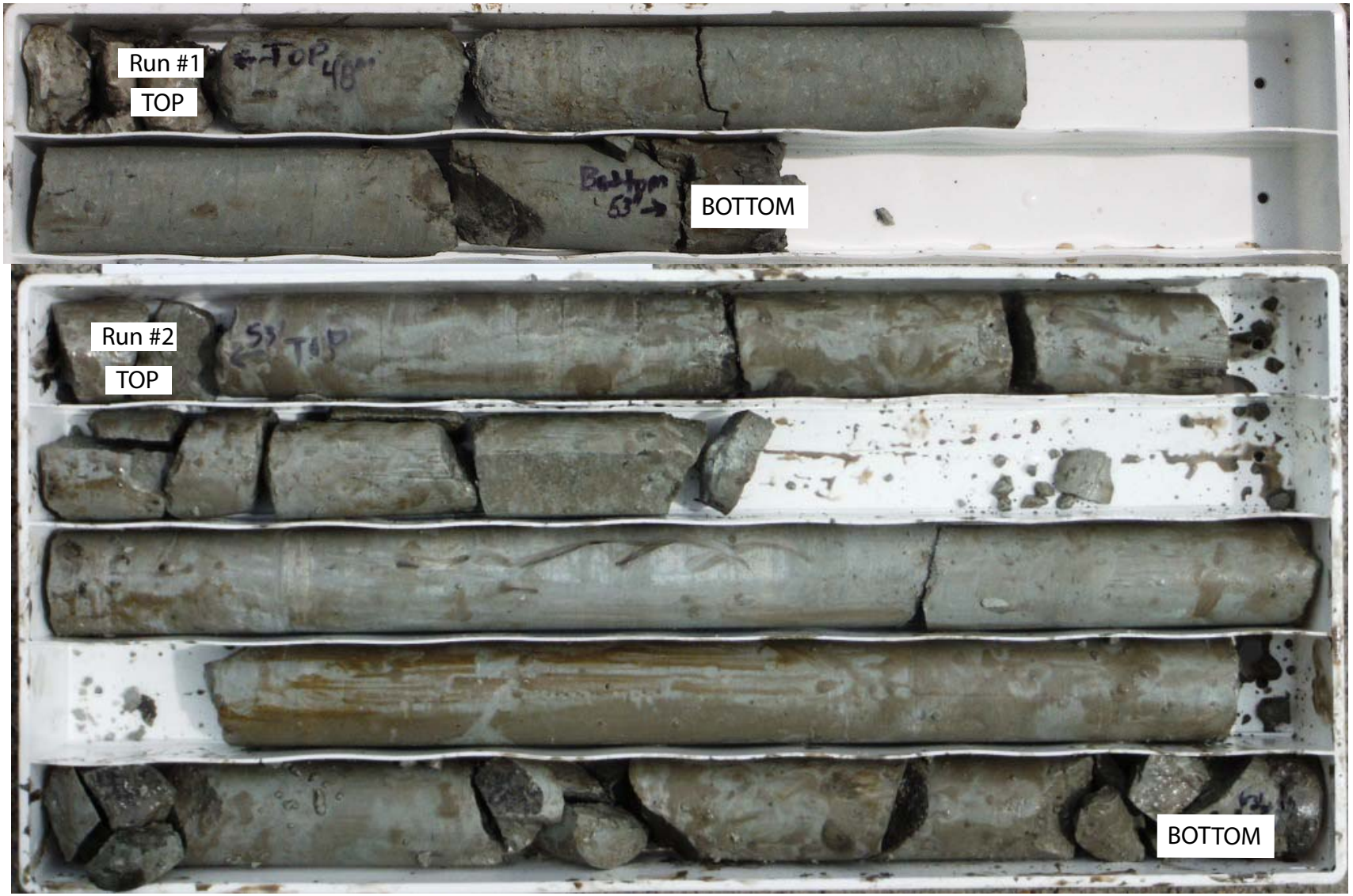
APPENDIX D



Boring BSB-01:
Run #1: 48′ to 53′, RECOVERY = 53%, RQD = 28%
Run #2: 53′ to 63′, RECOVERY = 85%, RQD = 61%

BEDROCK CORE: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE : GRAPHIC	APPENDIX D-1	DRAWN BY: MDLR CHECKED BY: MLS

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Boring BSB-02
Run #1: 45.5' to 55.5', RECOVERY = 70%, RQD = 40%

BEDROCK CORE: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE : GRAPHIC	APPENDIX D-2	DRAWN BY: MLS CHECKED BY: LMI

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Boring BSB-03:
Run #1: 41′ to 51′, RECOVERY = 100%, RQD = 25%

BEDROCK CORE: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE : GRAPHIC	APPENDIX D-3	DRAWN BY: MDLR CHECKED BY: MLS

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Boring BSB-04:
Run #1: 41′ to 51′, RECOVERY = 100%, RQD = 38%
Run #2: 51′ to 56′, RECOVERY = 98%, RQD = 70%

BEDROCK CORE: US ROUTE 6 BRIDGE OVER MARLEY CREEK
SN 099-0543, SECTION 33B (B-R), WILL COUNTY, ILLINOIS

SCALE : GRAPHIC	APPENDIX D-4	DRAWN BY: MDLR CHECKED BY: MLS

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