STRUCTURE GEOTECHNICAL REPORT
CIRCLE INTERCHANGE RECONSTRUCTION
RETAINING WALL 48 (PROPOSED SN 016-1835)
F.A.I ROUTE 94, (I-90/94 SB TO I-290 EB)
STATION 1403+78.00 TO STATION 1404+89.01
SECTION 2014-013 R&B-R
IDOT D-91-227-13, PTB 163/ITEM 001
COOK COUNTY, ILLINOIS

For

AECOM

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Original: August 22, 2017
Revised: NA

Technical Report Documentation Page

1. Title and Subtitle Structure Geotechnical Report Circle Interchange Reconstruction Retaining Wall 48, F.A.I. Route 94 Station 1403+78.00 to Station 1404+89.01		**2. Report Date** Original: August 22, 2017 Revised: N/A **3. Report Type** ☒ SGR ☐ RGR ☐ Draft ☒ Final ☐ Revised
4. Route / Section / County FAI 94/2014-013R&B -R/ Cook		**5. IDOT Job No./Contract** D-91-259-12/60X93
6. PTB / Item No. 163/001	**7. Existing Structure Number(s)** No existing wall	**8. Proposed Structure Number(s)** 016-1835
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11. Abstract

A 245.27-foot long, 21.57 feet maximum retained height new retaining wall will be constructed to retain the proposed SE Ramp north approach structure. The Mechanically Stabilized Earth (MSE) will wrap around the approach roadway and abutment portions. This report provides geotechnical recommendations for the design and construction of the proposed retaining wall.

Beneath the pavement or topsoil, the subsurface soils consists of up to 10 feet of primarily cohesive fill, up to 10 feet medium stiff to very stiff clay crust, up to 40 feet of very soft to medium stiff silty clay, 25 feet of very stiff to hard clay loam, and 32 feet of hard silty clay loam or dense to very dense silt to silty loam extending to the boring termination depths. Bedrock was encountered at elevations of about 481 to 485 feet. Groundwater may be encountered within the fill layers at the upper 4 to 10 feet, during times of heavy precipitation.

Based on the encountered subsoil conditions and the wall height, the proposed MSE wall is feasible with preloading or ground improvement. In addition, the MSE wall will require Class III LCCF materials to have sufficient foundation bearing resistance. We estimate the wall will have a maximum factored bearing resistance of 2,900 psf using a geotechnical resistance factor of 0.65. The wall will have sufficient resistance against sliding. Global stability analyses show adequate factors of safety.

The long-term consolidation settlement of foundation soils is estimated to be 2.1 inches near Station 1404+81 and 0.9 inches near Station 1404+50. We estimate the soil will achieve 50% of primary consolidation settlement in 12 months and 90% of primary consolidation in 56 months. To reduce settlements to acceptable range of 1-inch for the roadway, we recommend either with preloading for 12 months or a ground improvement by use of aggregate columns. The design and construction of aggregate columns should be as per IDOT Special Provision GBSP No. 71 *Aggregate Column Ground Improvement.*

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FOR
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1.0 INTRODUCTION

This report presents the results of Wang Engineering, Inc. (Wang) subsurface investigation, laboratory testing, and geotechnical engineering evaluations for the proposed wall SN 016-1835 (Retaining Wall 48) along F.A.I Route 94 (I-90/94 SB to I-290 EB) in the City of Chicago, Cook County, Illinois. A *Site Location Map* is presented as Exhibit 1.

The purpose of our investigation was to characterize the site soil and groundwater conditions, perform geotechnical engineering analyses, and provide recommendations for the design and construction of the new wall structure.

1.1 Project Description

The Circle Interchange is over 50 years old and has significant congestion and safety problems. The project is aiming to improve safety and mobility as well as upgrade the mainline and interchange facilities. The project will also improve other modes of transportation such as transit, pedestrians and bicyclists within the same corridor.

The Circle Interchange Reconstruction project is along Interstate 90/94 (I-90/94) from south of Roosevelt Road to north of Lake Street, along Interstate 290 (I-290) from Loomis Street to the Circle Interchange; and along Congress Parkway from the Circle Interchange to Canal Street/Old Post Office. The routes typically have three lanes of traffic in each direction with mostly one lane ramp at interchanges. Locally, the north leg is known as the Kennedy Expressway, the south leg as the Dan Ryan Expressway and the west leg as the Eisenhower Expressway. Within the project area, there are several cross street bridges over I-90/94 and I-290 considered for reconstruction. Along I-90/94, from south to north, the cross street overpasses include Taylor Street, Van Buren Street, Jackson Boulevard, and Adams Street. Along I-290, from west to east, the cross street overpasses include Morgan Street, Peoria Street, and Halsted Street.

The proposed improvements include additional through lanes in each direction on I-90/94. The horizontal alignment and vertical profiles throughout the interchange will be improved. A new two-lane flyover, Ramp NW (Flyover) will be constructed for I-90/94 northbound to I-290 westbound traffic. Cross street bridges, Morgan Street, Harrison Street, Halsted Street, Peoria Street, Taylor Street, Adams Street, Jackson Boulevard, and Van Buren Street will be reconstructed. Various existing ramps will be reconstructed and up to fifty new retaining walls will be constructed.

1.2 Proposed Structure

Based on the TSL plan dated August 15, 2017 provided by TranSystems, Wang understands the proposed Mechanically Stabilized Earth (MSE) retaining wall (SN 016-1835) will be required to retain the SE Ramp Bridge (SN 016-1714) north approach roadway as well as north abutment. The 245.27-foot wall begins at Station 1403+78.00, offset 6.16 feet right on west side of SE Ramp, wraps the proposed SE Ramp Bridge north abutment, and ends at Station 1403+78.00, 22.81 feet left on east side of SE Ramp. The wall will have a maximum retained height of 21.57 feet. The maximum wall height measured from the top of levelling pad to the top of Coping/Finished Grade at B.F. of wall will be 25.07 feet. The wall height increases gradually from 3.5 to 25.07 feet over the length of approximately 111 feet. There will be a 3.5-foot concrete parapet on top of the wall. The TSL plan is included in the *Type Size Location Plan* (Appendix D).

1.3 Existing Structure

There is no existing retaining wall structure due to a new alignment of Ramp SE Bridge.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The site is located within the City of Chicago at the I-90/94 and I-290 Circle Interchange. On the USGS *Chicago Loop 7.5 Minute Series* map, the bridge is located in the NE¼ of Section 16, Tier 39 N, Range 14 E of the Third Principal Meridian.

The following review of 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 present subsurface investigation results. For the study of the regional geologic framework, Wang considered northeastern Illinois in general and Cook County in particular. Exhibit 2 illustrates the *Site and Regional Geology*.

2.1 Physiography

The wall is situated within the Chicago Lake Plain Physiographic Subsection. The area is characterized by a flat surface that slopes gently toward the lake, largely made of groundmoraine till covered by thin and discontinuous lacustrine silt and clay. The ground elevation along the wall ranges from 595 feet at the south end to 582 feet at the north end.

2.2 Surficial Cover

The project area was shaped during the Wisconsinan-age glaciation, and more than 75-foot thick drift covers the bedrock (Leetaru et al. 2004). The glacial cover is made up of clay and silt of the Equality Formation of the Mason Group and diamictons of the Wadsworth and Lemont Formations of the Wedron Group (Hansel and Johnson 1996). The Equality Formation is made up of bedded silt and clay, locally laminated, with lenses and/or thin beds of sand and gravel. The Wadsworth Formation consists of relatively homogenous, massive, gray till with clay to silty clay matrix, with dolostone and shale clasts and occasional lenses of sorted and stratified silt. The Wadsworth Formation is underlain by the pebbly silty clay loam to silty loam diamicton of the Yorkville Member of the Lemont Formation, known informally as the Chicago “hardpan.”

From a geotechnical viewpoint, the Equality Formation is characterized by low strength, medium to high plasticity, and medium to high moisture content, whereas the Wadsworth Formation is characterized by low plasticity, medium to low moisture content, medium to very stiff consistency, poor permeability, and low compressibility. The Yorkville Member (hardpan) is characterized by low plasticity, high blow counts, and low moisture content (Bauer et al. 1991; Peck and Reed 1954).

2.3 Bedrock

In the project area, the glacigenic deposits unconformably rest over approximately 350-foot thick Silurian-age dolostone (Leetaru et al 2004). The top of bedrock may be encountered at 475 to 500 feet elevation or 75 to 100 feet below ground surface (bgs) or more. The Silurian dolostone dips gently eastward at a pace of 15 feet per mile. Only inactive faults are known in the area, and the seismic risk is minimal (Leetaru et al. 2004; Willman 1971). There are no records of mining activity in the area, but deep tunnel excavations are known to exist.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area revealed the native sediments consist of clay to silty clay diamicton of the Wadsworth Formation resting on top of more competent silty clay loam diamicton (hardpan) of the Lemont Formation, which in turn is underlain by bedrock. Sound dolostone bedrock was sampled at depths of 98 to 107 feet bgs, corresponding to 481.3 to 484.5 feet elevations, within the range predicted based on published geological data.

3.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations. All elevations in this report are based on NAVD 1988.

3.1 Subsurface Investigation

Since no specific subsurface investigation was carried out for the proposed Wall 48, Wang has referenced three structure borings, designated as 1714-B-01, 1714-B-02, and 1705-B-10 drilled for the SE and NW Ramps structures in October 2013.

In addition, Wang considered Piezometer 1703-PZ-01 located about 550 feet east of Wall 48. The piezometer was installed in accordance with ASTM D 5092, "*Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers.*"

The as-drilled boring locations were surveyed by Dynasty Group, Inc. and station and offset information for each boring were provided by AECOM. The station and offset referenced the wall alignment. Boring location data are presented in the *Boring Logs* (Appendix A). The as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 3).

A truck-mounted drilling rig equipped with hollow stem augers, was used to advance and maintain an open borehole to 10 feet depth after that mud rotary was used to the boring termination depth.

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-foot intervals to boring termination depths. Soil samples collected from each sampling interval were placed in sealed jars and transported to Wang Geotechnical Laboratory in Lombard, Illinois for further examination and laboratory testing.

Field boring logs, prepared and maintained by a Wang engineer or geologist, include lithological descriptions, visual-manual soil/rock classifications, results of Rimac and pocket penetrometer unconfined compressive strength tests, results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration. The SPT N value, shown on the soil profile, is the sum of the second and third blows per 6 inches. The soils were described and classified according to Illinois Division of Highways (IDH) Textural Classification system. The field logs were finalized by an experienced engineering geologist after verifying the field visual classifications and laboratory test results.

Groundwater observations were made during to a depth of 10 feet before using rotary wash method. Due to safety considerations, boreholes were backfilled with grout immediately upon completion. Groundwater levels in the piezometer were recorded autonomously at defined intervals by digital pressure loggers suspended within the water column. Barometric affects are compensated by a second in-air pressure logger installed in the riser pipe. Data is retrieved from loggers periodically, downloaded to computer for analysis.

3.2 Vane Shear Tests

Wang performed vane shear tests in Borings 1705-B-10 to determine in-situ shear strength of very soft to soft silty clay. In addition, vane shear test in Boring VST-06 was also considered. Boring VST-06 is located approximately 600 feet east of wall. Vane shear test was performed using calibrated RocTest vane shear equipment. Tests were performed in undisturbed and remolded conditions. The sensitivity shown on the borings is the ratio of shear strength in undisturbed and remolded conditions. In general, the vane shear values for soft clays were significantly higher than the corresponding values from unconfined compressive strength tests using the RIMAC apparatus. Vane shear test results were used for analyses.

3.3 Laboratory Testing

The soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limits (AASHTO T 89/T 90) and particle size analyses (AASHTO T 88) tests were performed on selected soil samples representing the main soil layers encountered during the investigation. Field visual descriptions of the soil samples were verified in the laboratory. Laboratory test results are shown in the *Boring Logs* (Appendix A), in the *Soil Profile* (Exhibit 4), and in the *Laboratory Test Results* (Appendix B).

The soil samples will be retained in our laboratory for 60 days following approval this report. After that time, soil samples will be discarded unless a specific written request is received as to their disposition.

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during our 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

Boring 1714-B-02 drilled at the existing westbound I-290 shoulder encountered 4 inches of asphalt over 8 inches of concrete. Borings 1714-B-01 and 1705-B-10 revealed 3 to 12 inches of brown to dark brown loamy topsoil. In descending order, the general lithologic succession encountered beneath the pavement structure or topsoil includes: 1) man-made ground (fill); 2) medium stiff to very stiff silty clay; 3) very soft to medium stiff clay to silty clay; 4) very stiff to hard clay to silty clay loam; 5) hard silty clay loam and dense to very dense silt to silty loam; and 6) strong dolostone.

1) Man-made ground (fill)

Underneath the topsoil or pavement structure, the borings encountered 4 to 10 feet of fill materials. Granular fill consists of medium dense, brown sand and loam with crushed stone and brick fragments. Cohesive fill includes very stiff to hard, brown and gray silty clay to silty clay loam and clay loam. The granular fill layer has N-values of 11 to 17 blows per foot and moisture content values of 8 to10%. The cohesive fill layer has unconfined compressive strength (Qu) values ranging from 2.6 to more than 4.5 tsf and moisture content values between 16 and 20%.

2) Medium stiff to very stiff silty clay to silty loam

Beneath the fill, at elevations of 577 to 583 feet, the borings encountered 3 to 10 thick of medium stiff to very stiff, gray silty clay to silty loam. This layer has Qu values ranging from 1.0 to 3.5 tsf and moisture content values between 16 and 24%. Laboratory index testing on a sample from this layer shows liquid limit (L_L) and plastic limit (P_L) values of 24% and 15%, respectively. This layer is commonly known as the "crust."

3) Very soft to medium stiff clay to silty clay

At elevations of 573 to 580 feet (8 to 20 feet bgs), the borings revealed up to 40 feet of very soft to medium stiff, gray clay to silty clay with Qu values of 0.08 to 0.98 tsf with an average of 0.36 tsf and moisture content values of 19 to 36% averaging 24%. As discussed in Section 4.2, undrained shear strength values from vane shear tests are generally higher than Rimac tests. The vane shear tests results are shown in Borings 1714-B-10 and VST-06, and range from 0.6 to greater than 2.6 tsf. Laboratory index testing results show L_L values of 33 to 35% and P_L values of 17 to 18%. According to the AASHTO soil classification, the subgrade soils belong mainly to the A-6 group. This layer is commonly known as the "Chicago Blue Clay."

The long-term consolidation properties of this clay to silty clay layer were obtained from nearby structure Borings 02-RWB-06ST, 1705-B-05A, and 08-ST-01 located about 750 to 1500 feet away from the Wall 48. The resulting soil parameters are summarized in Table 1 and the laboratory test results are attached in Appendix B. These parameters are used to estimate the primary consolidation settlement for the wall.

Table 1: Summary of Consolidation Testing

Boring ID	Test Depth (feet)	Test Elevation (feet)	C_C	C_S	e_O	OCR/ P'_c (psf)	Moisture Content (%)
02-RWB-06ST	18 to 20	562.6	0.240	0.038	0.747	1.6/3292	26
1705-B-05A	25 to 27	554.2	0.223	0.045	0.738	1.2/2886	26
08-ST-01	39 to 41	545.4	0.219	0.051	0.713	1.1/3586	25

4) Very Stiff to hard clay to silty clay loam

At elevations of 536 to 542 feet (47 to 52 feet bgs), the borings advanced through up to 25 feet of very stiff to hard clay to silty clay loam. The clay to silty clay has Qu values of 1.3 to 7.2 tsf with an average of 3.7 tsf and moisture content values of 11 to 27% averaging 19%. Laboratory index testing on a sample from this cohesive layer shows a L_L value of 35% and a P_L value of 17%. The borings encountered 2 to 5 feet of medium dense silt and sand layers with an N value of 13 blows per foot.

(5) Hard silty clay loam and very dense silt to silty loam

At elevations of 516 to 521 feet (67 to 77 feet bgs) the borings encountered up to 32 feet of hard silty clay loam to silty loam, dense to very dense silt to silty loam and very dense gravelly sand resting top of bedrock. This layer has Qu values of 4.4 and 10.3 tsf, moisture content values of 9 to 24%, and N values of 40 to over 50 blows per foot. Numerous sampler refusal and hard drilling conditions were recorded within this layer.

(6) Strong dolostone

The borings encountered strong bedrock at elevations of 481.3 to 484.5 feet or 98 to 107 feet bgs. Based on the 10-foot rock core obtained from borings, the measured RQD values are 50 to 86% in Borings 1705-B-10 and 1714-B-02, corresponding fair to good rock quality. *Bedrock core photographs* are shown in Appendix A.

4.2 Groundwater Conditions

Groundwater was not observed during or after drilling in borings due to the mud rotary drilling from 10 feet bgs. A Piezometer 1703-PZ-01 was installed for the nearby structure about 550 feet east of the proposed retaining wall 48 on November 12, 2014. The screen was placed with the top and bottom of piezometer screen elevations at 507.2 and 487.2 feet (75 to 95 feet bgs), respectively. A summary of the monitoring data between November 2014 and March 2017 is shown in Figure 1.

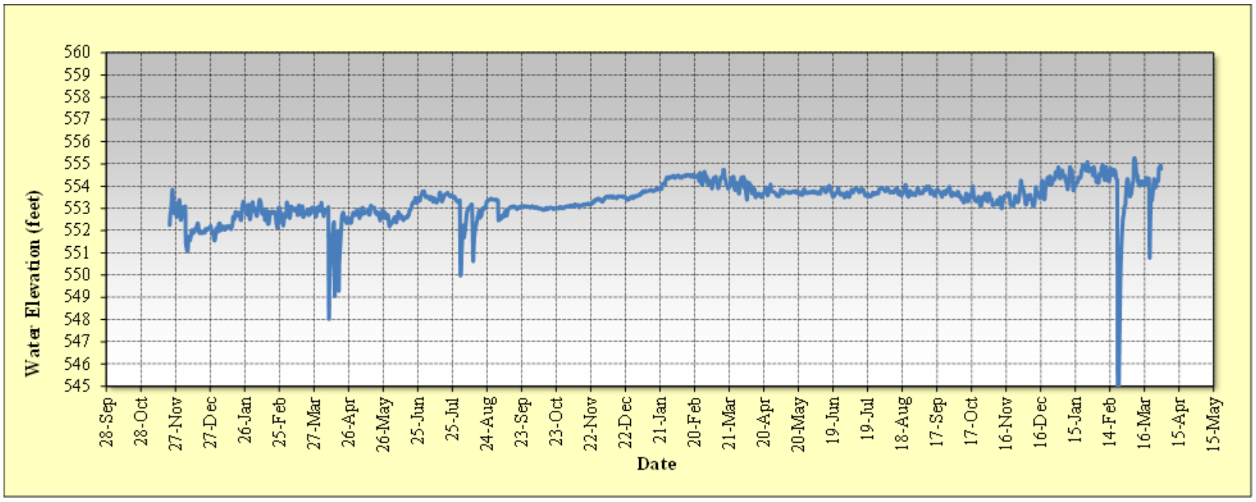

Figure 1: Summary of Groundwater Monitoring Data

The data shows groundwater that is under excess pressure head. The average hydrostatic elevation within the aquifer is about 553 feet. However, the excess pressure will not impact the proposed Wall 48 construction since the MSE wall is proposed.

Although groundwater was not observed within upper fill layers, we anticipate perched water may be encountered during times of heavy precipitation. Therefore, the design and construction of the wall should consider the perched water between elevation 582 and 587 feet within the fill layers.

4.3 Seismic Design Considerations

The retaining wall is located in Seismic Performance Zone (SPZ) 1 and is not required to be designed for seismic forces as per 2012 IDOT *Bridge Manual* (IDOT 2012).

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Retaining Wall Type Evaluation

Based on the TSL plan, the proposed Retaining Wall 48 is a fill wall supporting the north approach of the SE Ramp Bridge. The wall will have a maximum retained height of approximately 21.57 feet. The maximum wall height measured from the top of levelling pad to the top of Coping/Finished Grade at B.F. of wall will be 25.07 feet.

Consideration was given in using standard cast-in-place concrete cantilever (T-type) with spread footings, however, it was ruled out due to low bearing resistance and excessive settlements of foundation soils. They would need to be supported on driven piles or drilled shafts. Driven piles are not considered due to noise and vibration concerns so drilled shafts placed on hardpan could be used. The proposed MSE wall is a feasible option but will require preloading or ground improvement with lightweight fill to satisfy the maximum 1-inch settlement criterion due to the roadway.

The following sections present the results of our geotechnical engineering analyses and recommendations for the MSE wall design and construction.

5.2 Bearing Resistance and External Stability Analyses

The MSE retaining wall base should be established a minimum of 3.5 feet below the finished grade at the front face of the wall. Based on the TSL plan, the proposed MSE wall base elevations varied between 577.84 and 592.25 feet. Based on our boring data, the foundation soils at the MSE wall base elevations includes about 6 to 19 feet of medium stiff to hard fill and native clayey soils followed by up to 40 feet of soft to medium stiff clay to silty clay. We estimate the foundation soils will have a nominal bearing resistance of 4,500 psf and a factored bearing resistance of 2,900 psf based on a geotechnical resistance factor of 0.65 (AASHTO 2014).

We assumed a reinforcement length equal to 70 percent of the total wall height or a minimum of 8 feet. We note that there will be an overlap in reinforcement between Stations 1404+89 and 1404+50 due to the proposed ramp roadway width of 29.2 feet. At the highest portion of the wall near Station 1404+81, the wall will apply a maximum factored bearing pressure of 6,700 psf with a regular MSE wall fill material (unit weight is 125 pcf) which exceeds the factored bearing resistance available. To reduce the applied wall pressure, we have considered Class III Lightweight Cellular Concrete Fill (LCCF) with unit weight of 42 pcf. We estimate the wall with Class III LCCF will apply a maximum equivalent factored bearing pressure of 2,600 psf, thus the foundation soils will have sufficient bearing resistance to support the wall. For further analyses, we have considered Class III LCCF as MSE wall fill material and embankment fill between the MSE walls.

The estimated friction angle between an MSE wall base and underlying cohesive soil is 30º, and the corresponding friction coefficient is 0.58. MSE retaining walls are designed based on a geotechnical sliding resistance factor of 1.0 for soil-on-soil contact (AASHTO 2014). The resistance load against failure by sliding was calculated to be more than factored horizontal load without passive pressure in front of the wall; therefore the wall will be stable against sliding.

For the overturning/eccentricity, our analyses show the location of the resultant of reaction forces was found to be within middle two-thirds of the base width.

5.3 Settlement Analyses

We performed settlement analyses using data from Boring 1714-B-02 since it is more conservative and closest to the maximum height of the wall near Station 1404+81. We estimate the wall with Class III LCCF fill material will apply a maximum service pressure of 1,400 psf. In addition, we also performed settlement analysis near Station 1404+50 with a maximum service pressure of 850 psf. We calculated the corresponding long-term settlement of cohesive foundation soils using IDOT *Spreadsheet for Cohesive Soils* dated December 9, 2014 as well as hand calculations using consolidation properties obtained from laboratory test results.

Our settlement analyses indicate the walls will undergo about 2.1 inches of long-term settlement from the underlying cohesive soils near Station 1404+81 and about 0.9 inches near Station 1404+50, thus settlement governs the design. We estimate the soil will achieve 50% of primary consolidation settlement in 12 months and 90% of primary consolidation in 56 months. To reduce settlements to acceptable range of 1-inch for the roadway, we recommend either with preloading for 12 months or ground improvement by use of aggregate columns.

If at least 12 months is available after construction of ramp embankment and MSE Wall 48 without face panels before pavement placement, then the preloading is a viable option to reach the acceptable settlement for the roadway; however, it is our understanding that the required preloading period of 12 months may not be available due to construction constraints.

The installation of aggregate columns will create a composite material of lower overall compressibility and higher shear strength than the native soil thus increasing bearing capacity. Aggregate columns will also increase time rate of settlement, reduce total and differential settlements, and improve slope stability (FHWA 1983). The specialty contractor should design for the equivalent uniform service pressure of 1,400 psf at the proposed MSE wall base elevations. The estimated equivalent uniform service pressure includes a uniform surcharge of 250 psf and considers Class III LCCF (unit weight of 42 pcf) for the MSE wall reinforced zone and horizontal grade behind the wall.

A factor of safety of 2.5 should be considered. Based on our settlement analyses, we estimate ground improvement will be required between Stations 1404+50 and 1404+89. The design and construction of aggregate columns should be as per IDOT Special Provision GBSP No. 71 *Aggregate Column Ground Improvement*.

Removal and replacement with lightweight fill in lieu of the aggregate columns under the MSE wall was also considered but was found to require over 10 feet of deep replacement to reduce settlements to maximum 1-inch, making it not feasible.

5.4 Global Stability Analyses

Global stability analysis of the MSE walls was performed based on the soil conditions encountered along the abutment for the end wall. The global stability was analyzed using Slide Version 6.0 for both short-term (undrained) and long-term (drained) soil conditions as reported in Appendix C. The minimum required FOS against global instability according to IDOT is 1.5 for both conditions considering Class III MSE wall fill material. We estimate the wall has minimum undrained and drained FOS values of 1.9 and 3.7, respectively. The FOS meets the required minimum FOS of 1.5. Details of the global stability analysis are presented in Appendix C.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Excavation

Any required excavations should be performed in accordance with local, state, and federal regulations including current OSHA regulations. The potential effect of ground movements upon nearby structures and utilities should be considered during construction. Any open excavation to a depth of 4 feet should have a slope of 1:1.5 (V:H) for cohesive soils and 1:2 (V:H) for granular soils or flatter.

6.2 Dewatering

Based on the results of our investigation and proposed excavation for the wall, perched water is likely to be encountered during construction during times of heavy precipitation which should be removed through conventional sump and pump methods.

6.3 Filling and Backfilling

All fill and backfill materials will be as per IDOT *Standard Specification for Road and Bridge Construction* (IDOT 2016).

6.4 Wall Construction

The wall should be constructed as per IDOT *Standard Specification for Road and Bridge Construction* (IDOT 2016) and IDOT special provisions for *Mechanically Stabilized Earth Retaining Walls* (IDOT 2015). Class III LCCF should be as per IDOT District One special provision.

6.5 Construction Monitoring

There is no need for special construction monitoring for the retaining wall except normally required by the IDOT *Standard Specification for Road and Bridge Construction* (IDOT 2016).

6.6 Aggregate Column Installation and Existing 84-inch Storm Sewer

Aggregate columns for the MSE wall ground improvements may be installed before or after the installation of the abutment drilled shafts to bedrock. If the aggregate columns are installed before the drilled shafts, precautions must be taken to ensure that the installed aggregate columns are not disturbed during the subsequent shaft installations – depending on the final layout of the aggregate columns and drilled shafts, casing of the drilled shafts may be needed throughout the aggregate column depths to prevent lateral relaxation of the aggregate. If aggregate columns are installed afterwards, drilled shafts must be designed to incorporate the additional lateral stresses induced by the aggregate column installation.

The east end of the MSE wall 48 ground improvements are very close to the existing 84-inch storm sewer tunnel. Precautions must be taken in order not to overstress the existing tunnel walls during the aggregate column installation. The Contractor should submit a plan for protecting and monitoring the sewer tunnel during the aggregate column installations.

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 Retaining Wall 48 (SN016-1835) are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist AECOM 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,
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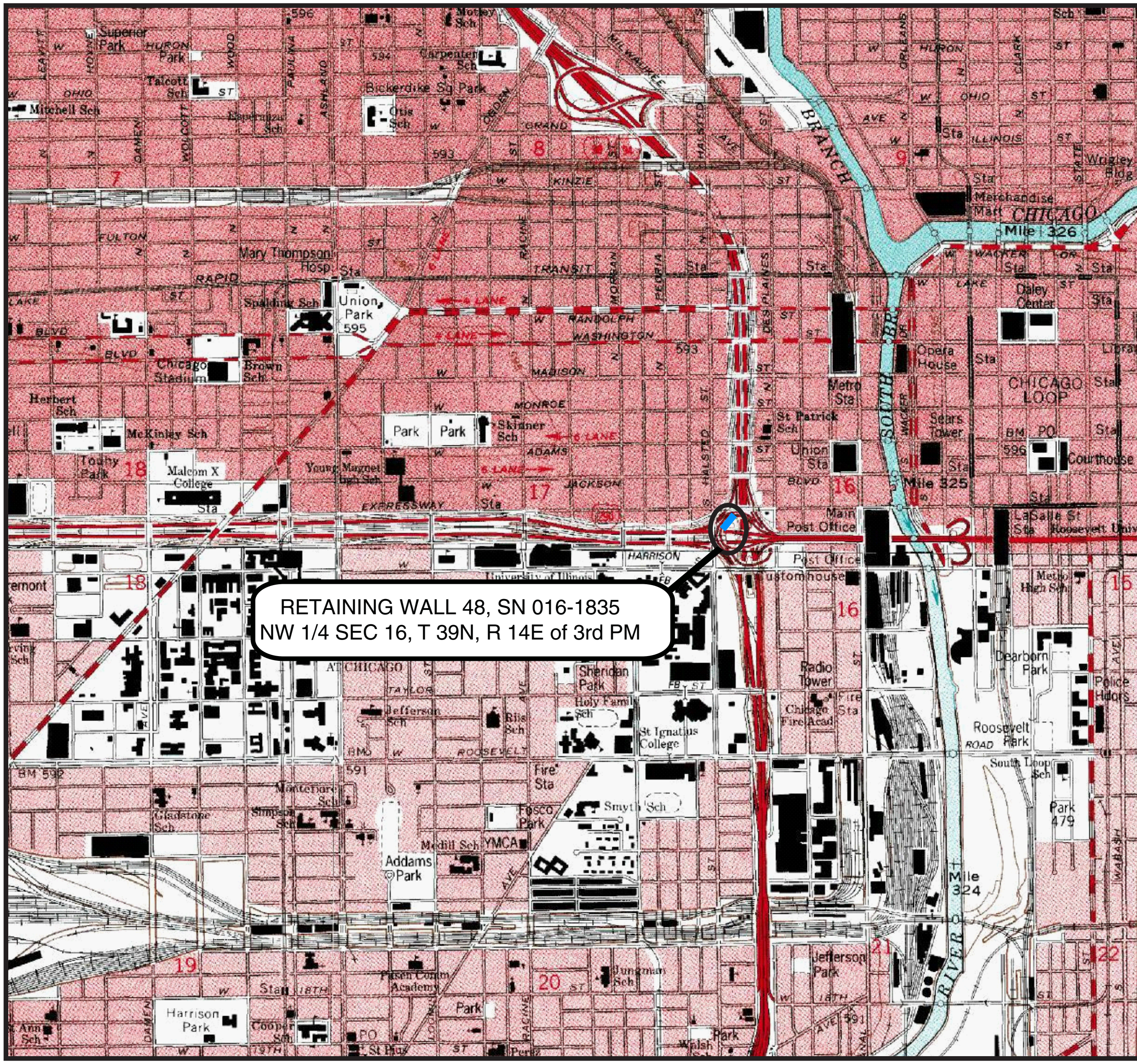
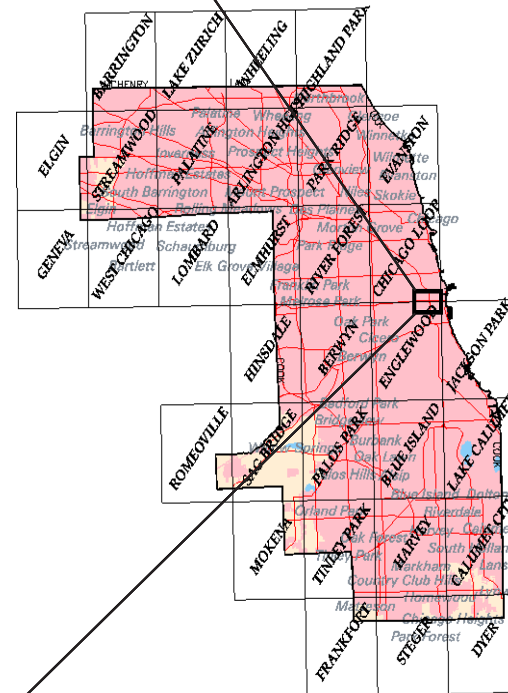
EXHIBITS



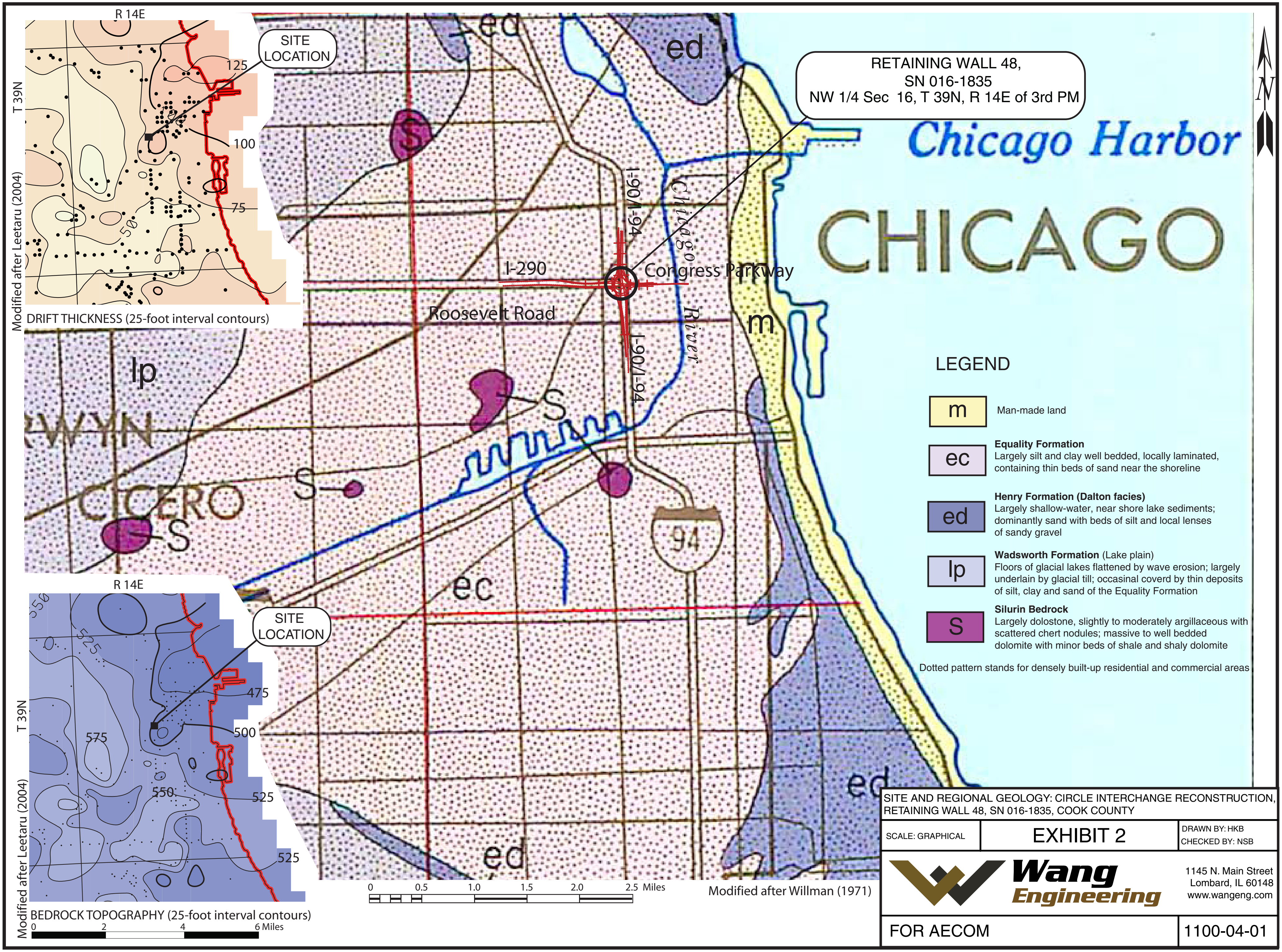
SCALE

0 0.25 0.5 Mile



Cook County

SITE LOCATION MAP: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 48, SN 016-1835, COOK COUNTY		
SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: HKB CHECKED BY: NSB
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01



SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 48, SN 016-1835, COOK COUNTY

SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: HKB CHECKED BY: NSB

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

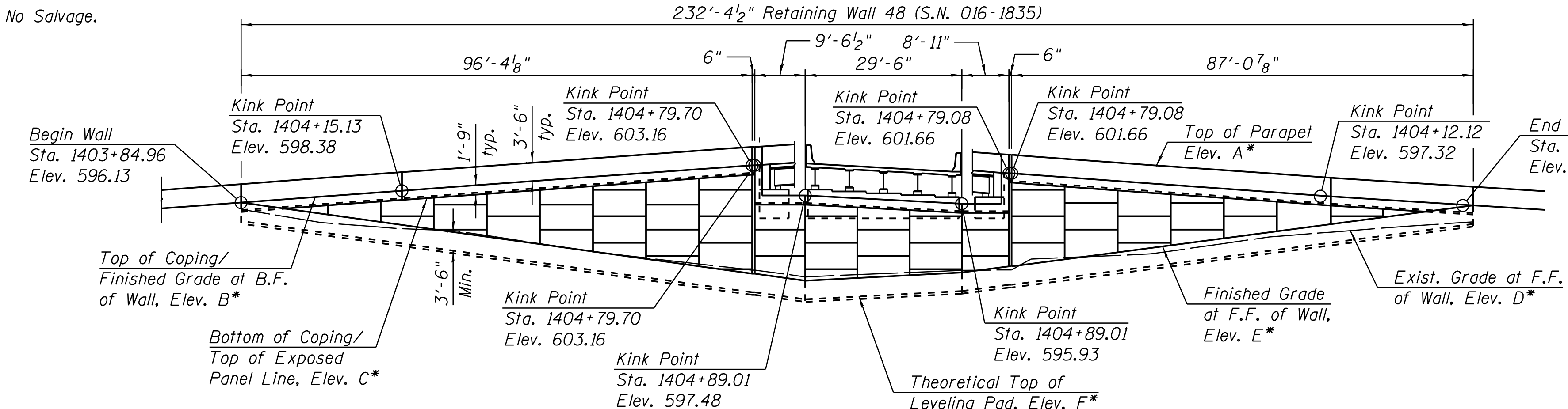
FOR AECOM	1100-04-01

Bench Mark: Chisel "X" on chain bolt of fire hydrant in front of 555 W. Harrison St. Elev. 594.46.

Existing Structure: None.

The existing bridge will be closed and traffic will be detoured during construction. Traffic on I-290 and I-90/94 will be maintained with stage construction.

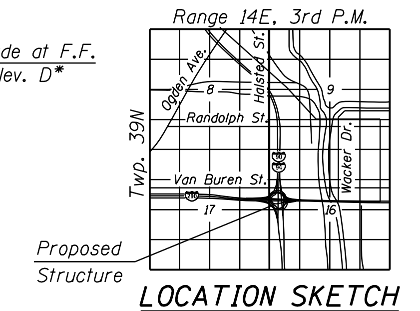
No Salvage.



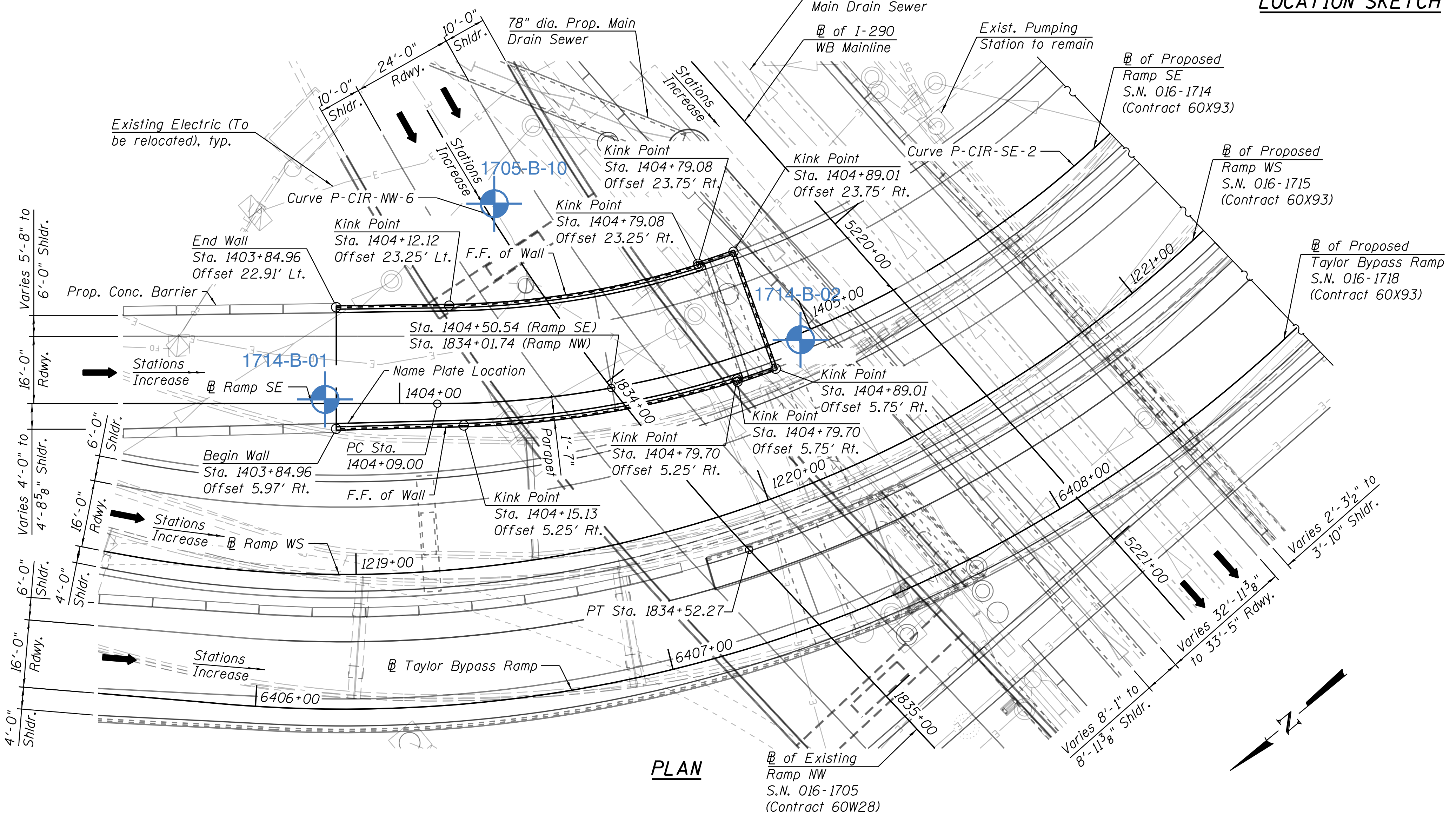
* For elevations, see Table 1 on Sheet 2 of 2.

ELEVATION

(Looking at F.F. of Wall)



LOCATION SKETCH



PLAN

NOTES:

1. Wall offsets are measured from the ℄ of Ramp SE to the front face of precast panels.
2. F.F. denotes Front Face.
3. B.F. denotes Back Face.

HIGHWAY CLASSIFICATION

Ramp SE	Ramp NW
Functional Class: Interstate	Functional Class: Interstate
ADT: 4,600 (2010); 5,000 (2040)	ADT: 32,500 (2012); 36,000 (2040)
ADTT: 123 (2012); 134 (2040)	ADTT: 2,483 (2012); 2,750 (2040)
DHV: 440 (2040)	DHV: 2,790 (2040)
Design Speed: 25 m.p.h.	Design Speed: 35 m.p.h.
Posted Speed: 25 m.p.h.	Posted Speed: 35 m.p.h.
One-Way Traffic	One-Way Traffic
Directional Distribution: 100%	Directional Distribution: 100%

CURVE DATA

(Ramp SE)

P-CIR-SE-2
P.I. Sta. = 1415+83.08
Δ = 157°44'18" (LT)
D = 24°48'12"
R = 231.00'
T = 1174.08'
L = 635.96'
E = 965.59'
e = 5.6%
T.R. = NA
S.E. Run = 128'
P.C. Sta. = 1404+09.00
P.T. Sta. = 1410+44.95

CURVE DATA

(Ramp NW)

P-CIR-NW-6
P.I. Sta. = 1831+44.22
Δ = 88°30'25" (LT)
D = 10°36'37"
R = 540.00'
T = 526.11'
L = 834.16'
E = 213.92'
e = 5.4%
T.R. = NA
S.E. Run = 66'
P.C. Sta. = 1826+18.11
P.T. Sta. = 1834+52.27

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications 7th Edition with 2015 and 2016 Interim Specifications

DESIGN STRESSES

FIELD UNITS

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

PRECAST UNITS

f'c = 4,500 psi

WALL DEFLECTION CRITERIA:

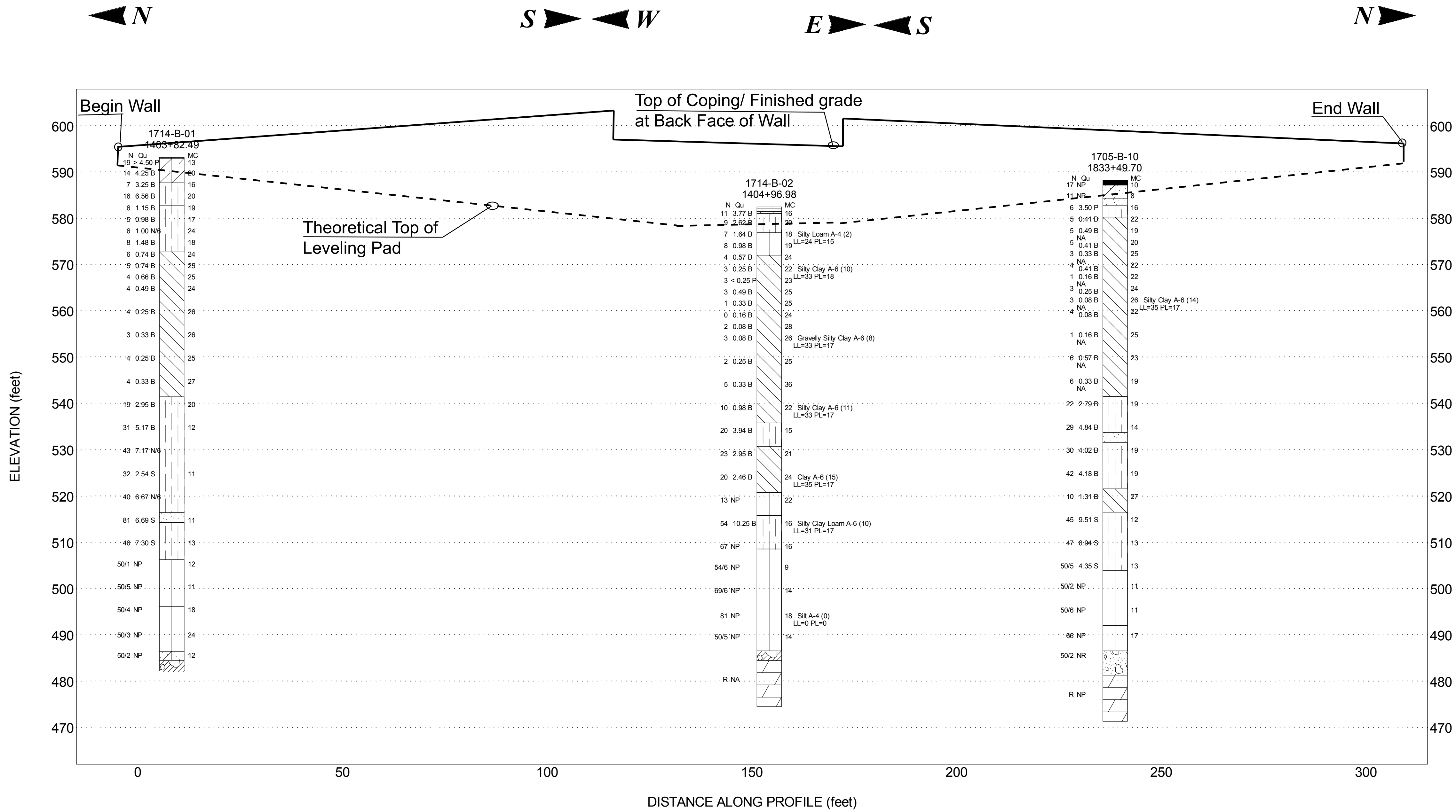
Maximum total lateral wall deflection at top of wall: _ inch.

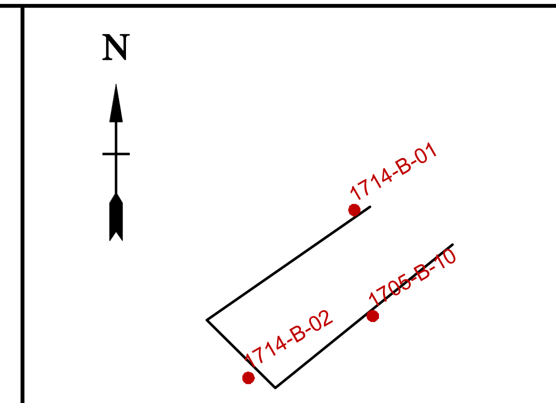
LEGEND

Electric
Prop. Storm Sewer
Exist. Storm Sewer
Light Pole
Soil Boring

BORING LOCATION PLAN: CIRCLE INTERCHANGE RECONSTRUCTION RETAINING WALL 48, SN 016-1835, COOK COUNTY		
SCALE: GRAPHICAL	EXHIBIT 3	DRAWN BY: HKB CHECKED BY: NSB
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01

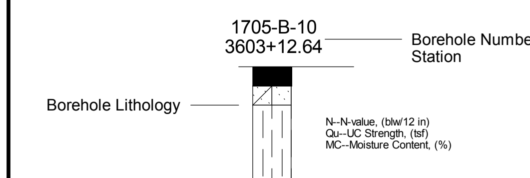
GENERAL PLAN AND ELEVATION
RETAINING WALL 48 ALONG
F.A.I. 94 (I-90/94 SB TO I-290 EB)
SECTION 2014-013 R&B-R
COOK COUNTY
STATION 1403+84.96 TO STATION 1404+89.01
STRUCTURE NO. 016-1835





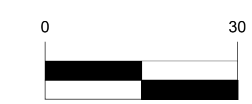
Site Map Scale 1 inch equals 110 feet

Explanation:



Water Level Reading at time of drilling.

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



Horizontal Scale (feet)

Vertical Exaggeration: 1x

Lithology Graphics

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

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

Soil Profile
Retaining Wall 48; SN 016-1835

WEI SINCE 1982

Circle Interchange Reconstruction
Section 17, T39N, R14E of 3rd PM

JOB NUMBER	PLATE NUMBER
1100-04-01	EXHIBIT 4

WEI 11X17 11000401.GPJ WANGENG.GDT 5/26/17

APPENDIX A

Wang Engineering
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Lombard, IL 60148
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Fax: 630 953-9938

BORING LOG 1705-B-10

WEI Job No.: 1100-04-01

Client **AECOM**
Project **Circle Interchange Reconstruction**
Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 588.29 ft
North: 1898131.01 ft
East: 1171315.43 ft
Station: 1833+49.70
Offset: 2.5590 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	12-inch thick, dark brown LOAM --TOPSOIL--					
587.3	Medium dense, brown LOAM, trace gravel, crushed stone, and brick fragments --FILL--		1	4 10 7	NP	10
584.3	Medium dense, brown SAND --FILL--	5	2	9 6 5	NP	8
582.8	Very stiff, gray SILTY CLAY, trace gravel		3	3 3 3	3.50 P	16
580.3	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel	10	4	3 2 3	0.41 B	22
			5	1 2 3	0.49 B	19
	--In-Situ Vane Shear, 13.0 feet-- --$S_{u\ undis}$ = 1061.9 psf-- --$S_{u\ remold}$ = 543.9 psf-- --Sensitivity = 1.95--		1			
		15	6	2 2 3	0.41 B	20
			7	0 2 1	0.33 B	25
	--In-Situ Vane Shear, 18.0 feet-- --$S_{u\ undis}$ = 1191.4 psf-- --$S_{u\ remold}$ = 543.9 psf-- --Sensitivity = 2.19--		2			
		20	8	1 2 2	0.41 B	22
			9	0 0 1	0.16 B	22
	--In-Situ Vane Shear, 23.0 feet-- --$S_{u\ undis}$ = 802.9 psf-- --$S_{u\ remold}$ = 414.4 psf-- --Sensitivity = 1.94--		3			
		25	10	0 2 1	0.25 B	24
	--L_L(%)=35, P_L(%)=17-- --%Gravel=2.9-- --%Sand=13.3-- --%Silt=49.9-- --%Clay=33.9-- --A-6 (14)--		11	1 1 2	0.08 B	26
	--In-Situ Vane Shear, 28.0 feet--		4			
	--$S_{u\ undis}$ = 699.3 psf-- --$S_{u\ remold}$ = 414.9 psf-- --Sensitivity = 1.69--	30	12	0 2 2	0.08 B	22
		35	13	0 0 1	0.16 B	25
	--In-Situ Vane Shear, 35.5 feet-- --$S_{u\ undis}$ = 880.6 psf-- --$S_{u\ remold}$ = 518.0 psf-- --Sensitivity = 1.70--		5			
		40	14	0 3 3	0.57 B	23

GENERAL NOTES

Begin Drilling **07-30-2013** Complete Drilling **08-01-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **mud in the borehole**
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 1705-B-10

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 588.29 ft
North: 1898131.01 ft
East: 1171315.43 ft
Station: 1833+49.70
Offset: 2.5590 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	--In-Situ Vane Shear, 40.5 feet-- --$S_{u\ undis}$ = 1809.5 psf-- --$S_{u\ remold}$ = 1137.4 psf-- --Sensitivity = 1.59--		6			
			15	2 2 4	0.33 B	19
	--In-Situ Vane Shear, 45.5 feet-- --$S_{u\ undis}$ = 2585.0 psf-- --$S_{u\ remold}$ = 1551.0 psf-- --Sensitivity = 1.66--	45	7			
541.5	Very stiff, gray SILTY CLAY, trace gravel					
		50	16	5 8 14	2.79 B	19
		55	17	8 12 17	4.84 B	14
533.8	Medium dense, gray, medium SAND					
531.5	Hard, gray SILTY CLAY, trace gravel and fine sand lenses					
		60	18	6 10 20	4.02 B	19
		65	18	5 12 30	4.18 B	19
521.5	Stiff, gray, laminated layers of CLAY and SILT					
		70	20	5 4 6	1.31 B	27
516.5	Hard, gray SILTY CLAY LOAM to SILTY LOAM, trace gravel					
		75	21	10 14 31	9.51 S	12
		80	22	18 22 25	8.94 S	13

GENERAL NOTES

Begin Drilling **07-30-2013** Complete Drilling **08-01-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **mud in the borehole**
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 1705-B-10

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 588.29 ft
North: 1898131.01 ft
East: 1171315.43 ft
Station: 1833+49.70
Offset: 2.5590 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type (recovery)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			SS	23	37 37 50/5	4.35 S	13
504.0	Very dense, gray SILT to SILTY LOAM, trace to some gravel	85					
	--HARD DRILLING (5 min/0.5')-- *--Possible Cobbles--*		SS	24	50/2	NP	11
		90					
	--HARD DRILLING-- *--Possible Cobbles--*		SS	25	50/6	NP	11
		95					
492.0	Very dense, gray SILT						
			SS	26	20 26 40	NP	17
		100					
486.5	Very dense, gray GRAVELLY SAND, trace cobbles --HARD DRILLING-- *--Possible Cobbles--*		SS	27	50/2	NR	
		105					
481.3	Strong, poor to fair rock quality, light gray, fresh, vertical and horizontal joints, joint breaks with little to no infill, horizontal stylolites, slightly vuggy DOLOSTONE		CORE	1	CORE	NP	
		110					
	--Run 1 - RECOVERY= 97.5%-- --RQD(top 5ft)=73%-- --RQD(10ft)=50%--						
		115					
471.3	Boring terminated at 117.00 ft						
		120					

GENERAL NOTES

Begin Drilling **07-30-2013** Complete Drilling **08-01-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **DRY**
At Completion of Drilling ▼ **mud in the borehole**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

0 3 6 9 12 inches

Boring 1705-B-10:
Run #1, 107' to 117', RECOVERY = 97.5% , RQD (Top 5ft)=73%, RQD (10ft)=50%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 48, SN 016-1835, COOK COUNTY		
SCALE: GRAPHICAL	1705-B-10	DRAWN BY: HKB CHECKED BY: NSB
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01

Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

BORING LOG 1714-B-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 593.22 ft
North: 1898191.77 ft
East: 1171304.89 ft
Station: 1403+82.49
Offset: 0.9133 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
593.0	3-inch thick, brown LOAM --TOPSOIL--					
	Hard, brown CLAY LOAM, trace gravel and brick fragments --FILL--		1	6 10 9	> 4.50 P	13
		5	2	7 7 7	4.25 B	20
587.7	Very stiff to hard, brown and gray SILTY CLAY, trace gravel --FILL--		3	3 3 4	3.25 B	16
		10	4	6 8 8	6.56 B	20
582.7	Medium stiff to stiff, gray SILTY CLAY, trace gravel		5	2 3 3	1.15 B	19
		15	6	2 2 3	0.98 B	17
			7	2 2 4	1.00 N/6	24
		20	8	2 4 4	1.48 B	18
572.7	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel		9	2 3 3	0.74 B	24
		25	10	2 3 2	0.74 B	25
			11	2 2 2	0.66 B	25
		30	12	2 2 2	0.49 B	24
		35	13	1 2 2	0.25 B	26
		40	14	1 1 2	0.33 B	26

GENERAL NOTES

Begin Drilling **10-16-2013** Complete Drilling **10-16-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
At Completion of Drilling **mud in the borehole**
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 1714-B-01

WEI Job No.: 1100-04-01

Client **AECOM**
Project **Circle Interchange Reconstruction**
Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 593.22 ft
North: 1898191.77 ft
East: 1171304.89 ft
Station: 1403+82.49
Offset: 0.9133 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type (recovery)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		45		15	2 2 2	0.25 B	25
		50		16	2 2 2	0.33 B	27
541.5	Very stiff to hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel						
		55		17	7 7 12	2.95 B	20
		60		18	16 15 16	5.17 B	12
		65		19	18 20 23	7.17 N/6	
		70		20	10 13 19	2.54 S	11
		75		21	12 17 23	6.67 N/6	
516.5	Gray SANDY LOAM --Wet--						
514.3	Hard, gray SILTY CLAY LOAM, trace gravel						
		80		22	33 41 40	6.69 S	11

GENERAL NOTES

Begin Drilling **10-16-2013** Complete Drilling **10-16-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
At Completion of Drilling **mud in the borehole**
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 1714-B-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 593.22 ft
North: 1898191.77 ft
East: 1171304.89 ft
Station: 1403+82.49
Offset: 0.9133 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		85	23	16 21 25	7.30 S	13
	--HARD DRILLING-- *--Possible Cobbles--*					
506.2	Very dense, gray SILTY LOAM, trace gravel and cobbles		24	50/1	NP	12
		90				
	--HARD DRILLING-- *--Possible Cobbles--*					
			26	50/5	NP	11
		95				
	--HARD DRILLING-- *--Possible Cobbles--*					
496.2	Very dense, gray SILT --Saturated--		27	50/4	NP	18
		100				
		105	28	30 45 50/3	NP	24
486.5	Very dense, gray GRAVELLY LOAM, trace pyrite and dolostone fragments					
484.5	--WEATHERED BEDROCK-- --ROLLER BIT REFUSAL--		29	50/2	NP	12
		110				
482.2	Boring terminated at 111.00 ft					
		115				
		120				

GENERAL NOTES

Begin Drilling **10-16-2013** Complete Drilling **10-16-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **mud in the borehole**
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 1714-B-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.53 ft
North: 1898095.52 ft
East: 1171244.20 ft
Station: 1404+96.98
Offset: 1.3189 RT

SOIL AND ROCK DESCRIPTION

Elevation (ft)	Soil and Rock Description
582.2	4-inch thick ASPHALT --PAVEMENT--
581.5	8-inch thick CONCRETE --PAVEMENT--
581.0	6-inch thick CRUSHED STONE --BASE COURSE--
	Very stiff, brown and gray SILTY CLAY LOAM, trace gravel --FILL--
577.0	Medium stiff to stiff, gray SILTY LOAM, trace gravel --L_L(%)=24, P_L(%)=15-- --%Gravel=14.0-- --%Sand=28.0-- --%Silt=45.7-- --%Clay=12.4--
572.0	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace to some gravel --L_L(%)=33, P_L(%)=18-- --%Gravel=10.6-- --%Sand=13.5-- --%Silt=45.8-- (15) --%Clay=30.1-- --A-6 (10)-- --L_L(%)=33, P_L(%)=17-- --%Gravel=23.0-- --%Sand=12.5-- --%Silt=38.7-- (30) --%Clay=25.9-- --A-6 (8)--

Depth markers (ft): 5, 10, 15, 20, 25, 30, 35, 40

Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
1	6, 5, 6	3.77 B	16
2	3, 4, 5	2.62 B	20
3	2, 3, 4	1.64 B	18
4	3, 4, 4	0.98 B	19
5	0, 2, 2	0.57 B	24
6	1, 1, 2	0.25 B	22
7	1, 1, 2	< 0.25 P	23
8	1, 1, 2	0.49 B	25
9	0, 0, 1	0.33 B	25
10	0, 0, 0	0.16 B	24
11	0, 0, 2	0.08 B	28
12	0, 1, 2	0.08 B	26
13	0, 0, 2	0.25 B	25
14	2, 2, 3	0.33 B	36

GENERAL NOTES

Begin Drilling: **10-08-2013** Complete Drilling: **10-08-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&R** Logger: **D. Kolpacki** Checked by: **C. Marin**
Drilling Method: **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **DRY**
At Completion of Drilling: **mud in the borehole**
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 1714-B-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.53 ft
North: 1898095.52 ft
East: 1171244.20 ft
Station: 1404+96.98
Offset: 1.3189 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	--L_L(%)=33, P_L(%)=17-- --%Gravel=8.5-- --%Sand=12.3-- --%Silt=46.1-- --%Clay=33.1-- --A-6 (11)--	45	15	2 4 6	0.98 B	22
535.8	Very stiff, gray SILTY CLAY, trace gravel					
		50	16	5 8 12	3.94 B	15
530.8	Very stiff, gray CLAY					
		55	17	4 9 14	2.95 B	21
	--L_L(%)=35, P_L(%)=17-- --%Gravel=2.9-- --%Sand=11.2--	60	18	6 8 12	2.46 B	24
	--%Silt=47.7-- --%Clay=38.2-- --A-6 (15)--					
520.8	Medium dense, gray SILT					
		65	19	8 7 6	NP	22
515.8	Hard, gray SILTY CLAY LOAM, trace gravel					
	--L_L(%)=31, P_L(%)=17-- --%Gravel=3.5-- --%Sand=14.1-- --%Silt=55.7-- --%Clay=26.7-- --A-6 (10)--	70	20	13 21 33	10.25 B	16
508.5	Very dense, gray SILT to SILTY LOAM, trace gravel	75	21	11 17 50	NP	16
			22	54/6	NP	9
		80				

GENERAL NOTES

Begin Drilling **10-08-2013** Complete Drilling **10-08-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR [78%]**
Driller **R&R** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **mud in the borehole**
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 1714-B-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.53 ft
North: 1898095.52 ft
East: 1171244.20 ft
Station: 1404+96.98
Offset: 1.3189 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			23	69/6	NP	14
		85				
	--%Gravel=1.9-- --%Sand=6.8-- --%Silt=83.8-- --%Clay=7.4-- --A-4 (0)--	90	24	31 45 36	NP	18
			25	50/5	NP	14
		95				
486.5	--HARD DRILLING-- --WEATHERED BEDROCK--					
484.5	Strong, white and light gray, rock quality, horizontally bedded DOLOSTONE, beds up to 18 inch, joint spacing up to 18 inch, joints with less than 0.2 inch or no infilling, vuggy and cherty, with stylolitic surfaces.	100	1	CORE		
	--Run 1 - RECOVERY= 93%-- --RQD= 86%--	105				
474.5	Boring terminated at 108.00 ft					
		110				
		115				
		120				

GENERAL NOTES

Begin Drilling	**10-08-2013**
Complete Drilling	**10-08-2013**
Drilling Contractor	**Wang Testing Services**
Drill Rig	**D-50 TMR [78%]**
Driller	**R&R**
Logger	**D. Kolpacki**
Checked by	**C. Marin**
Drilling Method	**3.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling	**DRY**
At Completion of Drilling	**mud in the borehole**
Time After Drilling	**NA**
Depth to Water	**NA**

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

0 3 6 9 12 inches

Boring 1714-B-02:
Run 1, 98' to 108', RECOVERY = 93%, RQD = 86%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 48, SN 016-1835, COOK COUNTY		
SCALE: GRAPHICAL	1714-B-02	DRAWN BY: HKB CHECKED BY: NSB
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FOR AECOM		1100-04-01

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BORING LOG VST-06

WEI Job No.: 1100-04-01

Client **AECOM**
Project **Circle Interchange Reconstruction**
Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 585.69 ft
North: 1898109.29 ft
East: 1171902.18 ft
Station: 5213+64.18
Offset: 85.921 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	Hard, brown SILTY CLAY LOAM, trace gravel --FILL--						
		5		1	7 6 6	> 4.50 P	16
580.2	Soft, gray SILTY CLAY LOAM			2	1 2 3	0.41 B	23
576.7		10					
	--In-Situ Vane Shear, 10.5 feet-- --$S_{u\ undis}$ = 972.0 psf-- --$S_{u\ remold}$ = 611.6 psf-- --Sensitivity = 1.6--			1	VS		
	--In-Situ Vane Shear, 13.0 feet-- --$S_{u\ undis}$ = 982.9 psf-- --$S_{u\ remold}$ = 589.7 psf-- --Sensitivity = 1.7--	15		2	VS		
	--In-Situ Vane Shear, 15.5 feet-- --$S_{u\ undis}$ = 873.7 psf-- --$S_{u\ remold}$ = 513.3 psf-- --Sensitivity = 1.7--			3	VS		
	--In-Situ Vane Shear, 18.0 feet-- --$S_{u\ undis}$ = 928.3 psf-- --$S_{u\ remold}$ = 360.4 psf-- --Sensitivity = 2.6--	20		4	VS		

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	--In-Situ Vane Shear, 20.5 feet-- --$S_{u\ undis}$ = 775.4 psf-- --$S_{u\ remold}$ = 360.4 psf-- --Sensitivity = 2.2--			5	VS		
	--In-Situ Vane Shear, 23.0 feet-- --$S_{u\ undis}$ = 600.6 psf-- --$S_{u\ remold}$ = 305.8 psf-- --Sensitivity = 2.0--	25		6	VS		
	--In-Situ Vane Shear, 25.5 feet-- --$S_{u\ undis}$ = 578.8 psf-- --$S_{u\ remold}$ = 316.7 psf-- --Sensitivity = 1.8--			7	VS		
	--In-Situ Vane Shear, 28.0 feet-- --$S_{u\ undis}$ = 611.6 psf-- --$S_{u\ remold}$ = 338.5 psf-- --Sensitivity = 1.8--	30		8	VS		
	--In-Situ Vane Shear, 30.5 feet-- --$S_{u\ undis}$ = 786.3 psf-- --$S_{u\ remold}$ = 382.2 psf-- --Sensitivity = 2.1--			9	VS		
	--In-Situ Vane Shear, 33.0 feet-- --$S_{u\ undis}$ = 698.9 psf-- --$S_{u\ remold}$ = 404.1 psf-- --Sensitivity = 1.7--	35		10	VS		
	--In-Situ Vane Shear, 35.5 feet-- --$S_{u\ undis}$ = 808.1 psf-- --$S_{u\ remold}$ = 502.4 psf-- --Sensitivity = 1.6--			11	VS		
	--In-Situ Vane Shear, 38.0 feet-- --$S_{u\ undis}$ = 982.9 psf-- --$S_{u\ remold}$ = 546.0 psf-- --Sensitivity = 1.8--	40		12	VS		

GENERAL NOTES

Begin Drilling **12-09-2015** Complete Drilling **12-14-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&N** Logger **F. Bozga** Checked by **A. Kurnia**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **mud in the borehole**
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 VST-06

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 585.69 ft
North: 1898109.29 ft
East: 1171902.18 ft
Station: 5213+64.18
Offset: 85.921 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--In-Situ Vane Shear, 40.5 feet-- --$S_{u\ undis}$ = 906.4 psf-- --$S_{u\ remold}$ = 524.2 psf-- --Sensitivity = 1.7--			13	VS		
	542.2	--In-Situ Vane Shear, 43.0 feet-- --$S_{u\ undis}$ = 677.1 psf-- --$S_{u\ remold}$ = 393.1 psf-- --Sensitivity = 1.7--			14	VS		
		Boring terminated at 43.50 ft	45					
			50					
			55					
			60					

GENERAL NOTES

Begin Drilling **12-09-2015** Complete Drilling **12-14-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&N** Logger **F. Bozga** Checked by **A. Kurnia**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
At Completion of Drilling **mud in the borehole**
Time After Drilling **NA**
Depth to Water **NA**

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BORING LOG 1703-PZ-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.49 ft
North: 1898127.96 ft
East: 1171807.47 ft
Station: 1104+74.81
Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--Drilled without sampling--	0–20					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Piezometer Data: *--Installed in Nov. 12, 2014* *--Bentonite Seal 70 to 72 feet* *--Top of Sand Pack at 72 feet* *--Top of Screen at 75.3 feet* *--Screen Length 20 feet* *--Bottom of Screen at 95.3 feet*	20					
		--piezometer stabilized water level reading -- --reading during well development (11/20/2014) = 32.00 feet bgs-- --reading date: 12/05/2014 = 31.10 feet bgs--	31–33					
			40					

GENERAL NOTES

Begin Drilling **11-10-2014** Complete Drilling **11-12-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR [100%]**
Driller **P&P** Logger **S. Woods** Checked by **CLM (-Coord)**
Drilling Method **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling ▽ **78 ?**
At Completion of Drilling ▼ **mud in the borehole**
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 1703-PZ-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.49 ft
North: 1898127.96 ft
East: 1171807.47 ft
Station: 1104+74.81
Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			45					
			50					
			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 (%)
			65					
			70					
		Piezometer Data: *--Installed in Nov. 12, 2014* *--Bentonite Seal 70 to 72 feet* *--Top of Sand Pack at 72 feet* *--Top of Screen at 75.3 feet* *--Screen Length 20 feet* *--Bottom of Screen at 95.3 feet*						
			75					
			80					

GENERAL NOTES

Begin Drilling **11-10-2014** Complete Drilling **11-12-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR [100%]**
Driller **P&P** Logger **S. Woods** Checked by **CLM (-Coord)**
Drilling Method **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling ▽ **78 ?**
At Completion of Drilling ▼ **mud in the borehole**
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 1703-PZ-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.49 ft
North: 1898127.96 ft
East: 1171807.47 ft
Station: 1104+74.81
Offset: 3.30157 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		85				
	Very dense, gray SILTY LOAM, trace gravel --Dry--	90	1	40 42 18/3	NP	13
		95	2	10 23 50/3	NP	20
	--Dolostone fragments--		3	15 30/2	NP	14
482.5		100				

Boring terminated at 100.00 ft

GENERAL NOTES

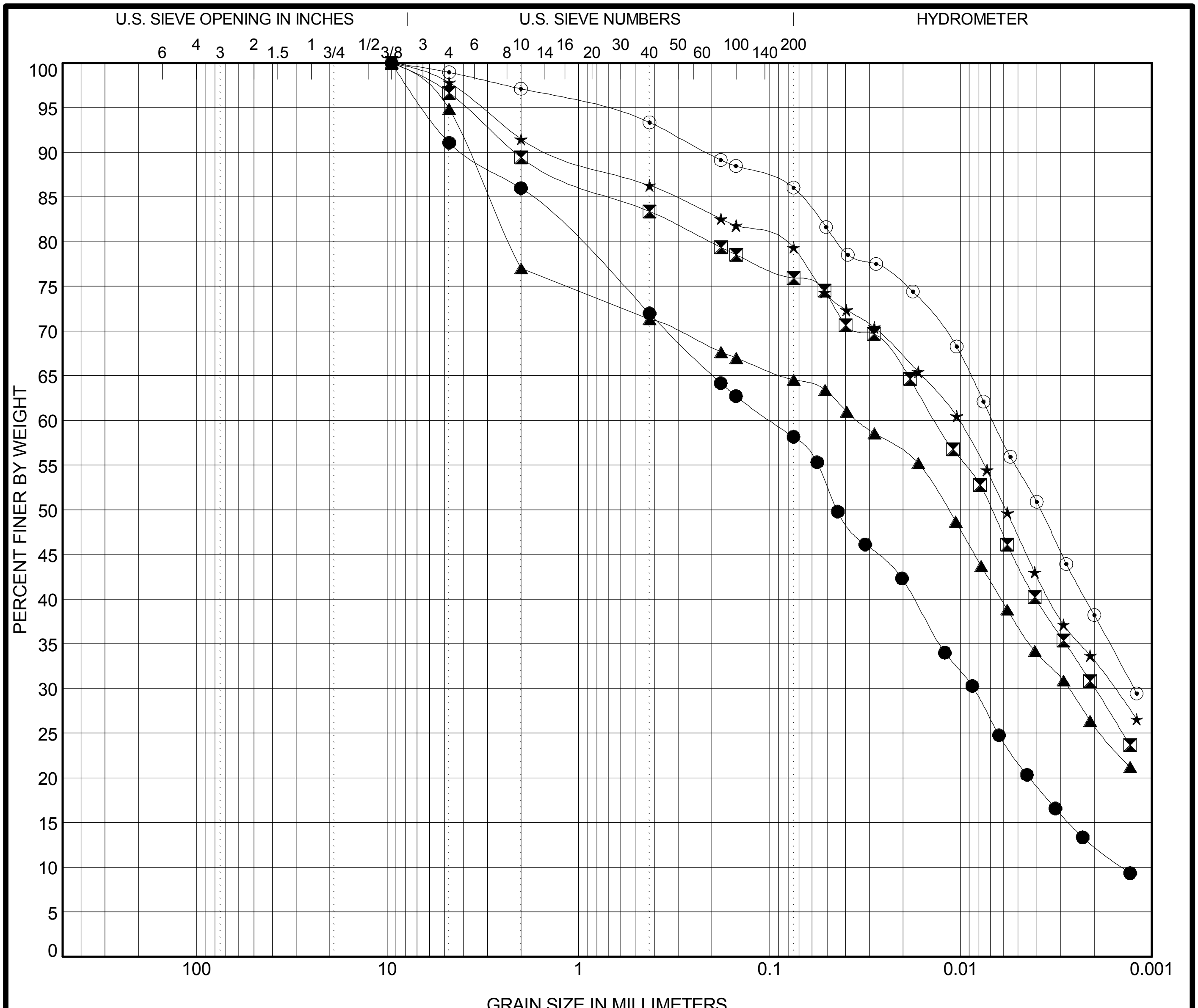
Begin Drilling **11-10-2014** Complete Drilling **11-12-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR [100%]**
Driller **P&P** Logger **S. Woods** Checked by **CLM (-Coord)**
Drilling Method **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling **78 ?**
At Completion of Drilling **mud in the borehole**
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
●	1714-B-02#3	6.0 ft	**Silty Loam**	24	15	9	0.52	69.46
⧗	1714-B-02#6	13.5 ft	**Silty Clay**	33	18	15		
▲	1714-B-02#12	28.5 ft	**Gravelly Silty Clay**	33	17	16		
★	1714-B-02#15	43.5 ft	**Silty Clay**	33	17	16		
⊙	1714-B-02#18	58.5 ft	**Clay**	35	17	18		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1714-B-02#3	6.0 ft	9.5	0.099	0.009	0.001	14.0	28.0	45.7	12.4
⧗	1714-B-02#6	13.5 ft	9.5	0.014	0.002		10.6	13.5	45.8	30.1
▲	1714-B-02#12	28.5 ft	9.5	0.034	0.003		23.0	12.5	38.7	25.9
★	1714-B-02#15	43.5 ft	9.5	0.01	0.002		8.5	12.3	46.1	33.1
⊙	1714-B-02#18	58.5 ft	9.5	0.007	0.001		2.9	11.2	47.7	38.2

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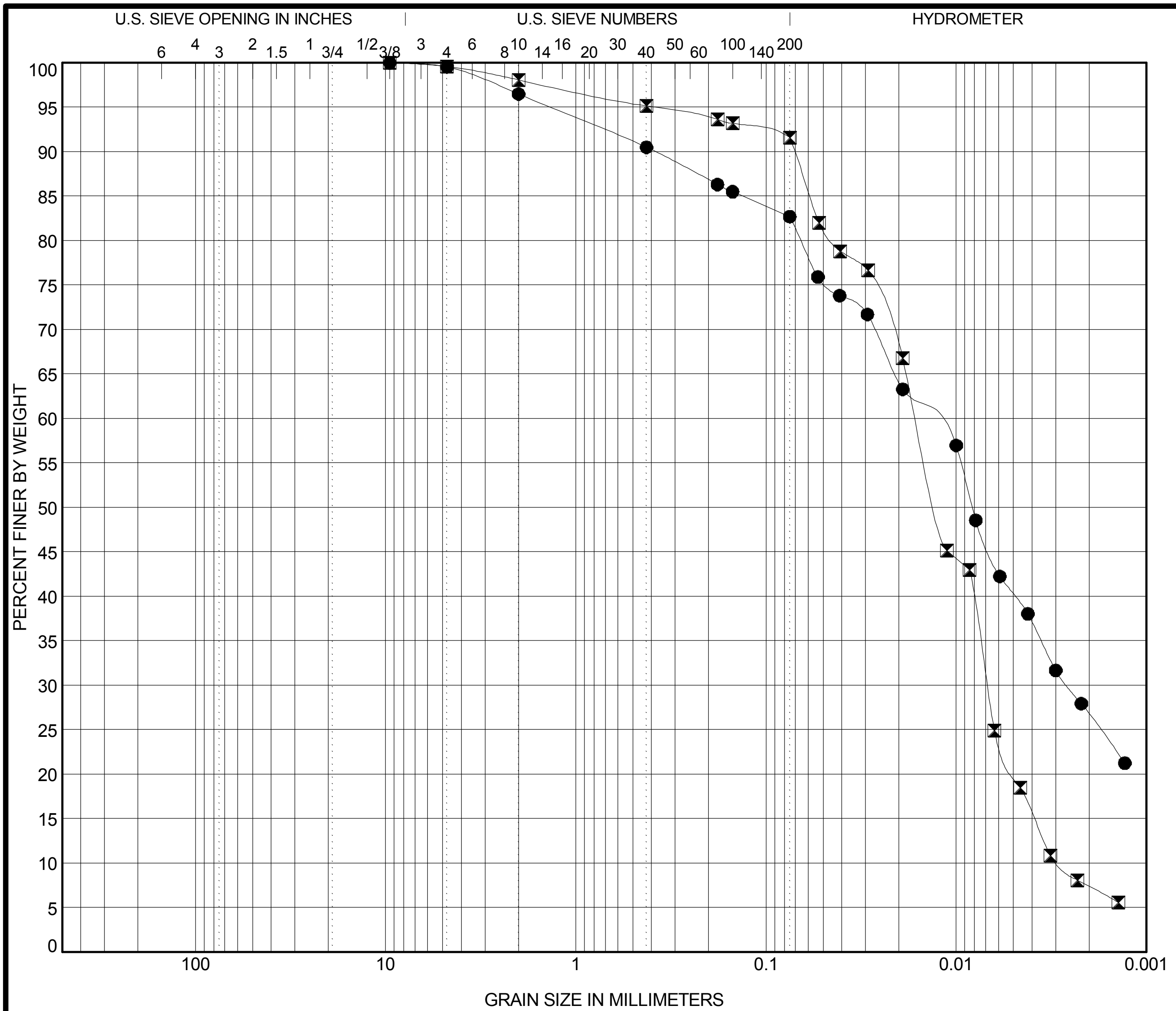
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01

WEI GRAIN SIZE IDH 11000401.GPJ US LAB.GDT 5/30/17



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification			IDH Classification	LL	PL	PI	Cc	Cu
●	**1714-B-02#20**	**68.5 ft**	**Silty Clay Loam**	**31**	**17**	**14**		
⧗	**1714-B-02#24**	**88.5 ft**	**Silt**	**NP**	**NP**	**NP**	**1.01**	**5.59**

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**1714-B-02#20**	**68.5 ft**	**9.5**	**0.014**	**0.003**		**3.5**	**14.1**	**55.7**	**26.7**
⧗	**1714-B-02#24**	**88.5 ft**	**9.5**	**0.016**	**0.007**	**0.003**	**1.9**	**6.8**	**83.8**	**7.4**

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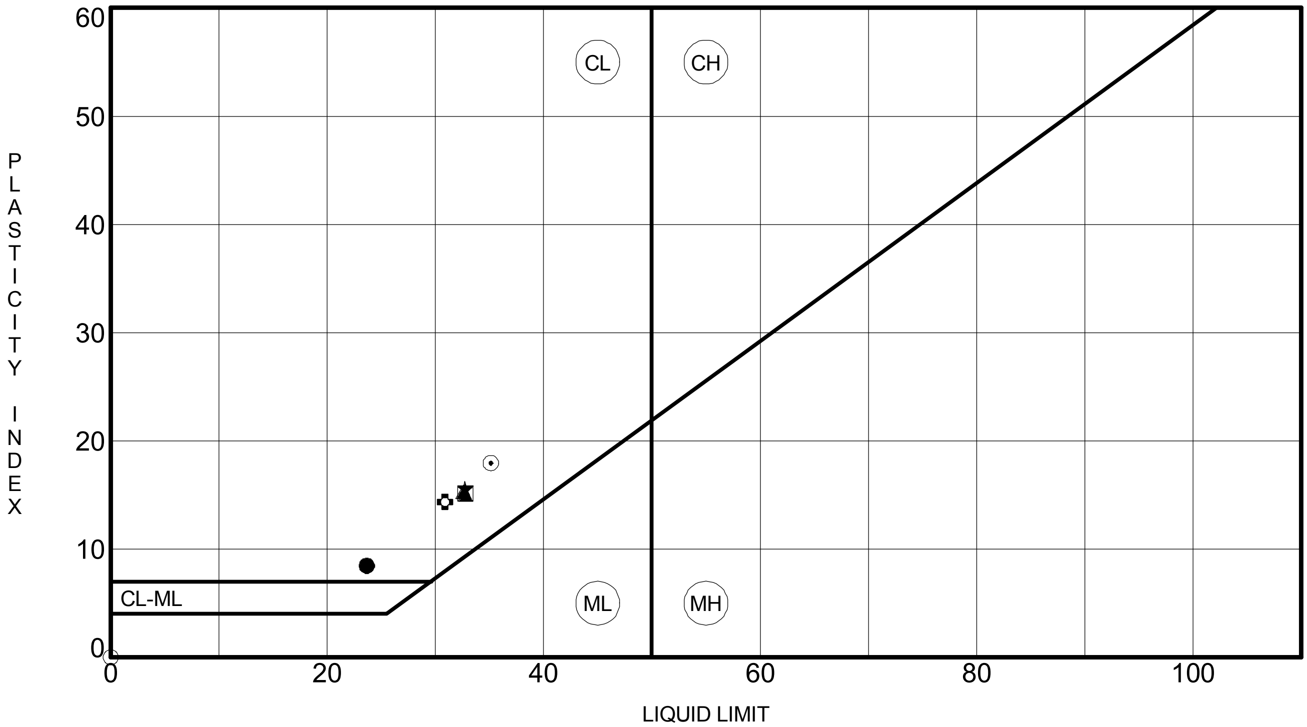
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	**1714-B-02#3**	**6.0 ft**	**24**	**15**	**9**	**58**	**Silty Loam**
⧗	**1714-B-02#6**	**13.5 ft**	**33**	**18**	**15**	**76**	**Silty Clay**
▲	**1714-B-02#12**	**28.5 ft**	**33**	**17**	**16**	**65**	**Gravelly Silty Clay**
★	**1714-B-02#15**	**43.5 ft**	**33**	**17**	**16**	**79**	**Silty Clay**
⊙	**1714-B-02#18**	**58.5 ft**	**35**	**17**	**18**	**86**	**Clay**
✿	**1714-B-02#20**	**68.5 ft**	**31**	**17**	**14**	**83**	**Silty Clay Loam**
○	**1714-B-02#24**	**88.5 ft**	**NP**	**NP**	**NP**	**92**	**Silt**

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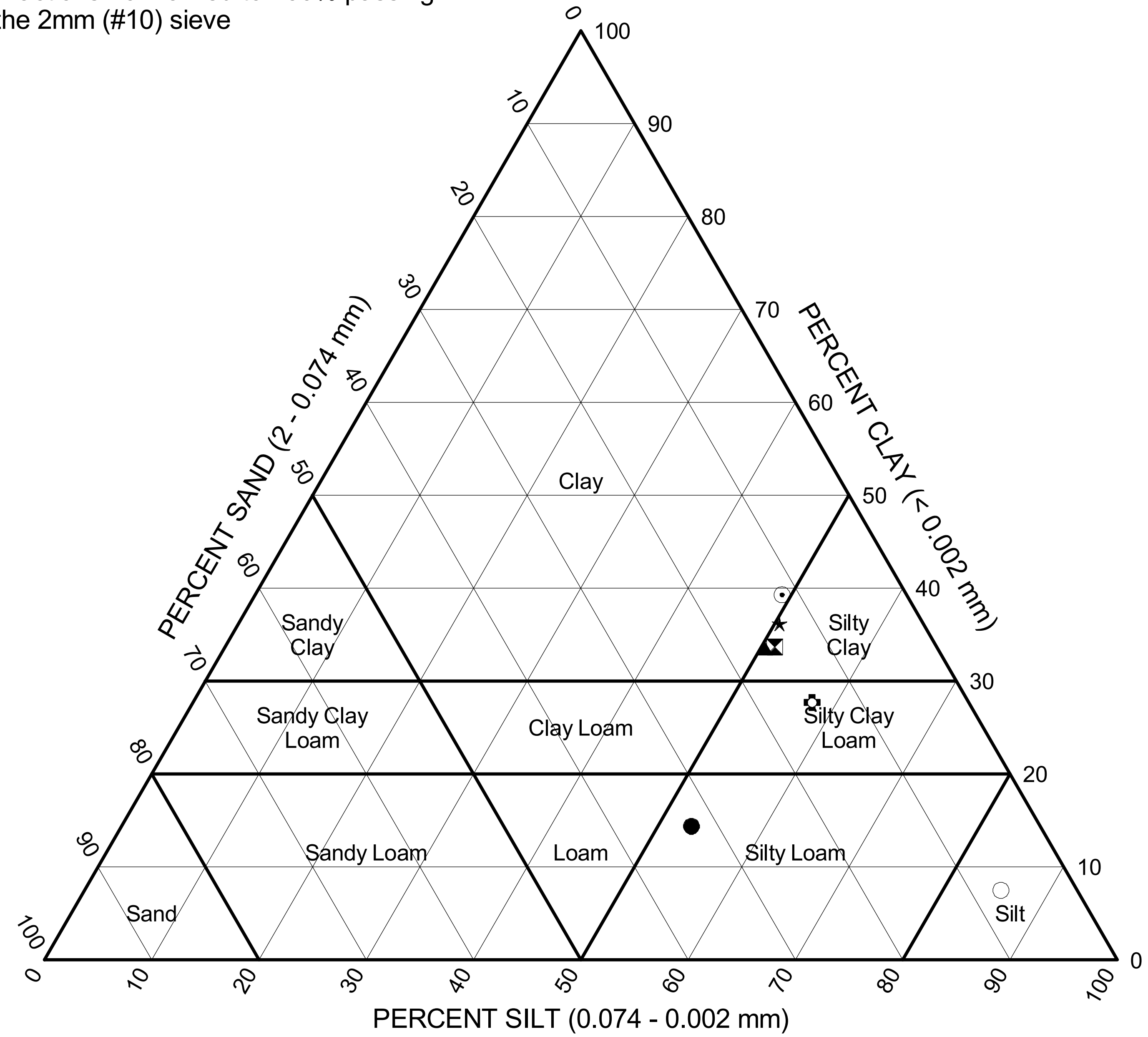
ATTERBERG LIMITS' RESULTS

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01

Fractions normalized to 100% passing the 2mm (#10) sieve



	Sample	Depth (ft)	Sand (%)	Silt (%)	Clay (%)	Classification		
						IL DOT	AASHTO	ASTM
●	1714-B-02#3	6.0	32.6	53.1	14.4	Silty Loam	A-4 (2)	CL
⧗	1714-B-02#6	13.5	15.1	51.2	33.7	Silty Clay	A-6 (10)	CL
▲	1714-B-02#12	28.5	16.2	50.3	33.6	Gravelly Silty Clay	A-6 (8)	CL
★	1714-B-02#15	43.5	13.4	50.4	36.2	Silty Clay	A-6 (11)	CL
⊙	1714-B-02#18	58.5	11.5	49.1	39.3	Clay	A-6 (15)	CL
✿	1714-B-02#20	68.5	14.6	57.7	27.7	Silty Clay Loam	A-6 (10)	CL
○	1714-B-02#24	88.5	6.9	85.4	7.5	Silt	A-4 (0)	ML

WEI_IDH 11000401.GPJ WANGENG.GDT 5/30/17

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IDH Textural Classification Chart

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01

Wang Engineering
1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

ONE-DIMENSIONAL CONSOLIDATION TEST
AASHTO T 216 / ASTM D 2435

Project: Circle Interchange
Client: AECOM
Soil Sample ID: Boring 02-RWB-06ST, ST#2, 18' to 20'
Sample Description: Gray LEAN CLAY with trace gravel (CL)
Tested by: M. Snider
Prepared by: M. Snider
Test date: 7/30/2013
WEI: 1100-04-01

Initial sample height =	1.001 in	Ring diameter =	2.495 in
Initial sample mass =	161.06 g	Ring mass =	109.95 g
Initial water content =	26.27%	Initial sample and ring mass =	271.01 g
Initial dry unit weight =	99.30 pcf	Tare mass =	14.22 g
Initial void ratio =	0.747	Final ring and sample mass =	263.63 g
Initial degree of saturation =	97.79%	Mass of wet sample and tare =	167.62 g
		Mass of dry sample and tare =	141.77 g
Final sample mass =	153.40 g	Initial dial reading =	0.01000 in
Final dry sample mass =	127.55 g	Final dial reading =	0.13366 in
Final water content =	20.27%	LL=	35 %
Final dry unit weight =	113.30 pcf	PL=	17 %
Final void ratio =	0.531	% Sand=	16.6 %
Final degree of saturation =	100.00%	% Silt=	51.4 %
Estimated specific gravity =	2.78	% Clay=	28.8 %
		In-Situ Vertical Effective Stress =	2100 psf

Compression and Swelling Indices

Compression index C_c = 0.208
Field corrected C_c = 0.240
Swelling index C_s = 0.038

Preconsolidation pressure,s_C
Casagrande Method = 3292 psf
Over-Consolidation Ratio (OCR) = 1.57

Load number	Vertical stress psf	Dial reading in	System deflection in	Vertical strain %	Void ratio	C_v ft^2/day	Cae %	Elapsed time min
1	100.0	0.01159	0.00010	0.17	0.744	N/A	N/A	1440
2	200.0	0.01313	0.00023	0.34	0.741	0.1560	0.08	1140
3	500.0	0.01977	0.00058	1.03	0.729	0.1392	0.10	1440
4	1000.0	0.02748	0.00090	1.84	0.715	0.1326	0.08	1380
5	2000.0	0.03883	0.00135	3.01	0.694	0.1464	0.17	1320
6	4000.0	0.06033	0.00193	5.22	0.656	0.1196	0.33	960
7	8000.0	0.08974	0.00253	8.22	0.603	0.0960	0.39	1440
8	16000.0	0.12525	0.00324	11.84	0.540	0.1022	0.43	1440
9	32000.0	0.15997	0.00413	15.39	0.478	0.1600	0.42	1440
10	8000.0	0.15965	0.00295	15.24	0.481	N/A	N/A	480
11	2000.0	0.14762	0.00198	13.95	0.503	N/A	N/A	2820
11	500.0	0.13528	0.00123	12.64	0.526	N/A	N/A	1440

Prepared by: ______________________ Date: ______________

Checked by: ______________________ Date: ______________

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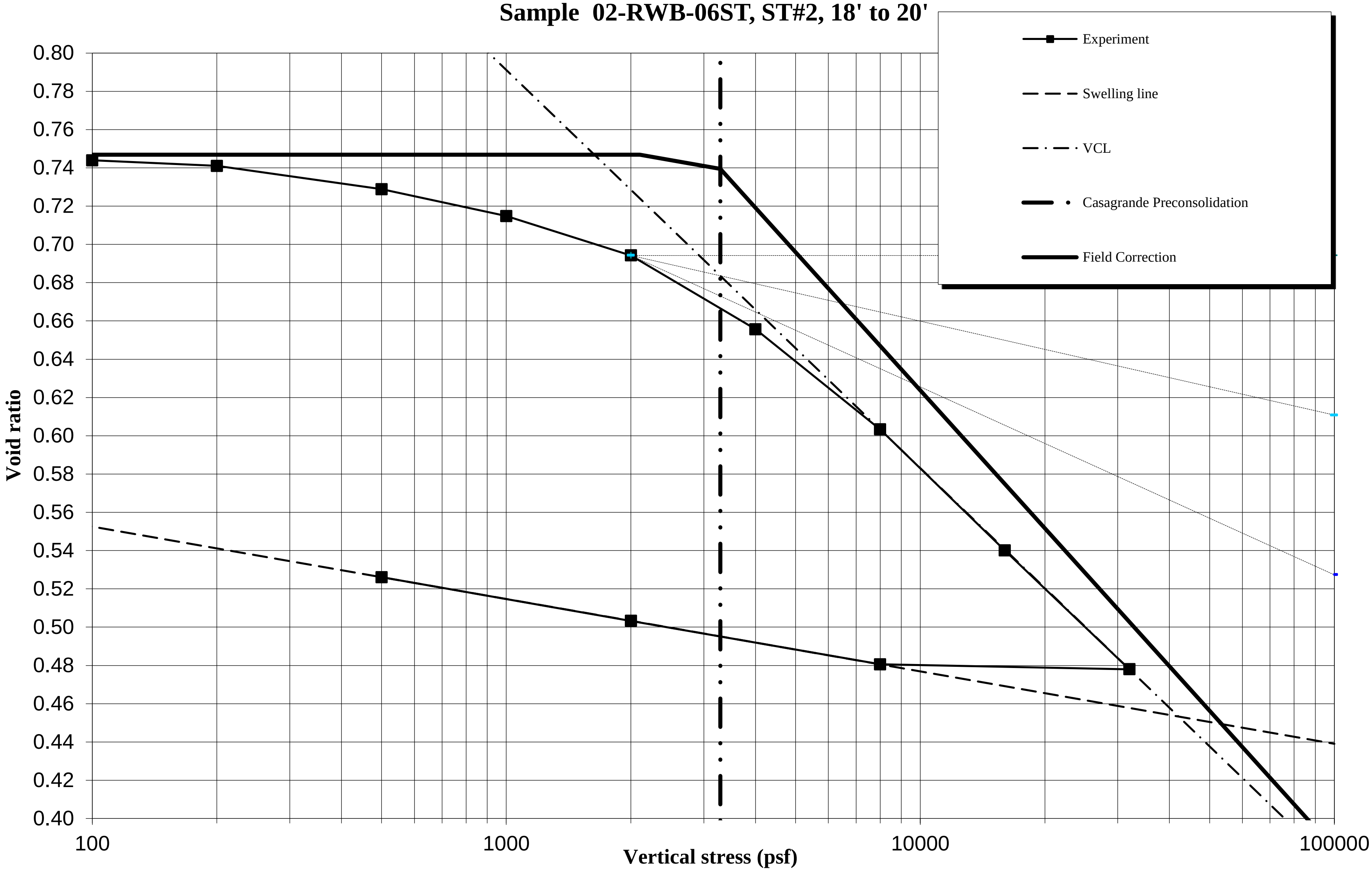
CONSOLIDATION CURVE

Sample 02-RWB-06ST, ST#2, 18' to 20'



s:\netprojects\1870701\consolidation\ch13\lws_wang_mls_1870701consol_40to42feet_120910.xls

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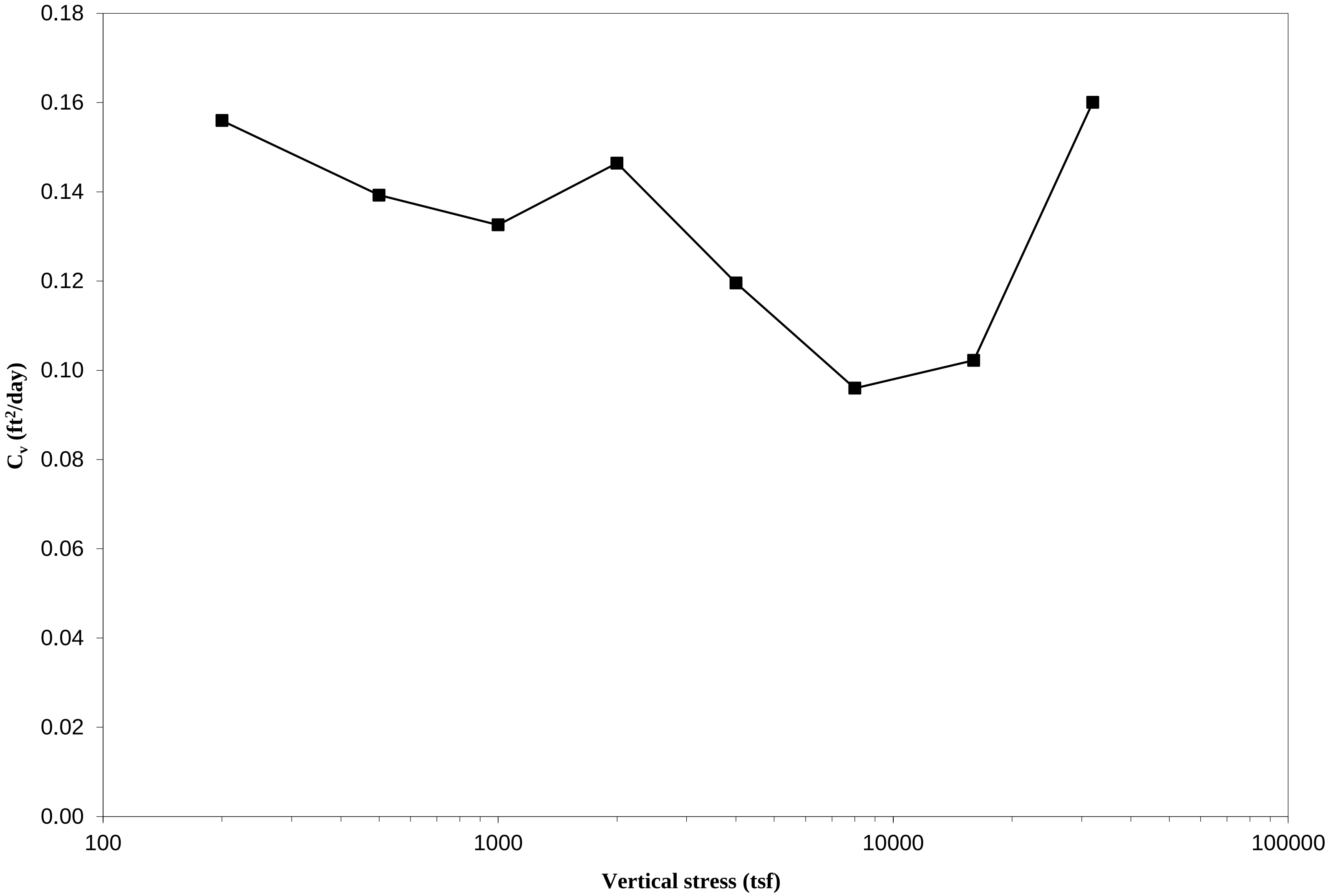
CONSOLIDATION COEFFICIENT (C_v) vs. VERTICAL STRESS

Sample 02-RWB-06ST, ST#2, 18' to 20'



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ONE-DIMENSIONAL CONSOLIDATION TEST
AASHTO T 216 / ASTM D 2435

Project: Circle Interchange
Client: AECOM
Soil Sample ID: Boring 1705-B05A, ST#3, 25' to 27'
Sample Description: Gray LEAN CLAY with trace gravel (CL)

Tested by: M. Snider
Prepared by: M. Snider
Test date: 7/30/2013
WEI: 1100-04-01

Initial sample height =	0.997 in	Ring diameter =	2.496 in
Initial sample mass =	160.54 g	Ring mass =	109.55 g
Initial water content =	25.63%	Initial sample and ring mass =	270.09 g
Initial dry unit weight =	99.81 pcf	Tare mass =	13.58 g
Initial void ratio =	0.738	Final ring and sample mass =	262.68 g
Initial degree of saturation =	96.54%	Mass of wet sample and tare =	166.60 g
		Mass of dry sample and tare =	141.37 g
Final sample mass =	153.02 g	Initial dial reading =	0.01000 in
Final dry sample mass =	127.79 g	Final dial reading =	0.12368 in
Final water content =	19.74%	LL=	33 %
Final dry unit weight =	112.66 pcf	PL=	17 %
Final void ratio =	0.540	% Sand=	13.8 %
Final degree of saturation =	100.00%	% Silt=	49.3 %
Estimated specific gravity =	2.78	% Clay=	33.9 %

In-Situ Vertical Effective Stress = 2500 psf

Compression and Swelling Indices

Compression index C_c = 0.192
Field corrected C_c = 0.223
Swelling index C_s = 0.045

Preconsolidation pressure,s_C
Casagrande Method = 2886 psf
Over-Consolidation Ratio (OCR) = 1.15

Load number	Vertical stress psf	Dial reading in	System deflection in	Vertical strain %	Void ratio	C_v ft^2/day	Cae %	Elapsed time min
1	100.0	0.01019	0.00010	0.03	0.738	N/A	N/A	1440
2	200.0	0.01167	0.00023	0.19	0.735	0.1311	0.06	1140
3	500.0	0.01742	0.00058	0.80	0.724	0.1012	0.07	1440
4	1000.0	0.02494	0.00090	1.59	0.710	0.1030	0.09	1380
5	2000.0	0.03802	0.00135	2.95	0.687	0.1213	0.18	1350
6	4000.0	0.06526	0.00193	5.74	0.638	0.1031	0.37	960
7	8000.0	0.09293	0.00253	8.57	0.589	0.1018	0.36	1440
8	16000.0	0.12371	0.00324	11.73	0.534	0.1184	0.38	1440
9	32000.0	0.15605	0.00413	15.06	0.476	0.1519	0.39	1440
10	8000.0	0.15508	0.00295	14.85	0.480	N/A	N/A	480
11	2000.0	0.14033	0.00198	13.27	0.507	N/A	N/A	2820
11	500.0	0.12566	0.00123	11.72	0.534	N/A	N/A	1440

Prepared by: ______________________ Date: ______________

Checked by: ______________________ Date: ______________

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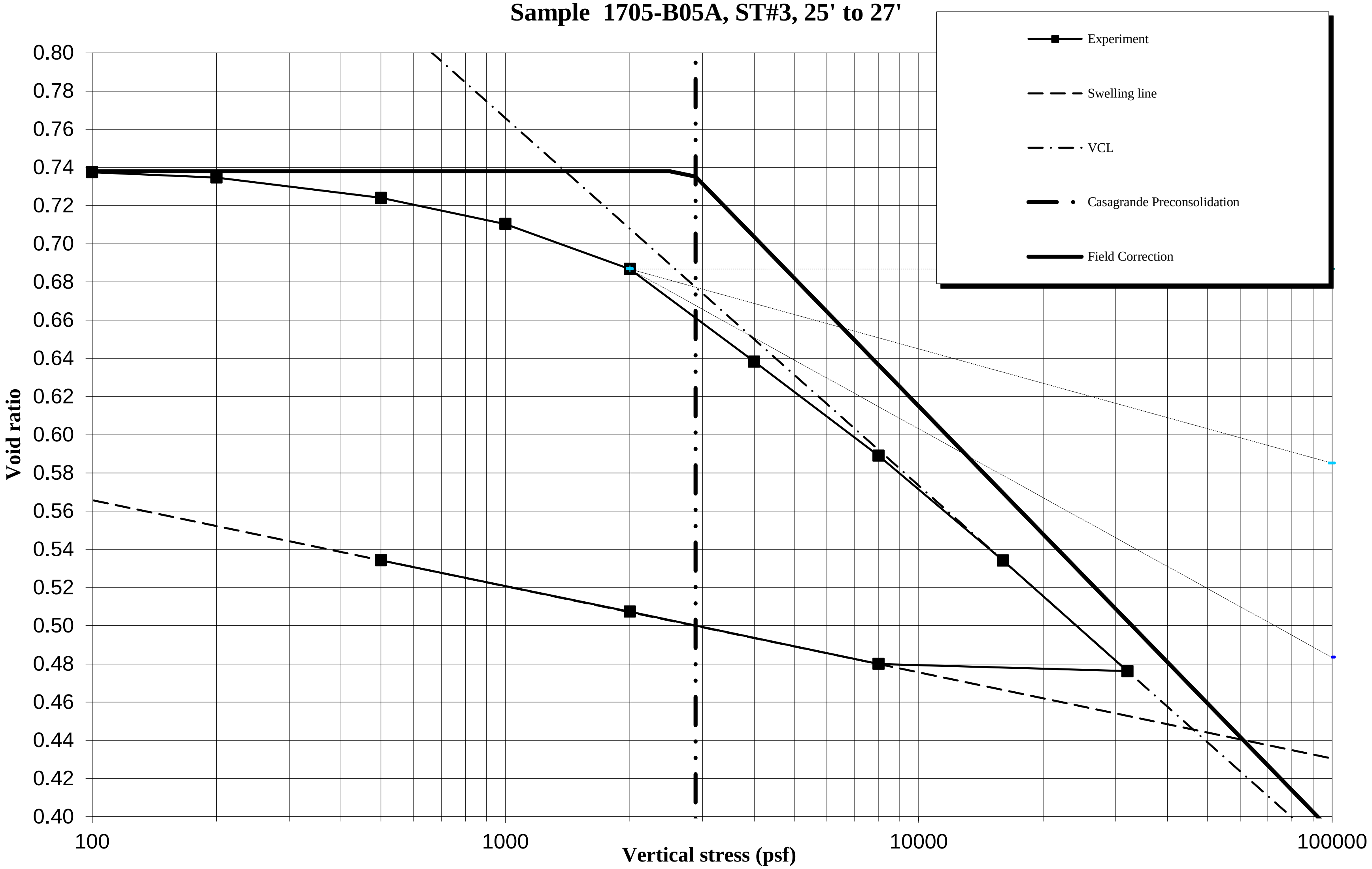
CONSOLIDATION CURVE

Sample 1705-B05A, ST#3, 25' to 27'



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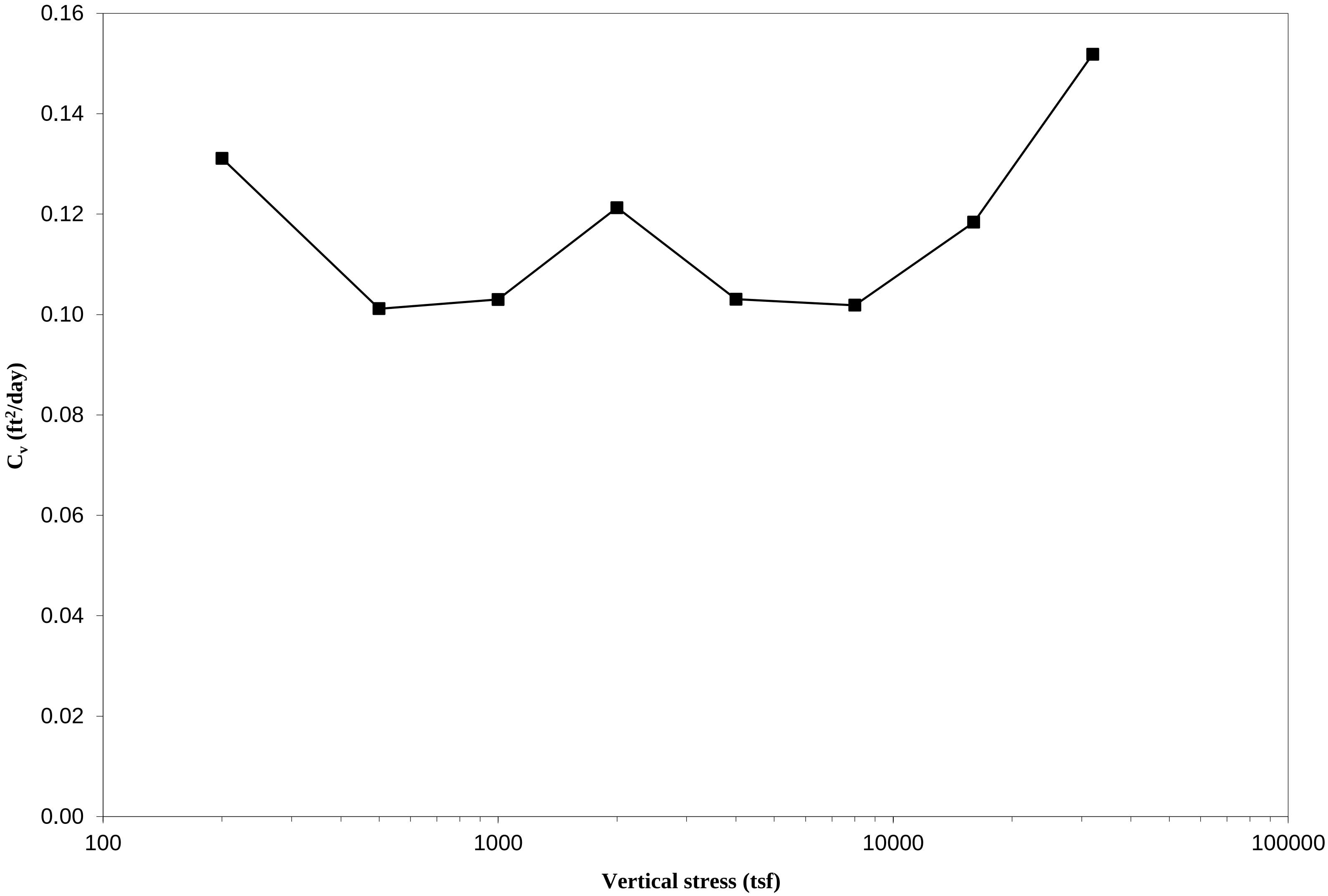
CONSOLIDATION COEFFICIENT (C_v) vs. VERTICAL STRESS

Sample 1705-B05A, ST#3, 25' to 27'



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ONE-DIMENSIONAL CONSOLIDATION TEST

AASHTO T 216 / ASTM D 2435

Project: Circle Interchange
Client: AECOM
Soil Sample ID: Boring 08-ST-01, ST#11, 39' to 41'
Sample Description: Gray CLAY with trace gravel (CL)

Tested by: M. Snider
Prepared by: M. Snider
Test date: 1/8/2015
WEI: 1100-04-01

Initial sample height =	1.002	in
Initial sample mass =	163.22	g
Initial water content =	25.37%	
Initial dry unit weight =	101.26	pcf
Initial void ratio =	0.713	
Initial degree of saturation =	98.90%	
Final sample mass =	157.86	g
Final dry sample mass =	130.19	g
Final water content =	21.25%	
Final dry unit weight =	112.18	pcf
Final void ratio =	0.546	
Final degree of saturation =	100.00%	
Estimated specific gravity =	2.78	

Ring diameter =	2.495	in
Ring mass =	109.57	g
Initial sample and ring mass =	272.79	g
Tare mass =	71.58	g
Final ring and sample mass =	267.91	g
Mass of wet sample and tare =	229.44	g
Mass of dry sample and tare =	201.77	g
Initial dial reading =	0.01000	in
Final dial reading =	0.10757	in
LL=	n.a.	%
PL=	n.a.	%
% Sand=	n.a.	%
% Silt=	n.a.	%
% Clay=	n.a.	%
In-Situ Vertical Effective Stress =	3400	psf

Compression and Swelling Indices

Compression index C_c =	0.182
Field corrected C_c =	0.219
Swelling index C_s =	0.051

Preconsolidation pressure,s_C

Casagrande Method =	3586	psf
Over-Consolidation Ratio (OCR) =	1.05	

Load number	Vertical stress (psf)	Dial reading (in)	System deflection (in)	Vertical strain (%)	Void ratio	C_v (ft^2/day)	Cae (%)	Elapsed time (min)
1	100.0	0.00988	0.00010	0.00	0.713	N/A	N/A	1245
2	200.0	0.01152	0.00023	0.17	0.710	0.0635	0.07	2775
3	500.0	0.01982	0.00058	1.04	0.695	0.0811	0.10	1788
4	1000.0	0.02901	0.00090	1.99	0.679	0.0809	0.10	1410
5	2000.0	0.04280	0.00135	3.41	0.655	0.0851	0.16	1440
6	4000.0	0.06159	0.00193	5.34	0.622	0.0814	0.26	1344
7	8000.0	0.08722	0.00253	7.96	0.577	0.0889	0.32	3270
8	16000.0	0.11708	0.00324	11.01	0.525	0.0832	0.43	1944
9	32000.0	0.14821	0.00413	14.21	0.470	0.1154	0.37	1440
10	8000.0	0.14412	0.00295	13.68	0.479	N/A	N/A	1440
11	2000.0	0.12727	0.00198	11.90	0.509	N/A	N/A	1440
11	500.0	0.10982	0.00123	10.08	0.540	N/A	N/A	3240

Prepared by: ______________________ Date: ______________

Checked by: ______________________ Date: ______________

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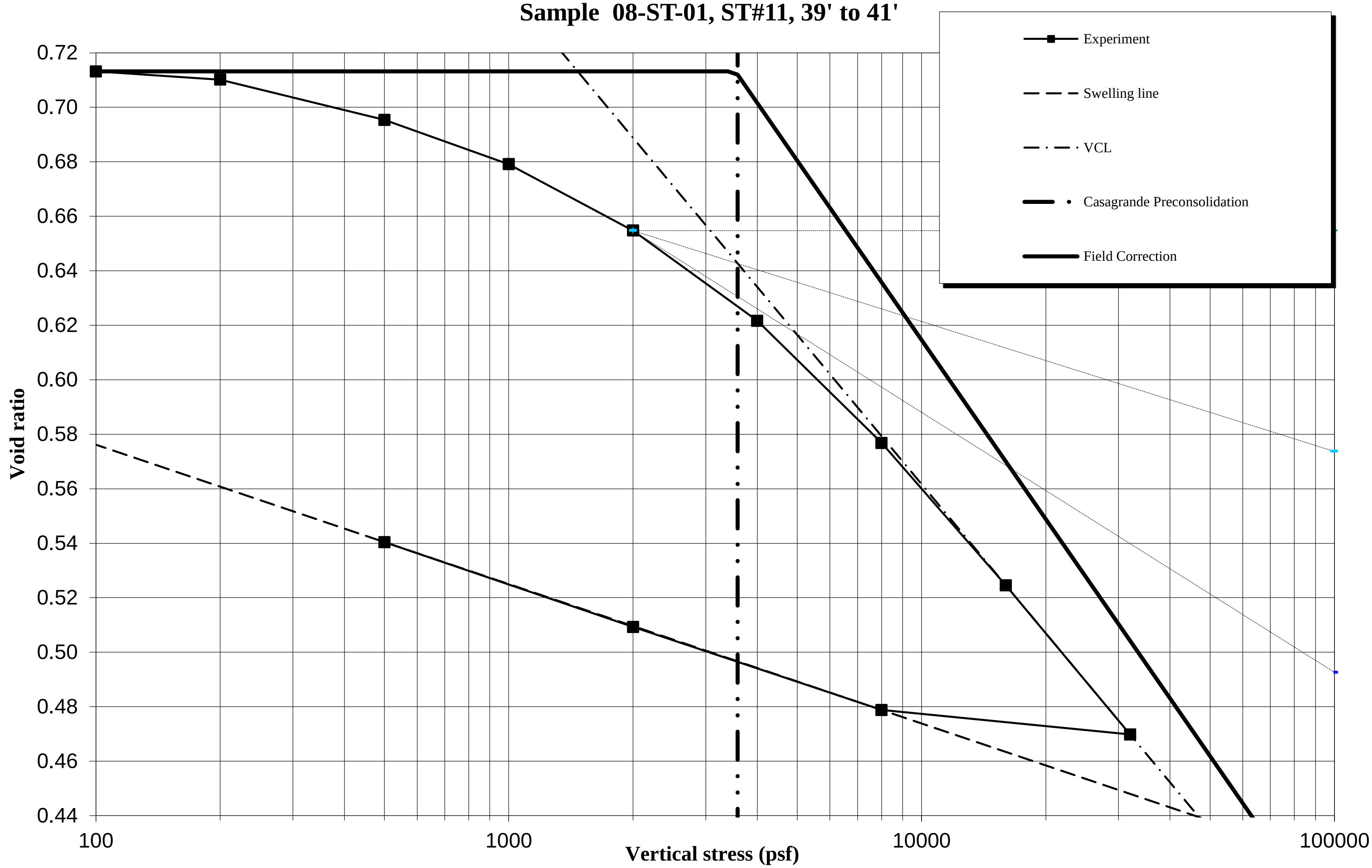
CONSOLIDATION CURVE

Sample 08-ST-01, ST#11, 39' to 41'



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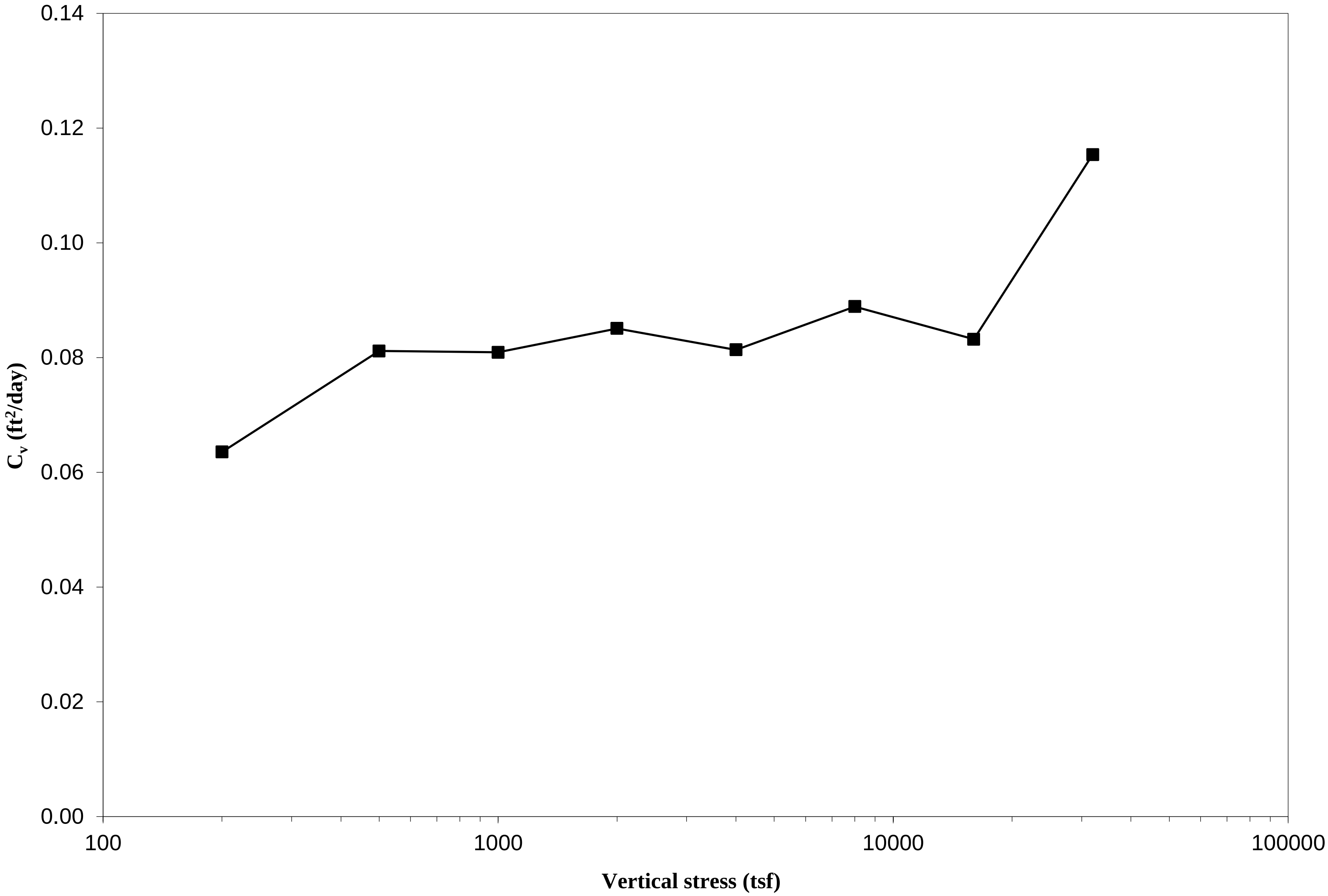
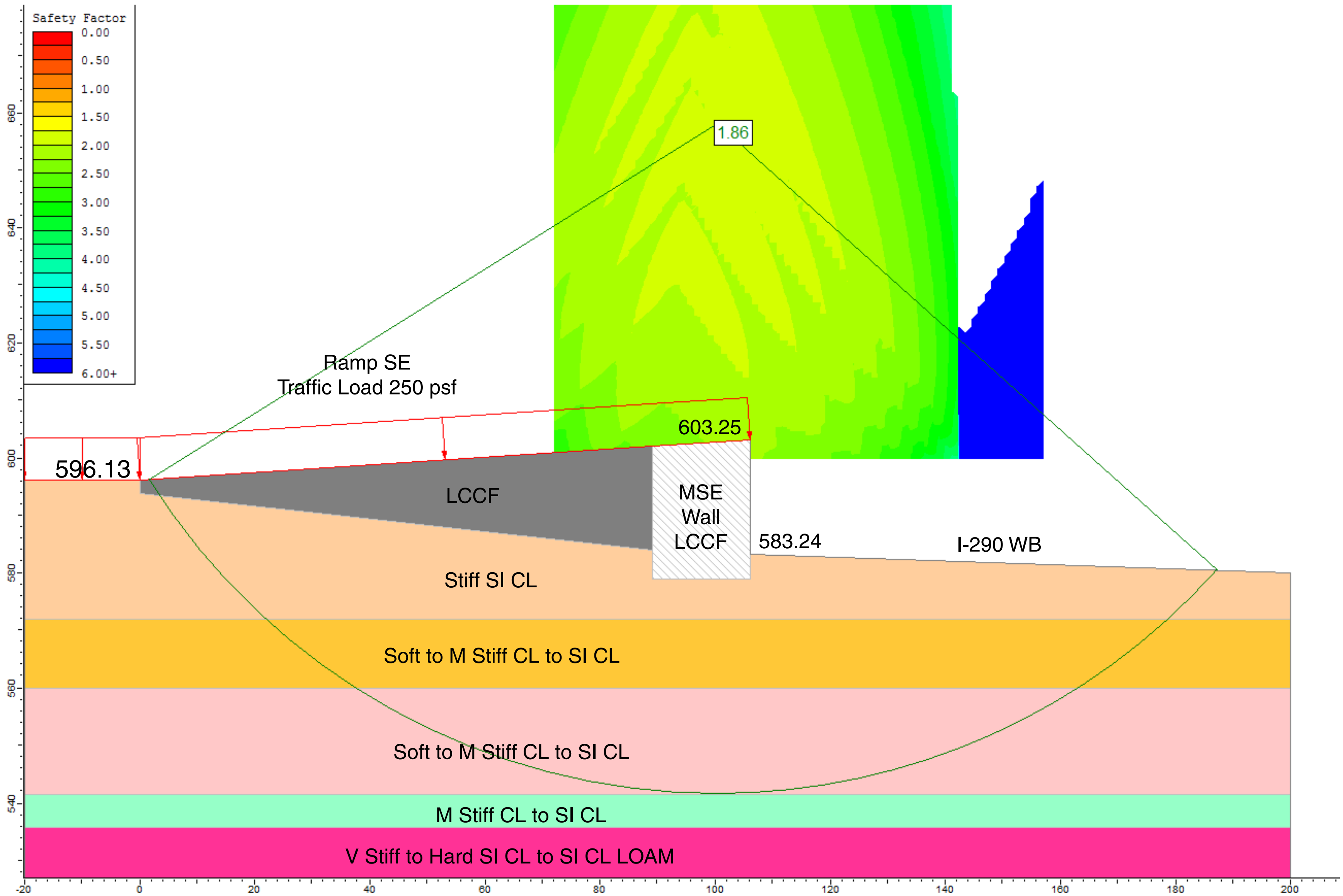
CONSOLIDATION COEFFICIENT (C_v) vs. VERTICAL STRESS

Sample 08-ST-01, ST#11, 39' to 41'



AASHTO R18

APPENDIX C



Undrained Analysis for MSE Wall Along North Abutment, Station 1404+81.07, Ref Borings 1714-B-01 & 1714-B-02

Layer ID	Description	Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	LCCF Class III	42	0	36
2	Stiff SI CL	120	1200	0
3	Soft to M Stiff CLAY to SILTY CLAY	110	600	0
4	Soft to M Stiff CLAY to SILTY CLAY	110	470	0
5	M Stiff CLAY to SILTY CLAY	115	1050	0
6	V Stiff to Hard SI CL to SI CL LOAM	120	3900	0

GLOBAL STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 48, SN 016-1835, COOK COUNTY

SCALE: GRAPHICAL

APPENDIX C-1

DRAWN BY: H. Bista
CHECKED BY: M. Seyhun

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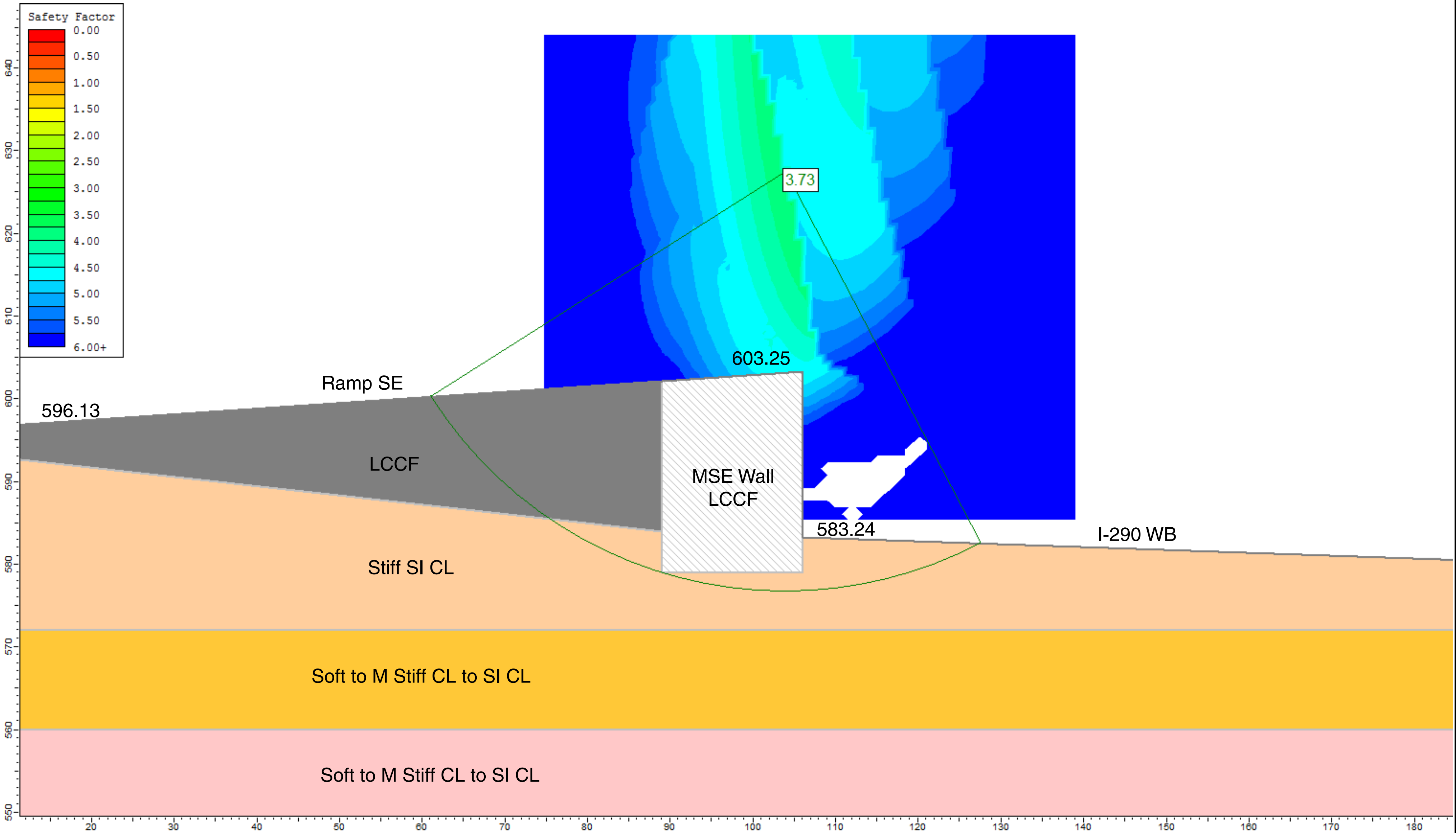
FOR AECOM

1100-04-01



Drained Analysis for MSE Wall Along North Abutment, Station 1404+81.07, Ref Borings 1714-B-01 & 1714-B-02

Layer ID	Description	Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	LCCF Class III	42	0	36
2	Stiff SI CL	120	100	30
3	Soft to M Stiff CLAY to SILTY CLAY	110	0	28
4	Soft to M Stiff CLAY to SILTY CLAY	110	0	28

GLOBAL STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 48, SN 016-1835, COOK COUNTY

SCALE: GRAPHICAL | APPENDIX C-2 | DRAWN BY: H. Bista | CHECKED BY: M. Seyhun

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FOR AECOM | 1100-04-01

APPENDIX D

Bench Mark: Chisel "X" on chain bolt of fire hydrant in front of 555 W. Harrison St. Elev. 594.46.

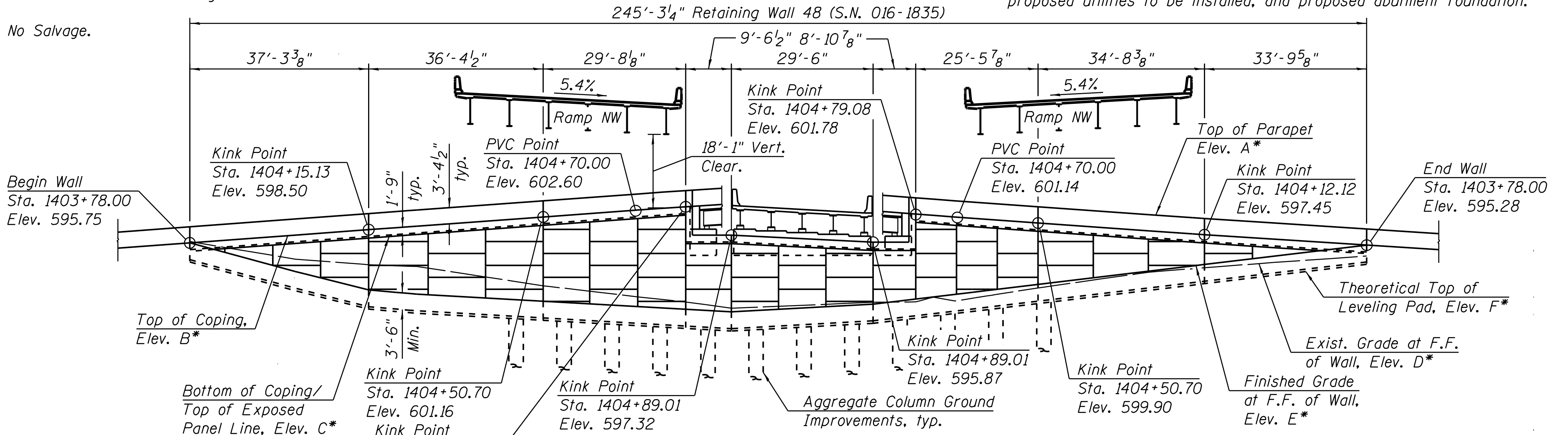
Existing Structure: None.

The existing bridge will be closed and traffic will be detoured during construction. Traffic on I-290 and I-90/94 will be maintained with stage construction.

No Salvage.

NOTES:

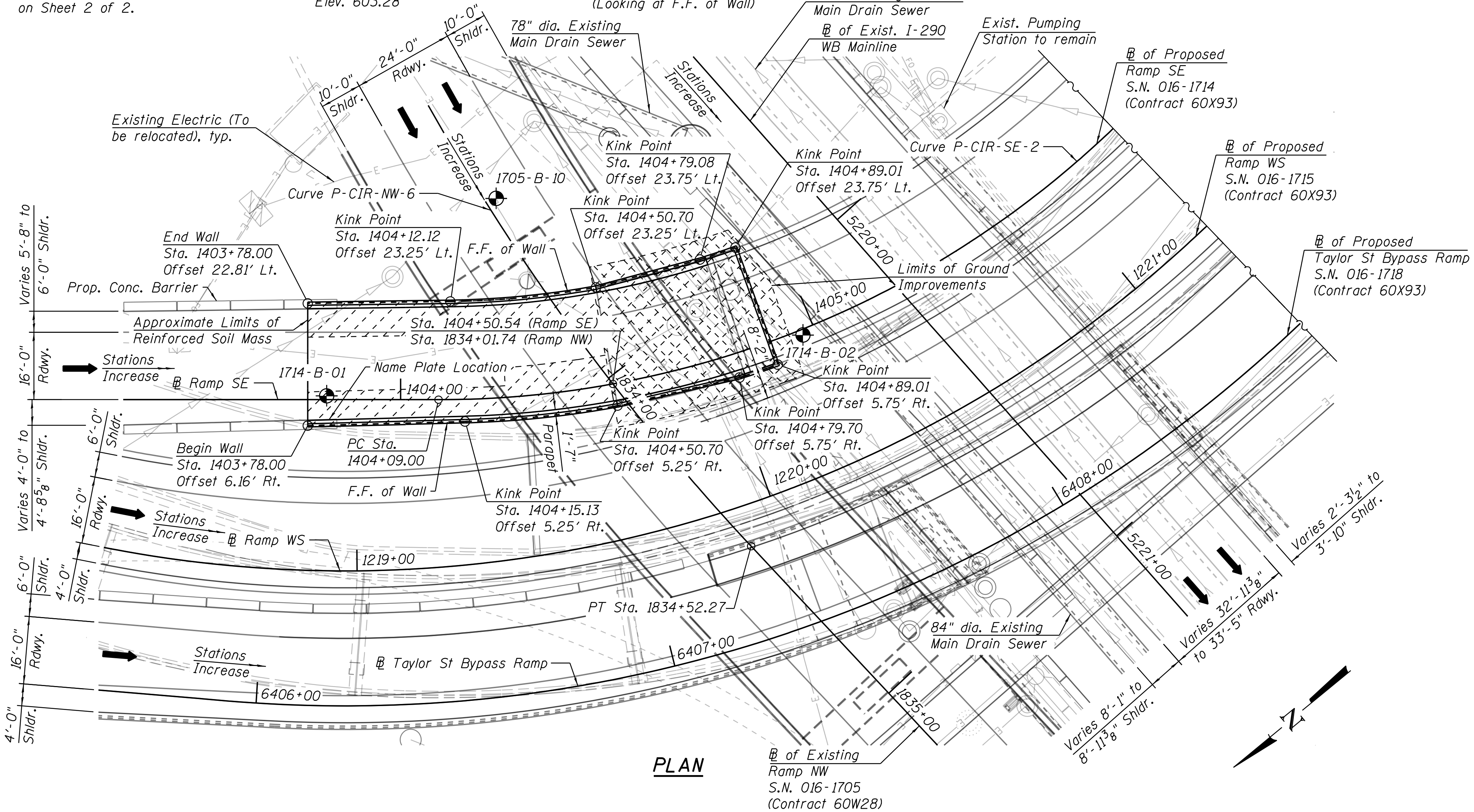
1. Wall offsets are measured from the ℄ of Ramp SE to the front face of precast panels.
2. F.F. denotes Front Face.
3. B.F. denotes Back Face.
4. Aggregate columns must be spaced to avoid interference with existing utilities to remain, proposed utilities to be installed, and proposed abutment foundation.



* For elevations, see Table 1 on Sheet 2 of 2.

UNFOLDED ELEVATION

(Looking at F.F. of Wall)



PLAN

HIGHWAY CLASSIFICATION

Ramp SE	Ramp NW
Functional Class: Interstate	Functional Class: Interstate
ADT: 4,600 (2010); 5,000 (2040)	ADT: 32,500 (2012); 36,000 (2040)
ADTT: 123 (2012); 134 (2040)	ADTT: 2,483 (2012); 2,750 (2040)
DHV: 440 (2040)	DHV: 2,790 (2040)
Design Speed: 25 m.p.h.	Design Speed: 35 m.p.h.
Posted Speed: 25 m.p.h.	Posted Speed: 35 m.p.h.
One-Way Traffic	One-Way Traffic
Directional Distribution: 100%	Directional Distribution: 100%

CURVE DATA

(Ramp SE)

P-CIR-SE-2
P.I. Sta. = 1415+83.08
Δ = 157°44'18" (LT)
D = 24°48'12"
R = 231.00'
T = 1174.08'
L = 635.96'
E = 965.59'
e = 5.6%
T.R. = NA
S.E. Run = 128'
P.C. Sta. = 1404+09.00
P.T. Sta. = 1410+44.95

CURVE DATA

(Ramp NW)

P-CIR-NW-6
P.I. Sta. = 1831+44.22
Δ = 88°30'25" (LT)
D = 10°36'37"
R = 540.00'
T = 526.11'
L = 834.16'
E = 213.92'
e = 5.4%
T.R. = NA
S.E. Run = 66'
P.C. Sta. = 1826+18.11
P.T. Sta. = 1834+52.27

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications 7th Edition with 2015 and 2016 Interim Specifications

DESIGN STRESSES

FIELD UNITS

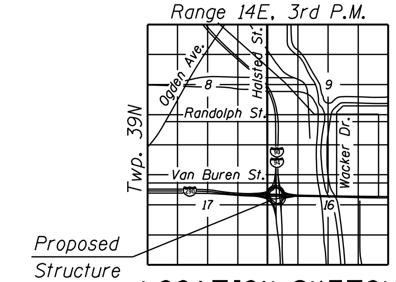
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

PRECAST UNITS

f'c = 4,500 psi

LEGEND

Electric
Exist. Storm Sewer
Light Pole
Soil Boring
Limits of Soil Reinforcement
Limits of Soil Reinforcement With Ground Improvements

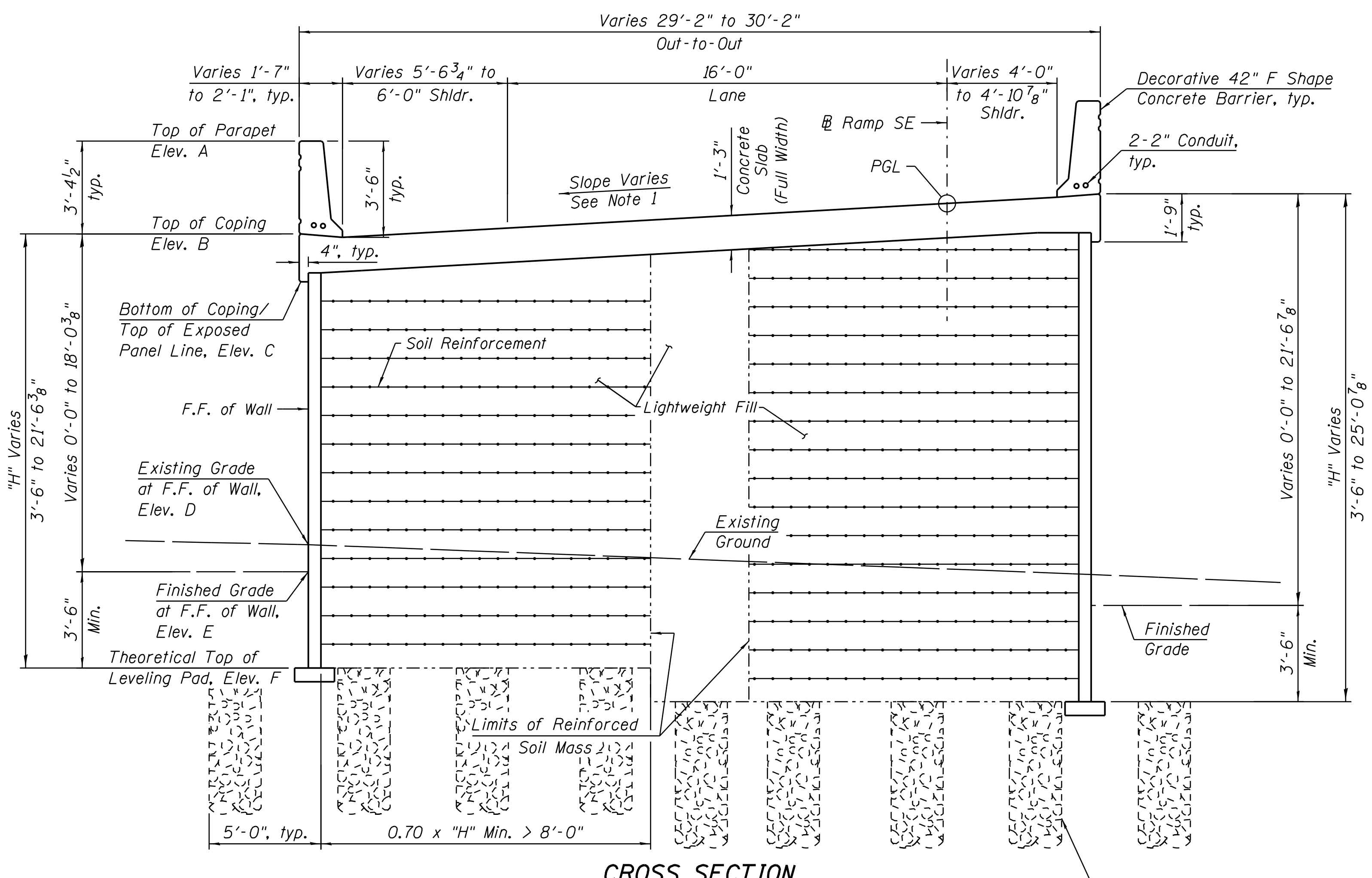


LOCATION SKETCH

GENERAL PLAN
RETAINING WALL 48 ALONG
F.A.I. 94 (I-90/94 SB TO I-290 EB)
SECTION 2014-013 R&B-R
COOK COUNTY
STATION 1403+78.00 TO STATION 1404+89.01
STRUCTURE NO. 016-1835

TranSystems	USER NAME = jrmickens	DESIGNED - WJC	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	SHEET NO. 1 OF 2 SHEETS
		CHECKED - MDS/JNP	REVISED -		
	PLOT SCALE = 32.00 ' / in.	DRAWN - WJC	REVISED -		
	PLOT DATE = 8/15/2017	CHECKED - MDS/JNP	REVISED -		

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-013 R&B-R	COOK	2	1
		CONTRACT NO. 60X93		
	ILLINOIS FED. AID PROJECT			



CROSS SECTION

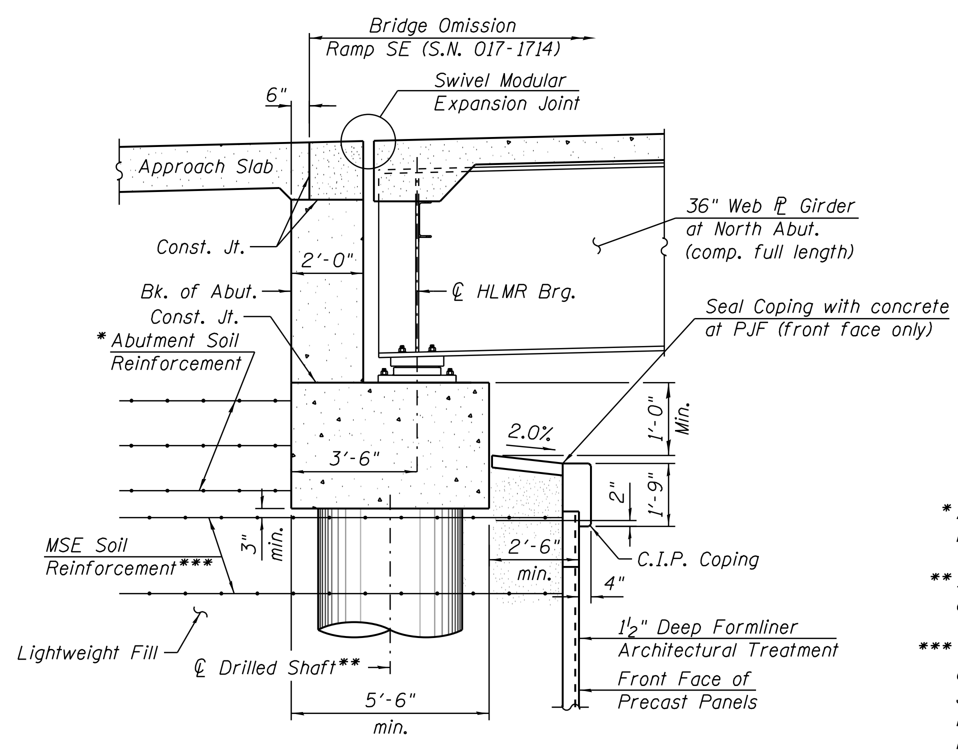
(Looking Upstation)

Aggregate Column Ground Improvements (Sta. 1404+50.00 to Sta. 1404+89.01), typ.

TABLE 1 - WALL ELEVATIONS

Station	Offset	Elevation A	Elevation B	Elevation C	Elevation D	Elevation E	Elevation F
1403+78.00	6.16' Rt.	599.12	595.75	594.00	595.97	595.75	592.25
1404+00.00	5.57' Rt.	600.76	597.38	595.63	592.35	589.77	586.27
1404+15.13	5.25' Rt.	601.88	598.50	596.75	591.19	585.92	582.42
1404+25.00	5.25' Rt.	602.62	599.24	597.49	590.82	585.06	581.56
1404+50.70	5.25' Rt.	604.54	601.16	599.41	586.80	583.57	580.07
1404+70.00	5.17' Rt.	605.97	602.60	600.85	584.47	582.44	578.94
1404+75.00	5.42' Rt.	606.33	602.96	601.21	583.94	582.15	578.65
1404+79.70	5.75' Rt.	606.66	603.28	601.53	583.40	581.88	578.38
1404+81.07	5.75' Rt.	606.75	603.38	601.63	583.24	581.80	578.30
1404+89.01	5.75' Rt.	-	597.32	595.57	582.11	581.34	577.84
1404+89.01	23.75' Lt.	-	595.87	594.12	583.35	582.97	579.47
1404+80.66	23.75' Lt.	605.27	601.89	600.14	583.42	583.86	580.36
1404+79.08	23.75' Lt.	605.16	601.78	600.03	583.43	584.03	580.53
1404+75.00	23.87' Lt.	604.88	601.50	599.75	584.42	584.47	580.97
1404+70.00	23.93' Lt.	604.52	601.14	599.39	583.61	585.01	581.51
1404+50.70	23.25' Lt.	603.28	599.90	598.15	586.35	587.08	583.58
1404+25.00	23.25' Lt.	601.65	598.27	596.52	589.64	589.85	586.35
1404+12.12	23.25' Lt.	600.83	597.45	595.70	590.55	591.23	587.73
1404+00.00	23.11' Lt.	600.06	596.69	594.94	591.47	592.64	589.14
1403+78.00	22.81' Lt.	598.65	595.28	593.53	592.59	595.28	591.78

Elevation A- Top of Parapet
Elevation B- Top of Coping
Elevation C- Bottom of Coping / Top of Exposed Panel Line
Elevation D- Existing Grade at F.F. of Wall
Elevation E- Finished Grade at F.F. of Wall
Elevation F- Theoretical Top of Leveling Pad



SECTION THRU ABUTMENT

(Horiz. Dim. @ Rt. L's)

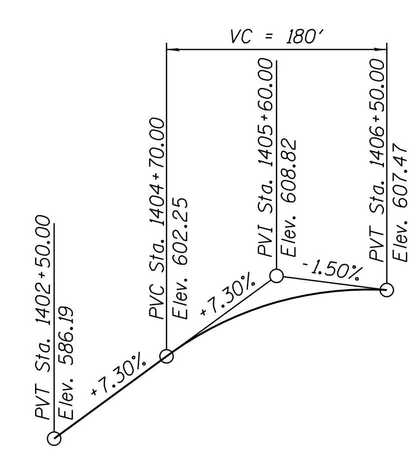
* Abutment Soil Reinforcement to resist lateral loads in lieu of drilled shafts.

** Size, spacing and number to be determined in design.

*** The M.S.E. Wall supplier's internal stability design shall account for the anchorage slab's bearing pressure surcharge of 1.0 ksf and horizontal sliding force of 0.83 kips/ft of wall.

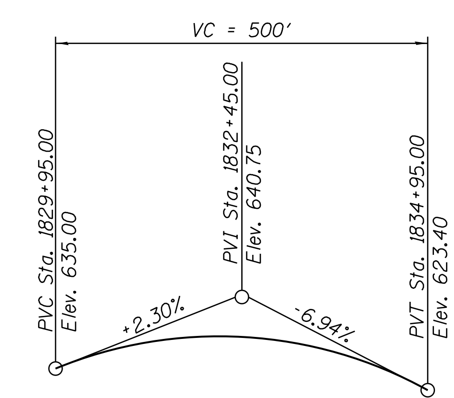
NOTES:

1. Direction of slope referenced from right edge of pavement.
   Slope Transition (0.00% to -5.60%) Sta. 1403+38.82 to Sta. 1404+68.00
   Constant Cross Slope (-5.60%) Sta. 1404+68.00 to Sta. 1409+90.00



PROFILE GRADE

(Along ℄ Ramp SE)



PROFILE GRADE

(Along ℄ Ramp NW)

CROSS SECTION & DETAILS
RETAINING WALL 48 ALONG
F.A.I. 94 (I-90/94 SB TO I-290 EB)
SECTION 2014-013 R&B-R
COOK COUNTY
STATION 1403+78.00 TO STATION 1404+89.01
STRUCTURE NO. 016-1835