STRUCTURE GEOTECHNICAL REPORT
CIRCLE INTERCHANGE RECONSTRUCTION
INTERSTATE 290 RETAINING WALL 11
STATION 5132+58.15 TO 5133+00.00
PR SN 016-1800, SECTION 2014-002R&B
IDOT D-91-227-13, PTB 163/ITEM 001
COOK COUNTY, ILLINOIS

for

AECOM

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submitted by

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Technical Report Documentation Page

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11. Abstract

To facilitate the widening of eastbound Interstate 290 east of South Racine Avenue, Retaining Wall 11 will be constructed within the existing south embankment. The wall will have a total length of 50.5 feet, extending from Station 5132+58.15 to 5133+00.00, connecting to the existing Wall 13 along the I-290 shoulder, and then extending at an approximately 45° skew back into the south embankment. The ground line behind the wall will be flat, with the embankment in front of the wall graded at 1:3 (V:H) back down to the I-290 shoulder. The wall will have a maximum total height of 14.3 feet at the connection to existing Wall 13, and will decrease in height back into the embankment until the height is about 1 to 2 feet. The maximum exposed height is 8.6 feet.

The existing embankment material consists of 5 to 8 feet of loose to very dense gravelly sand fill. Beneath the fill materials, borings encountered 5 to 10 feet of medium stiff to very stiff clay overlying up to 34 feet of very soft to medium stiff silty clay. Deeper foundation soils include very stiff silty clay and very dense silt to silty loam. Groundwater was encountered near the bottom of the fill material and is expected within granular layers dividing the various clayey materials.

We recommend designing Retaining Wall 11 as a drilled-and-set soldier pile and lagging wall. The soldier pile and lagging wall will likely require a wide flange section to avoid excessive deflection. The shafts would require temporary casing in some locations to protect against groundwater infiltration and soft soil squeeze. Vertical settlements within a distance equal to the exposed height behind the wall will range from about 0.7 to 3.4 inches depending on the wall stiffness. If the lateral deflection meets the IDOT criteria of 1.0% of the wall height, the maximum vertical settlement behind the wall is estimated at about 1.5 inches. The global stability factor of safety for the wall at the minimum recommended embedment elevation of 545 feet is 1.7 to 3.9.

We do not anticipate stage construction or other excavations along the length of the wall.

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1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluations for the construction of Retaining Wall 11 along eastbound Interstate 290 (I-290) located 650 feet east of Racine Avenue in Chicago, Cook County, Illinois. A *Site Location Map* is presented as Exhibit 1.

1.1 Proposed Structure

Wang Engineering, Inc. (Wang) understands the design engineer, TranSystems Corporation (TranSystems), envisions removing existing Retaining Wall 13 east of West Congress Parkway and constructing Retaining Wall 11 as an extension of the remaining wall segment to facilitate grading down to the I-290 elevation. Wall 11 will tie into existing Wall 13 along the I-290 shoulder at Station 5132+58.15 and will run for 50.5 feet at about a 45° skew back into the existing embankment section. The end of Wall 11 will be offset 57.1 feet south of the eastbound I-290 centerline.

The wall is proposed as a soldier pile and lagging wall and the TSL plan sheets provided by TranSystems and dated November 2016 show the maximum exposed wall height, defined as the height from the finished grade in front of the wall to the top of the fascia panel, of 8.6 feet at the junction with existing Wall 13. The maximum total wall height from the bottom to the top of the fascia panel is 14.3 feet. The soil in front of the wall will be graded down to the I-290 elevation at 1:3 (V:H).

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 new retaining wall.

1.2 Existing Structure

The existing Retaining Wall 13 is a reinforced-concrete cantilever wall supported on multiple rows of driven piles and runs for a total of 1000 feet east of Racine Avenue along I-290. The initial 650 feet of wall, scheduled to remain in place, supports West Congress Parkway and is 50 feet from the back of the University of Illinois at Chicago Pavilion and adjacent parking structure. The eastern 350 feet of Wall 13 to be removed supports embankment, which gradually grades down to the I-290 shoulder level.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The project area is located within the City of Chicago, along the north side of I-290 between South Morgan Street and South Racine Avenue. On the USGS *Chicago Loop 7.5 Minute Series* map, the wall crosses the SW¼ and SE¼ of Section 17, 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 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 site is situated within the Chicago Lake Plain Physiographic Subsection (Leighton 1948). In general the area is characterized by a flat surface and underlain largely by till that slopes gently toward the lake. At the wall location, the I-290 roadway is at an elevation of about 580 feet and was constructed within a minor cut. The north (WB) slope is graded between 1:2 and 1:4 (V:H) up to an elevation of 593 feet along West Congress Parkway.

2.2 Surficial Cover

The project area was shaped during the Wisconsinian-age glaciation, and an approximately 90-foot thick drift covers the bedrock. 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 (Hansel and Johnson 1996). 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. The diamicton of the Wadsworth Formation is underlined by the pebbly silty clay loam to silty loam diamicton of the Yorkville Member of the Lemont Formation locally known as Chicago hardpan (Johnson and Hansel 1989). The Equality Formation sediments consist 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 (Hansel and Johnson 1996). 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 strength, 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 a 350-foot thick Silurian-age dolostone (Leetaru et al. 2004) at depths ranging from 85 to 95 feet below ground surface (bgs).

Structurally, no faults have been mapped in the area (Kolata and Nimz 2010). No underground mines have been mapped in the area (ISGS 2013) and although there are a number of freight tunnels that throughout the interchange, there are no tunnels beneath the proposed Retaining Wall 11 location.

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 lacustrine deposits, silty clay diamictons, hardpan, and gravelly sands that overlie the bedrock. Dolostone bedrock was encountered at 98 feet bgs in Boring 11-RWB-03.

3.0 METHODS OF INVESTIGATION

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

3.1 Subsurface Investigation

The subsurface investigation, performed by Wang in October 2013 and December 2015, consisted of three structure borings designated as 11-RWB-01, 11-RWB-02, and 11-RWB-03 as well as a vane shear boring designated as VST-05. The borings were drilled along West Congress Parkway from elevations of 593.0 to 593.6 and were advanced to depths of 45 to 106 feet bgs. Northings and eastings were surveyed by Dynasty Surveying, with elevations, stations and offsets provided by AECOM. The boring locations are presented in the *Boring Logs* (Appendix A) and the as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 3).

A truck-mounted drilling rig, equipped with solid stem augers and mud rotary equipment, 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-foot intervals thereafter. Samples collected from each interval were placed in sealed jars for further examination. The field vane shear testing in Boring VST-05 was conducted at 2.5-foot intervals beginning at 17 feet bgs and continuing to the termination depth at 45 feet. A groundwater monitoring well was installed at a depth of 98 feet bgs behind the retaining wall off the southwest corner of the Peoria Street Bridge approximately 1200 feet east of Wall 11.

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

Groundwater observations were made during and at the end of drilling operations. Due to safety considerations, boreholes were backfilled with grout immediately upon completion.

3.2 Laboratory Testing

Soil samples were tested in the laboratory for moisture content (AASHTO T-265). Atterberg limits (AASHTO T 89/90) and particle size (AASHTO T 88) analyses were performed on selected samples. Field visual descriptions of the soil samples were verified in the laboratory and the tested samples were classified in accordance with the IDH Textural Classification chart. Laboratory test 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 pavement structure along West Congress consists of a 1.5-inch thick asphalt overlay on top of 10 inches of concrete and 12 inches of aggregate base. The embankment area behind existing Wall 13 is covered with 4 inches of silty loam topsoil. In descending order, the general lithologic succession encountered beneath the pavement and topsoil includes 1) man-made ground (fill); 2) medium stiff to very stiff silty clay to clay; 3) very soft to medium stiff clay to silty clay; 4) very stiff silty clay; 5) very dense silt to silty loam; and 6) very dense sandy gravel.

(1) Man-made ground (fill)

Immediately beneath the West Congress pavement the borings encountered 5 to 8 feet of medium dense to very dense, brown and gray gravelly sand fill with some slag. The fill has N-values of 17 to 49 blows per foot of penetration with the gravel causing two sampler refusals with greater than 50 blows per 6 inches of penetration. The initial sample in Boring VST-05, taken at 3.5 to 5 feet below grade showed an N-value of 8 blows per foot across loose, brown fine sand fill and stiff, gray silty clay fill. Based on the field testing immediately behind the wall and off the existing roadway in Borings VST-05 and 11-RWB-01 we consider the granular fill to be in a loose to medium dense state at about 40% relative density.

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

Immediately beneath the fill, the borings revealed a 5- to 10- foot thick layer of medium stiff to very stiff, gray silty clay and clay. The upper silty clay has unconfined compressive strength (Q_u) values of 0.8 to 2.8 tsf and an average of 1.3 tsf. The moisture content values measured 16 to 26% with an average of about 21%. An in-situ vane shear test performed within this layer had an undisturbed shear strength (S_u) value of 1,000 psf.

(3) Very soft to medium stiff clay to silty clay

At an average elevation of 579 feet the borings encountered up to 34 feet of very soft to medium stiff, gray ‘blue’ clay to silty clay. The clay has field Q_u values of 0.2 to 0.9 tsf with an average of 0.4 tsf and moisture content values of 24 to 29% with an average 26%. The results of the vane shear testing are used to divide this layer into two general sublayers. From the top elevation of the layer at 579 feet down to an elevation of 564 feet, the clay has a very soft to soft consistency with vane shear S_u values of 470 to 540 psf and an average of 500 psf. The shear strength values below elevation 564 feet are noticeably higher, ranging from 590 to 920 psf and averaging 750 psf.

(4) Very stiff silty clay

At an elevation of 546 feet the borings encountered 5 feet of very stiff, gray silty clay. The silty clay has a Q_u value of 2.6 tsf and moisture content values of 20 and 21%.

(5) Very dense silt and silty loam

Underlying the clayey materials at an average elevation of 542 feet, the borings advanced through very dense, gray silt and silty loam with N-values greater than 50 blows per 6 inches of penetration. This 'hardpan' has moisture contents of 10 to 21%. At 67 feet below grade in Boring 11-RWB-01 and continuing to the termination depth, this material grades slightly more towards silty clay, with a Q_u value greater than 9.0 tsf and moisture contents consistent with the hardpan soils at 13 to 14%. In Boring 11-RWB-03, this soil is dense, coarse sand at an elevation of 533 feet and 60 feet bgs.

(6) Very dense sandy gravel

At an elevation of 511 feet, Boring 11-RWB-03 encountered 16 feet of very dense, gray sandy gravel with cobbles and boulders. A boulder at 506 feet was cored following rotary refusal, only to advance an additional 10 feet through sandy gravel. The gravel has N-values representing sampler refusal and we estimate establishing the tip of the soldier piles in this layer will be difficult.

4.2 Groundwater Conditions

Groundwater was encountered while drilling within the lower portion of the fill material at 5 to 6 feet bgs and within both the silty loam and sandy gravel (**Layer 6**) below an elevation of 536 feet. At the completion of drilling, groundwater was measured at 52 to 77 feet bgs, or at the boundary between the clayey and silty materials (**Layers 4 and 5**). These boundaries often have thin granular, water-bearing layers that should be accounted for during the design and construction of the wall.

The piezometer screen along Peoria Street was installed within the lower, primary aquafer encountered during the subsurface investigation as sandy gravel (**Layer 6**). A summary of the monitoring data between early December 2014 and October 2016 is shown in Figure 1. The data shows groundwater that is under excess pressure head. The average hydrostatic elevation within the aquifer is about 554 feet, or about 12 feet above the top of the very dense silty loam and into the medium stiff clay of **Layer 3**. This excess pressure will complicate soldier pile drilling for shafts extended into the hardpan layer. The groundwater level for design of the wall should be taken at 555 feet; the small amount of water encountered within the bottom third of the fill is perched during times of heavy precipitation.

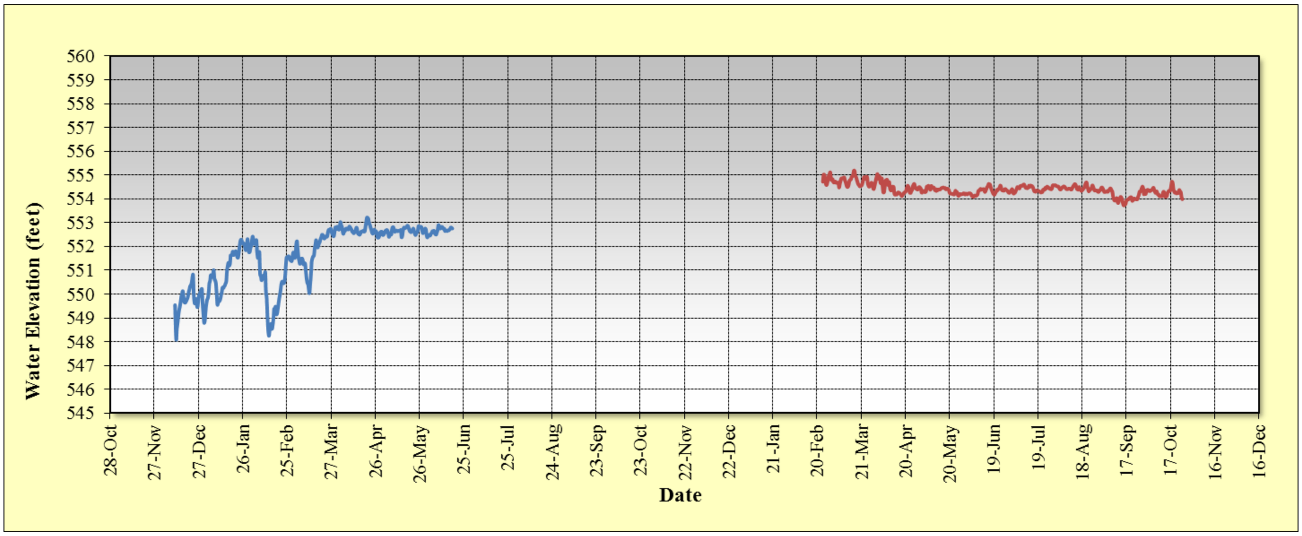

Figure 1: Groundwater Monitoring Data within Sandy Gravel

4.3 Seismic Design Considerations

Retaining walls in Seismic Performance Zone 1 do not require seismic site class or liquifaction analyses.

5.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

Geotechnical evaluations and recommendations for the retaining wall design are included in the following sections. The wall will be constructed entirely in a cut section and we recommend constructing either a drilled-and-set soldier pile and lagging wall or a drilled shaft, tangent-pile style wall for the full proposed length; mechanically-stabilized earth (MSE) and reinforced concrete cantilever (RCC) walls will require large temporary shoring efforts and are not recommended. If soldier piles are designed, they should be placed in precored boreholes, as pile driving (including steel sheet piling) is discouraged along this section of I-290.

The wall begins with a vertical expansion joint at Station 5132+58.15, adjacent to existing Retaining Wall 13. This is also the maximum height of the wall, with a total height of 14.3 feet and an exposed height of 8.6 feet. The wall extends back 50.5 feet into the existing embankment skewed at about 45° to the I-290 alignment with the wall gradually decreasing in height to about 1 or 2 feet at Station 5133+00. The embankment in front of the wall will be graded down to I-290 at 1:3 (V:H).

5.1 Soldier Pile and Lagging Design

We recommend placing the soldier piles within prebored holes with diameters of at least 36 inches and the combination of soldier piles and shafts should be designed for both lateral earth pressure and lateral deformation. The embedment depth in moment equilibrium for the wall sections should be designed in accordance with the LRFD guidelines (AASHTO 2016). Generally, overconsolidated clayey soils, such as the stiff to very stiff clays and very dense silty loam will exhibit lower overall shear strength in the long-term condition; normally-consolidated clayey soils, however, such as the very soft to medium stiff blue clay will likely exhibit significantly lower shear strength in the short-term condition. Therefore, the lateral earth pressure analysis should performed for walls in both the short-term (undrained) and long-term (drained) condition using the soil parameters shown in Tables 1 and 2. The undrained shear strength properties of the soft to medium stiff silty clay are taken from the vane shear testing results shown in Boring VST-05 and the passive pressure coefficients for the layers above Elevation 581 feet account for the 1:3 slope in front of the wall. The drained soft to medium stiff silty clay friction angle parameters have been taken from the average of consolidated-undrained (CU) triaxial tests performed on this layer from throughout the Circle Interchange project.

Table 1: Short-term (Undrained) Geotechnical Parameters for Design of Soldier Pile Walls

Soil Description (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
GRAVELLY SAND FILL (1) Surface to EL 587 feet	120	0	30	0.31	1.70 (1:3)
M Stiff to Stiff SILTY CLAY(2) EL 587 to 578 feet	120	1000	0	1.00	1.00
Soft SILTY CLAY (3) EL 578 to 564 feet	120	450	0	1.00	1.00
Soft to M Stiff SILTY CLAY(3) EL 564 to 547 feet	120	600	0	1.00	1.00
V stiff SILTY CLAY (4) EL 547 to 542 feet	125	2500	0	1.00	1.00
V Dense SILTY LOAM (5) EL 542 to 527 feet	130	0	38	0.24	4.20
Hard SILTY CLAY (6) EL 527 to 518 feet	125	4000	0	1.00	1.00

The lateral deformation of the wall should be designed for movement and moment fixity at the base of the prebore and a limiting lateral movement of 1.0% of the exposed wall height in accordance with the criteria provided to Wang by IDOT via e-mail on November 14, 2016. The evaluation should be performed using the parameters shown in Table 3 via p-y curve (COM624) method. The values in Table 3 also reflect the results of the field vane shear testing discussed in Section 4.1. The lateral movement should be limited to avoid concerns with water and sewer utilities running within Congress Parkway.

Table 2: Long-term (Drained) Geotechnical Parameters for Design of Soldier Pile Walls

Soil Description (Layer)	Unit Weight, γ (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
GRAVELLY SAND FILL (1) Surface to EL 587 feet	120	0	30	0.31	1.70 (1:3)
M Stiff to Stiff SILTY CLAY(2) EL 587 to 578 feet	120	0	26	0.39	1.40 (1:3)
Soft SILTY CLAY (3) EL 578 to 564 feet	120	0	26	0.39	2.56
Soft to M Stiff SILTY CLAY(3) EL 564 to 547 feet	120	0	26	0.39	2.56
V stiff SILTY CLAY (4) EL 547 to 542 feet	125	100	30	0.33	3.00
V Dense SILTY LOAM (5) EL 542 to 527 feet	130	0	38	0.24	4.20
Hard SILTY CLAY (6) EL 527 to 518 feet	125	100	32	0.31	3.26

Vertical settlement of the ground surface behind the wall is a function of the wall stiffness and resulting lateral wall movement during construction. However, research has found that excavations in soft to medium clay have a maximum settlement envelope extending approximately 1 times the excavation depth behind the wall and the maximum vertical settlement ranges from approximately 0.4 to 2.0% of the wall height (Wang et al 2010, Clough and O'Rourke 1990). At Retaining Wall 11, we can expect vertical settlement ranging from 0.7 inches to 3.4 inches behind the wall, depending on the wall stiffness. If the wall is designed for 1% lateral deflection, the maximum vertical settlement is estimated at approximately 1.5 inches. The UIC parking garage is at least 65 feet from the back of the retaining wall and is on deep foundations. Therefore, there is no concern of movement at the building. The anticipated movement would only affect the eastern edge of the Congress Parkway pavement and minor repair of the damaged roadway should be anticipated.

Table 3: Recommended Parameters for Lateral Load Analysis of Soldier Pile Walls

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} (%)
GRAVELLY SAND FILL (1) Surface to EL 587 feet	120	0	30	60	--
M Stiff to Stiff SILTY CLAY(2) EL 587 to 578 feet	120	1000	0	100	0.8
Soft SILTY CLAY (3) EL 578 to 564 feet	120	450	0	60	1.0
Soft to M Stiff SILTY CLAY(3) EL 564 to 547 feet	120	600	0	70	1.0
V stiff SILTY CLAY (4) EL 547 to 542 feet	125	2500	0	1500	0.5
V Dense SILTY LOAM (5) EL 542 to 527 feet	130	0	38	120	--
Hard SILTY CLAY (6) EL 527 to 518 feet	125	4000	0	2000	0.4

5.2 Stage Construction Design Recommendations

Stage construction and temporary shoring are not anticipated along this structure.

5.3 Global Stability

The global stability of the retaining wall at Station 5132+58 was analyzed based on the soil profile described in Section 4.1 and the information provided in the GPE. Due to the presence of soft and medium stiff clay, the tip of the shaft should not terminate above an elevation of 545 feet. The minimum required FOS for both short (undrained) and long-term (drained) conditions is 1.5 (IDOT 2012). *Slide v6.0* evaluation exhibits employing the Bishop Simplified method of analysis are shown in Appendix C. We estimate the foundation soil at EL 545 feet has a minimum undrained FOS of 1.7 (Appendix C-1) and a drained FOS of 3.9 (Appendix C-2). The FOS meets the minimum requirement.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 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 within the fill material and within interbedded sand layers between the very stiff silty clay and very dense silty loam, as discussed in Section 4.2. These layers were encountered at elevations of about 540 feet and were screened with a piezometer; the will locally impact preboring of the soldier pile locations. The Contractor should be prepared with temporary casing to seal these interbeds off in the event that they are exposed. The temporary casing should also be provided to prevent shaft squeeze within the soft and deformable clays.

6.2 Filling and Backfilling

There are no fill sections indicated on the GPE. If the existing embankment is over-excavated during the removal of the eastern 350 feet of existing Retaining Wall 13, however, the area will require fill materials. Fill material required to attain the final design elevations should be pre-approved prior to placement. Compacted cohesive or granular soil conforming to IDOT Section 204 would be acceptable as structural fill (2016) as long as it is not placed behind the wall. The fill material should be free of organic matter and debris. Fill should be placed in lifts and compacted according to IDOT Section 205, *Embankment* (2016).

Backfill materials must be pre-approved by the Resident Engineer. To backfill void areas behind and around the soldier pile wall we recommend the porous granular embankment conforming to the requirements specified in the IDOT Recurring Special Provision, *Granular Backfill for Structures* (2017). Backfill material should be placed and compacted in accordance with the Special Provision.

6.3 Earthwork Operations

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 may cause problems with new embankment compaction.

It is recommended that an experienced geotechnical engineer be retained to inspect the exposed subgrade, monitor earthwork operations, and provide material inspection services during the construction phase of this project. In the event that soldier pile prebores are indicated on the plans as extending to a specific elevation, the inspector should ensure during construction that the prebore does not terminate in soft or medium stiff clay. The prebore should continue until the underlying very stiff silty clay is encountered and confirmed by field shear strength testing.

6.4 Drilled Shaft Encasement

Groundwater was encountered within the lower portions of the fill, about 6 feet below the ground surface, and **will be encountered** during drilling of the soldier pile prebores. The installation of prebores extending into the very dense silt and silty loam (**Layer 5**) will encounter groundwater that will present challenges in maintaining an open borehole. The Contractor must be prepared to install temporary casings when this groundwater is encountered. Failure to anticipate the challenges posed by the groundwater at this location will result in caving or heaving sand and weakening of the foundation soils.

The squeeze ratio (Budiman et al. 2005) between elevations of 575 and 565 feet is estimated between about 5.5 and 6. The potential for shaft squeeze in the soft clay will depend on the final diameter of the shafts, but the upper limit to avoid squeezing will likely be around 5.5; therefore, we recommend temporary casing installed to an elevation of 560 feet at the shaft locations. In addition, the following note should appear on the final plans:

‘Due to the squeeze potential of the clay soils, the use of temporary casing will be required to Elevation 560 feet to properly construct the shafts. Casing may be pulled or remain in place, as determined by the Contractor at no cost to the Department.’

The tip of the shaft should not be terminated within the soft to medium stiff clay. The shaft should extend to a minimum elevation of 545 feet.

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 in 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 wall 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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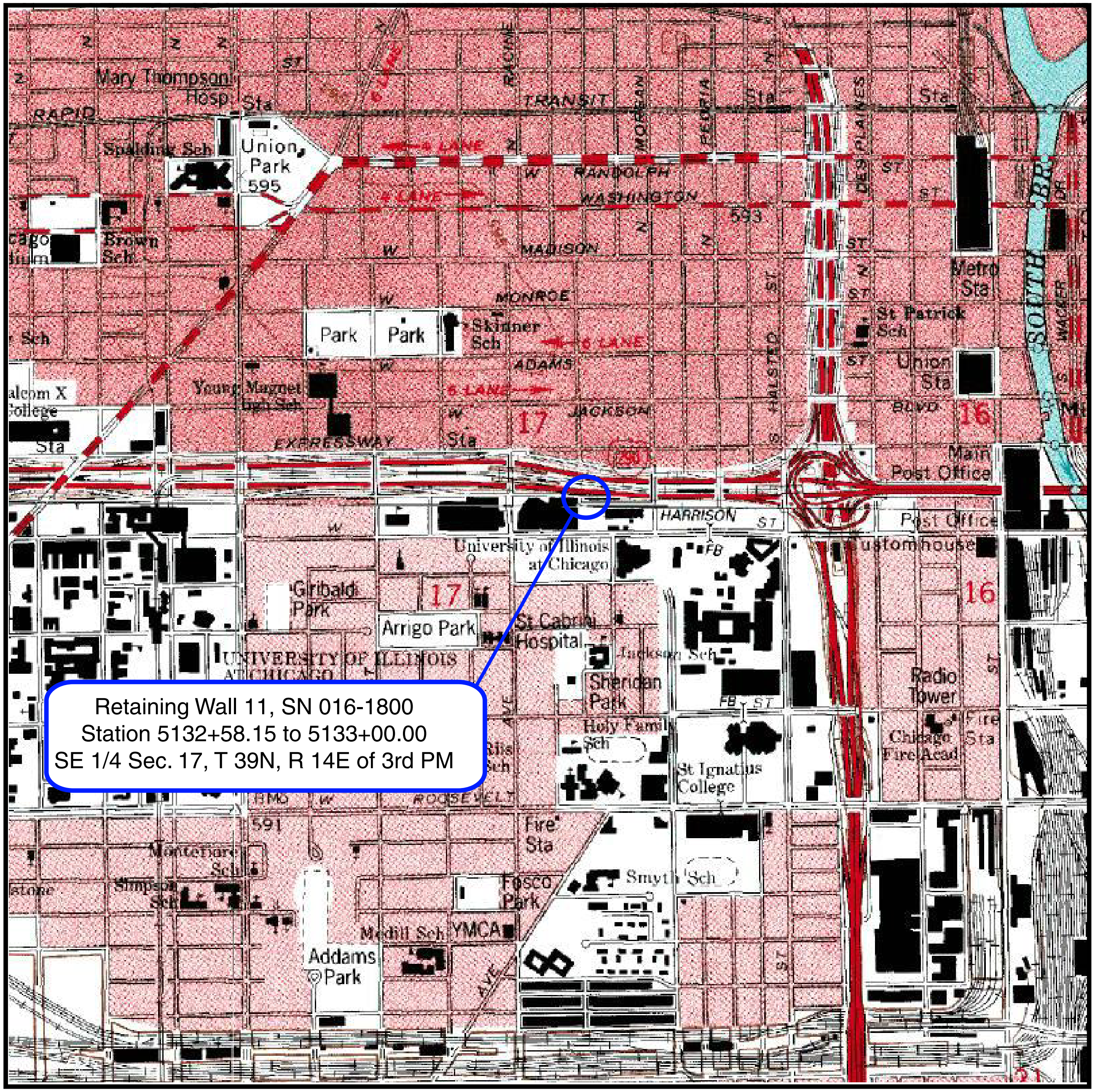
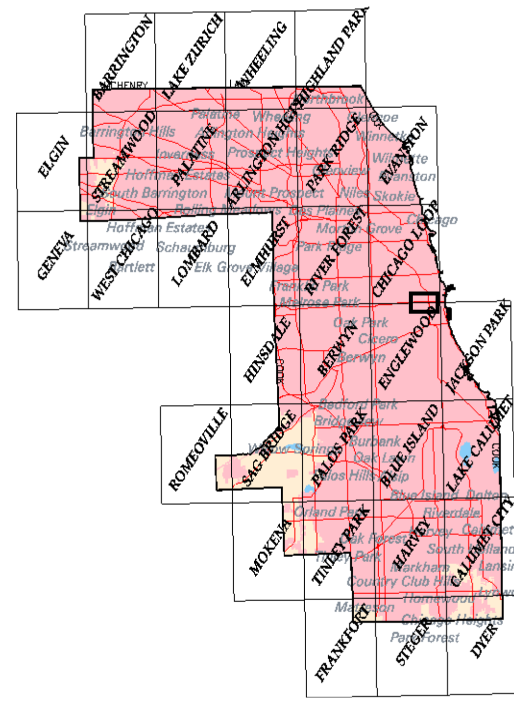
EXHIBITS



0 0.25 0.5 Mile



Cook County

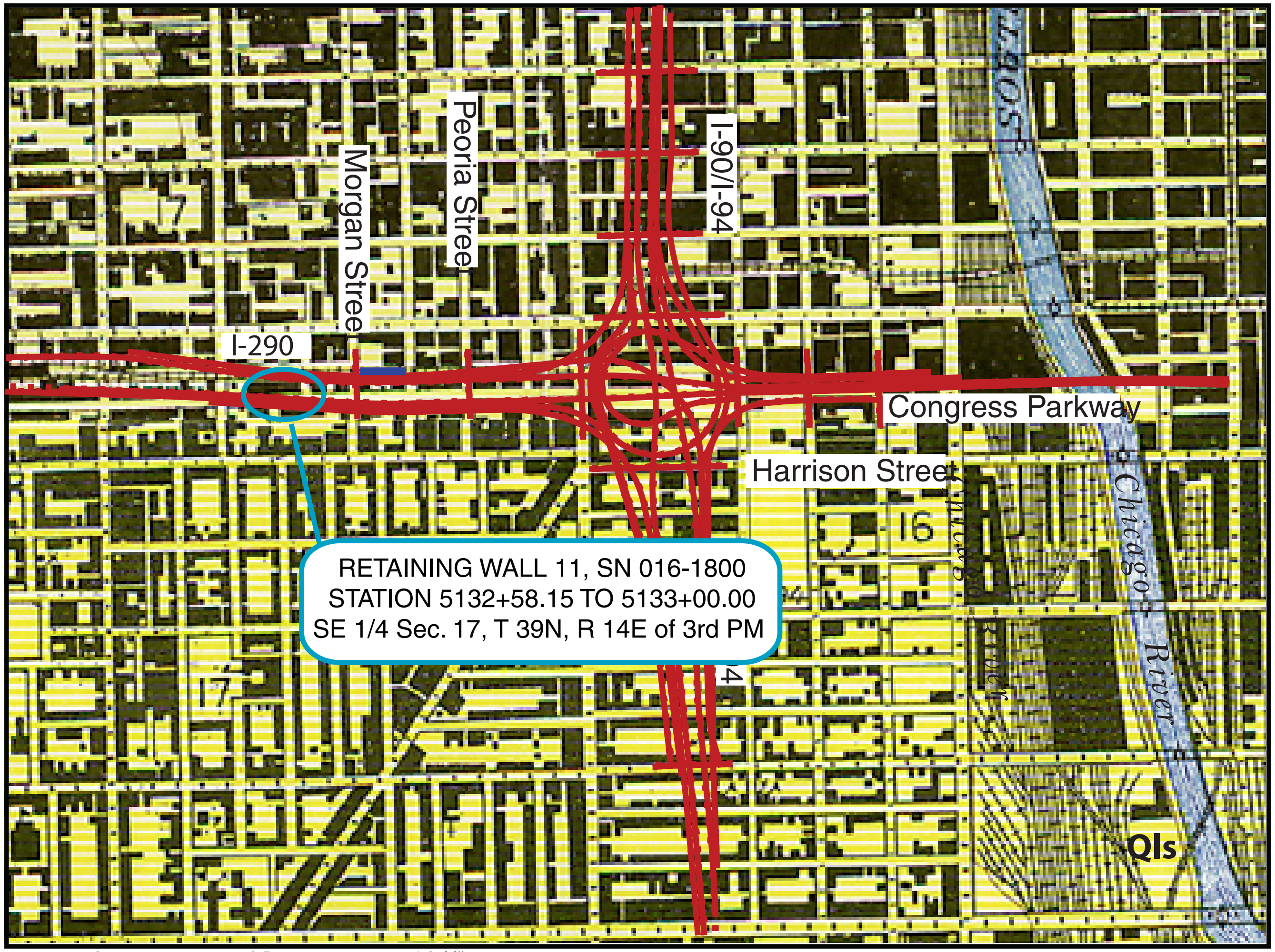
SITE LOCATION MAP: CIRCLE INTERCHANGE RECONSTRUCTION
RETAINING WALL 11, SN 016-1800, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: C. Marin CHECKED BY: M. Snider

Wang Engineering

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

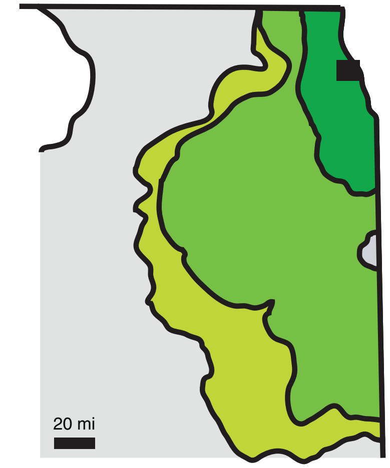
FOR AECOM | 1100-04-01



0 0.5 1.0 Miles

Modified after Bretz (1926)

REGIONAL GEOLOGY



Wedron Group

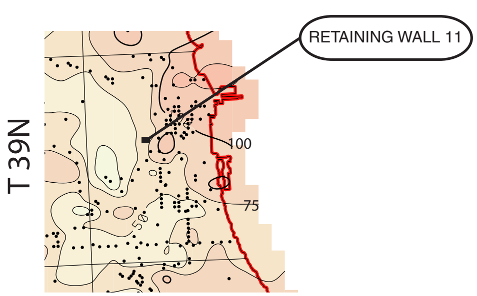
- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

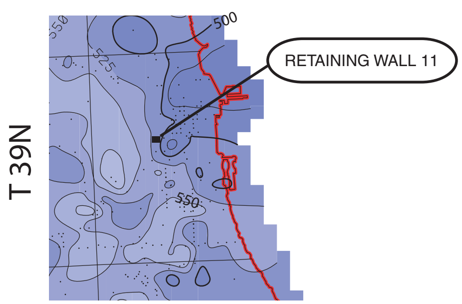
Legend

Qls — Glacial lake bottom (Covered by lacustrine deposits)

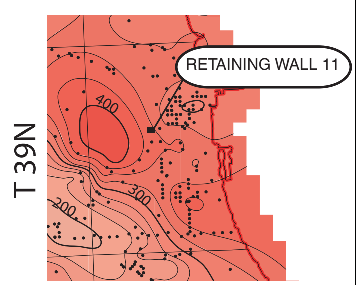
DRIFT THICKNESS



BEDROCK TOPOGRAPHY



SILURIAN BEDROCK THICKNESS



Modified after Leetaru et. al. (2004)

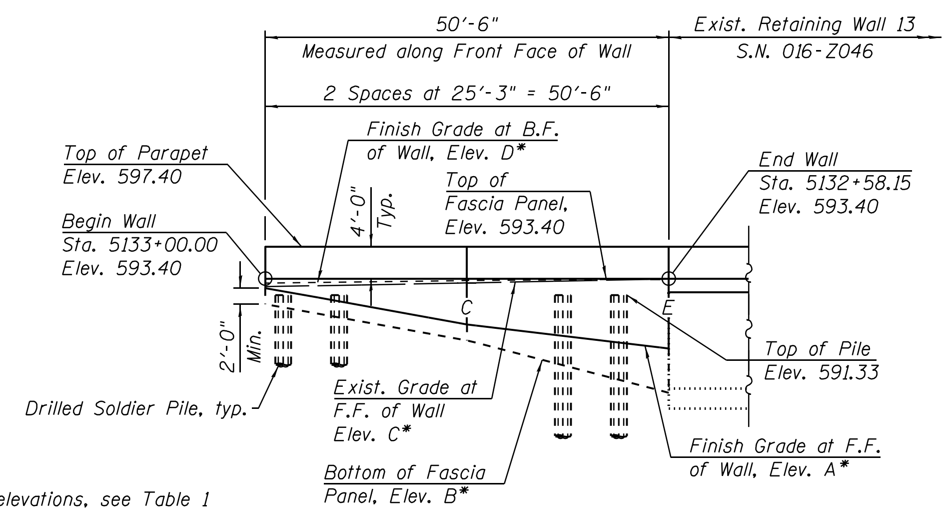
0 2 4 8 miles

SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION RETAINING WALL 11, SN 016-1800, COOK COUNTY, ILLINOIS		
SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: D. Wind CHECKED BY : C. Marin
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01

Bench Mark: Cut square on northwest corner of sign foundation at north side of Harrison Street, approximately 80' west of west line of Morgan Street. Elevation 593.07.

Existing Structure: None.

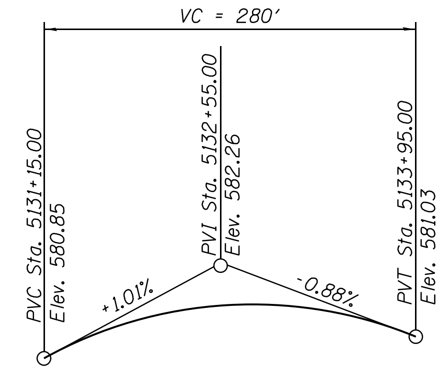
Traffic is to be maintained during construction.



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

ELEVATION

(Looking Southwest at F.F. of Wall. Proposed Concrete Barrier not shown for clarity.)



PROFILE GRADE

(Along ℄ I-290 EB)

LEGEND:

- Ex. Chain Link Fence
- Combined Sewer
- Electric
- Ex. Storm Sewer
- Prop. Storm Sewer
- Water
- Ex. ITS Cable
- Soil Boring
- Exist. Retaining Wall 13 to be removed

HIGHWAY CLASSIFICATION

F.A.I. Rte. 290 EB
Functional Class: Interstate
ADT: 32,500 (2012); 33,000 (2040)
ADTT: 380 (2012); 386 (2040)
DHV: 2,610 (2040)
Design Speed: 50 m.p.h.
Posted Speed: 45 m.p.h.
One-Way Traffic
Directional Distribution: 100%

DESIGN SPECIFICATIONS

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

DESIGN STRESSES

FIELD UNITS

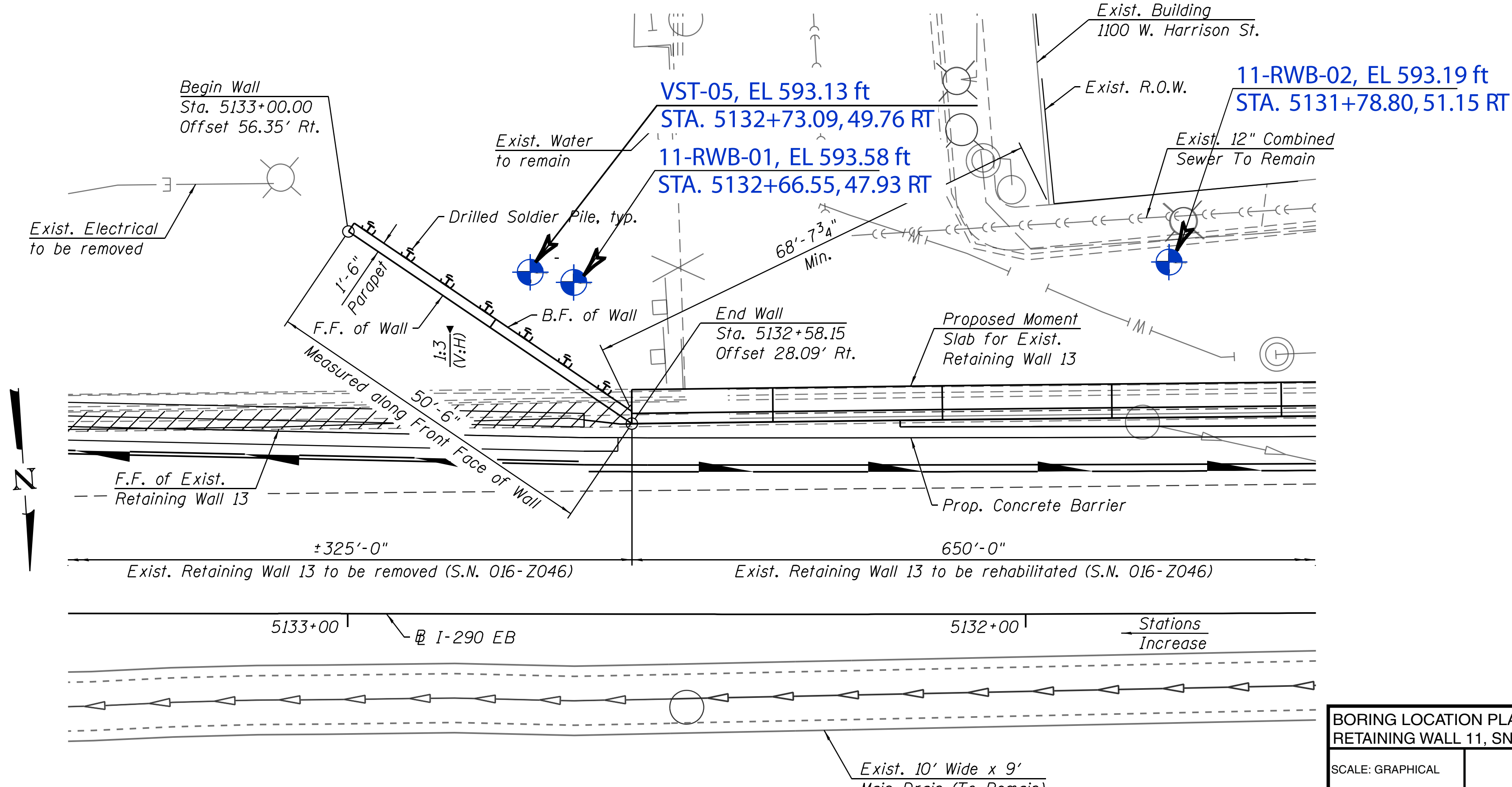
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

SOLDIER PILES

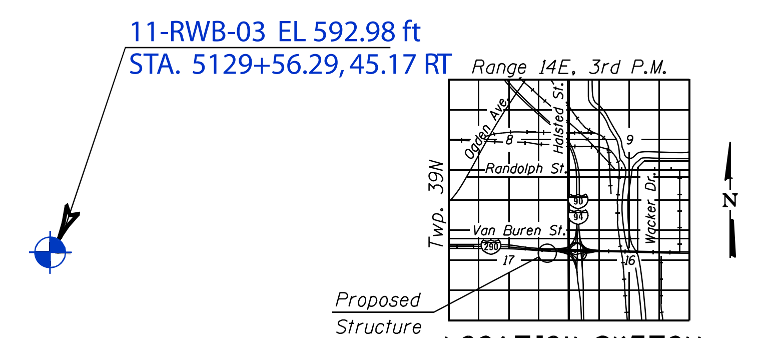
fy = 50,000 psi (AASHTO M260 Gr. 50)

WALL DEFLECTION CRITERIA:

Maximum total lateral wall deflection at top of wall: 1 inch.



PLAN



LOCATION SKETCH

Notes:

1.) Wall offsets are measured from the ℄ of F.A.I. Rte. 290 EB to the front face of cast-in-place fascia panels.
2.) C denotes Construction Joint
3.) E denotes Expansion Joint
4.) F.F. denotes Front Face.
5.) B.F. denotes Back Face.
6.) Wall to be built along straight chords between construction and expansion joints.
7.) Shaft diameter, spacing and tip elevation to be determined during final design.

GENERAL PLAN AND ELEVATION
RETAINING WALL 11 ALONG
F.A.I. RTE. 290 (EISENHOWER EXPRESSWAY)
SECTION 2014-002R&B
COOK COUNTY
STATION 5132+58.15 TO STATION 5133+00.00
STRUCTURE NO. 016-1800

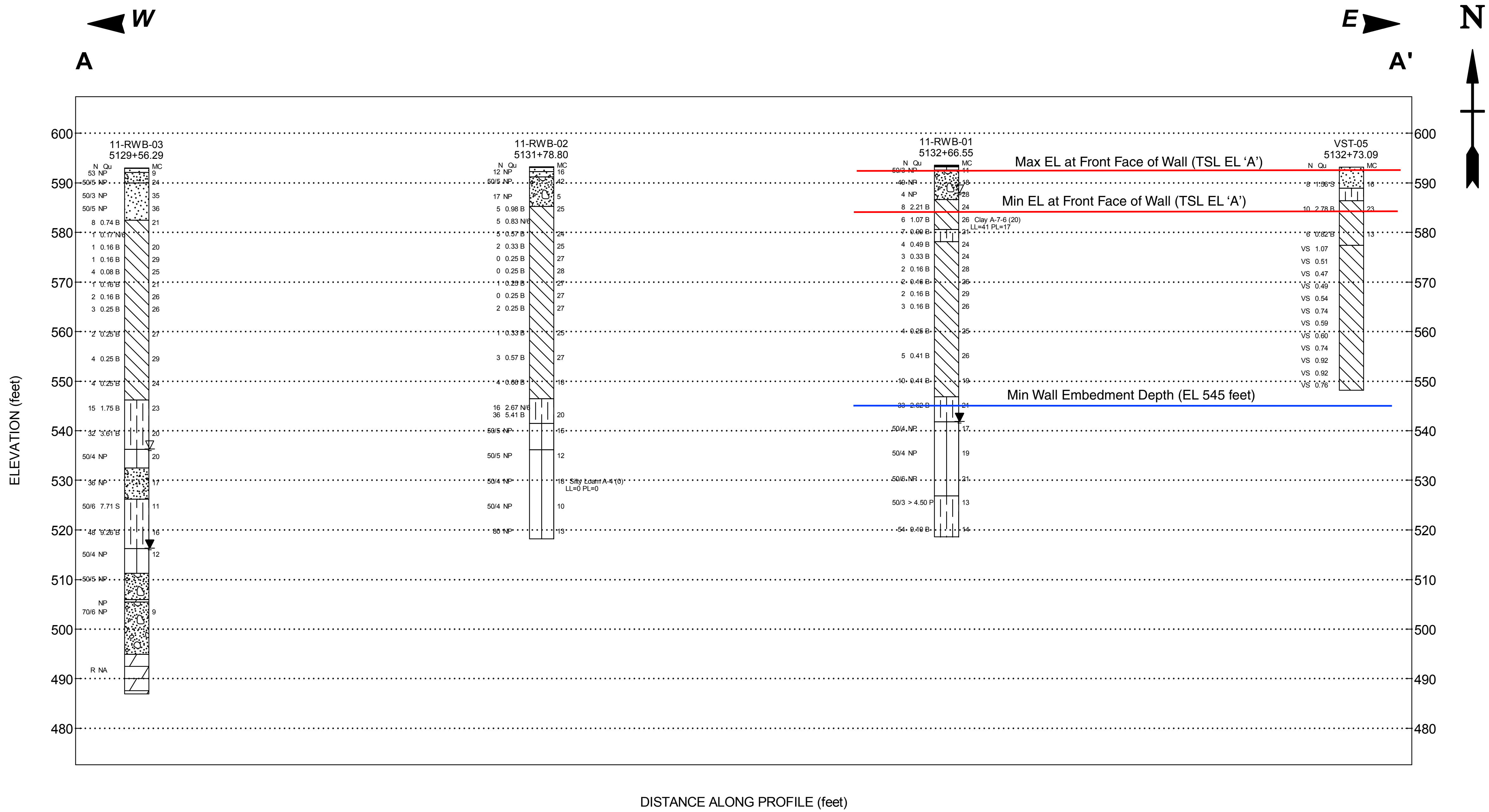
BORING LOCATION PLAN: CIRCLE INTERCHANGE RECONSTRUCTION RETAINING WALL 11, SN 016-1800, COOK COUNTY, ILLINOIS			
SCALE: GRAPHICAL	EXHIBIT 3	DRAWN BY: MLS CHECKED BY: CTF	
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com	
FOR AECOM		1100-04-01	

TranSystems	USER NAME = wjcolletti	DESIGNED - WJC	REVISED -
		CHECKED - DL	REVISED -
	PLOT SCALE = 24.00 ' / in.	DRAWN - WJC	REVISED -
	PLOT DATE = 11/17/2016	CHECKED - DL/TLR	REVISED -

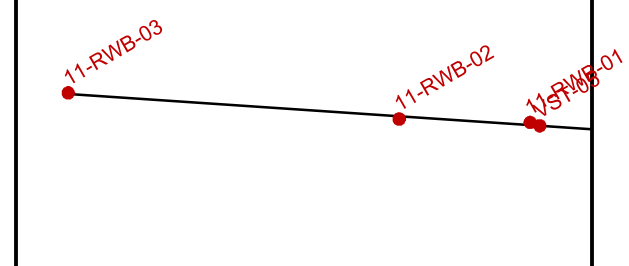
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
290	2014-002R&B	COOK	2	1
		CONTRACT NO. 60X76		
		ILLINOIS FED. AID PROJECT		

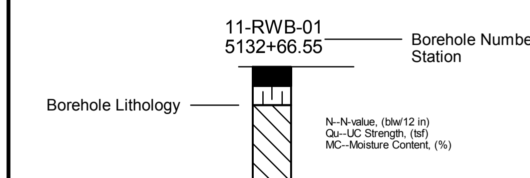


N



Site Map Scale 1 inch equals 130 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: 1.5x

Lithology Graphics

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

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

Soil Profile A-A'
Retaining Wall 11
SN 016-1800

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 11/9/16

APPENDIX A

Wang Engineering
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1145 N Main Street
Lombard, IL 60148
Telephone: (630) 953-9928
Fax:

BORING LOG 11-RWB-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: 593.58 ft
North: 1897883.55 ft
East: 1169168.23 ft
Station: 5132+66.55
Offset: 47.9312 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION
593.3	4-inch thick, dark brown SILTY LOAM --TOPSOIL--
592.6	Brown SILTY CLAY LOAM --FILL--
	Dense to very dense, brown GRAVELLY SAND --FILL--
586.6	Stiff to very stiff, brown and gray CLAY to SILTY CLAY, trace gravel --L_L(%)=41, P_L(%)=17-- --%Gravel=3.0-- --%Sand=13.2-- --%Silt=48.0-- --%Clay=35.8-- --A-7-6 (20)--
580.6	Medium stiff, gray SILTY CLAY
578.1	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel

Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	1	50/3	NP	11
5	2	8, 37, 12	NP	18
	3	5, 2, 2	NP	28
10	4	2, 3, 5	2.21 B	24
	5	2, 2, 4	1.07 B	26
15	6	2, 3, 4	0.90 B	21
	7	2, 2, 2	0.49 B	24
20	8	1, 2, 1	0.33 B	24
	9	0, 1, 1	0.16 B	28
25	10	0, 1, 1	0.16 B	26
	11	0, 1, 1	0.16 B	29
30	12	1, 1, 2	0.16 B	26
35	13	1, 2, 2	0.25 B	25
40	14	2, 2, 3	0.41 B	26

GENERAL NOTES

Begin Drilling **10-23-2013** Complete Drilling **10-23-2013**
Drilling Contractor **Wang Testing Services** Drill Rig
Driller **P&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ∇ **6.00 ft**
At Completion of Drilling ▼ **52.00 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 11-RWB-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: 593.58 ft
North: 1897883.55 ft
East: 1169168.23 ft
Station: 5132+66.55
Offset: 47.9312 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		45	15	2 3 7	0.41 B	19
546.8	Very stiff, gray SILTY CLAY, trace gravel					
		50	16	5 10 23	2.62 B	21
541.8	Very dense, gray SILT --Saturated--					
		55	18	39 50/4	NP	17
		60	19	41 50/4	NP	19
		65	20	33 50/6	NP	21
526.8	Hard, gray SILTY CLAY LOAM to SILTY LOAM, trace gravel					
		70	21	33 50/3	> 4.50 P	13
	--HARD DRILLING-- *--Possible Cobbles--*					
518.6		75	22	18 25 29	9.10 B	14
	Boring terminated at 75.00 ft					

GENERAL NOTES

Begin Drilling **10-23-2013** Complete Drilling **10-23-2013**
Drilling Contractor **Wang Testing Services** Drill Rig
Driller **P&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **6.00 ft**
At Completion of Drilling ▼ **52.00 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 11-RWB-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: 593.19 ft
North: 1897885.77 ft
East: 1169080.64 ft
Station: 5131+78.80
Offset: 51.1460 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
593.1	1.5-inch thick ASPHALT --PAVEMENT--					
592.2	10-inch thick CONCRETE --PAVEMENT--		1	3 3 9	NP	16
591.2	12-inch thick CRUSHED STONE --BASE COURSE--					
	Medium dense to very dense, gray and green GRAVELLY SAND, some slag --FILL--		2	50/5	NP	42
		5	3	16 9 8	NP	5
585.2	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel		4	5 2 3	0.98 B	25
		10	5	2 3 2	0.83 N/6	
			6	3 3 2	0.57 B	24
		15	7	0 0 2	0.33 B	25
		20	8	0 0 0	0.25 B	27
			9	0 0 0	0.25 B	28
		25	10	0 0 1	0.25 B	27
			11	0 0 0	0.25 B	27
		30	12	0 0 2	0.25 B	27
		35	13	0 0 1	0.33 B	25
		40	14	0 1 2	0.57 B	27

GENERAL NOTES

Begin Drilling **10-22-2013** Complete Drilling **10-22-2013**
Drilling Contractor **Wang Testing Services** Drill Rig
Driller **R&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
At Completion of Drilling **unable to measure**
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 11-RWB-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: 593.19 ft
North: 1897885.77 ft
East: 1169080.64 ft
Station: 5131+78.80
Offset: 51.1460 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			15	0 / 1 / 3	0.66 B	18
		45				
546.4	Very stiff to hard, gray SILTY CLAY, trace gravel					
			16	3 / 7 / 9	2.67 N/6	
		50				
			17	8 / 14 / 22	5.41 B	20
541.4	Very dense, gray SILT					
			18	38 / 50/5	NP	15
		55				
	--HARD DRILLING-- *--Possible Cobbles--*					
536.2	Very dense, gray SILTY LOAM, trace gravel					
			19	29 / 50/5	NP	12
		60				
	--L_L(%)=NP, P_L(%)=NP-- --%Gravel=0.2-- --%Sand=20.9-- --%Silt=75.0-- --%Clay=3.9-- --A-4 (0)--	65	20	20 / 30 / 50/4	NP	18
		70	21	26 / 40 / 50/4	NP	10
			22	20 / 32 / 48	NP	13
518.2	Boring terminated at 75.00 ft	75				
		80				

GENERAL NOTES

Begin Drilling: **10-22-2013** Complete Drilling: **10-22-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **R&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **unable to measure**
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 11-RWB-03

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 592.98 ft
North: 1897903.26 ft
East: 1168859.46 ft
Station: 5129+56.29
Offset: 45.1732 RT

Elevation (ft)	Soil and Rock Description	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
592.9	1.5-inch thick ASPHALT --PAVEMENT--					
592.1	9.5-inch thick CONCRETE --PAVEMENT--					
	Very dense, brown, coarse SAND, little gravel and cinders --FILL--		1	12 25 28	NP	9
590.0	Very dense, brown SANDY LOAM, trace slag --FILL--		2	50/5	NP	24
		5	3	16 50/3	NP	35
			4	19 50/5	NP	36
582.5	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel	10	5	2 4 4	0.74 B	21
			6	1 1 0	0.17 N/6	
		15	7	0 0 1	0.16 B	20
			8	0 0 1	0.16 B	29
		20	9	0 2 2	0.08 B	25
			10	0 0 1	0.16 B	21
		25	11	2 1 1	0.16 B	26
			12	4 2 1	0.25 B	26
		30	13	0 0 2	0.25 B	27
		35	14	1 2 2	0.25 B	29
		40				

GENERAL NOTES

Begin Drilling **10-23-2013** Complete Drilling **10-29-2013**
Drilling Contractor **Wang Testing Services** Drill Rig
Driller **R&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **57.00 ft**
At Completion of Drilling **77.00 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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Fax:

BORING LOG 11-RWB-03

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 592.98 ft
North: 1897903.26 ft
East: 1168859.46 ft
Station: 5129+56.29
Offset: 45.1732 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		45	15	0 2 2	0.25 B	24
546.2	Stiff to very stiff, gray SILTY CLAY, trace to little gravel					
		50	16	3 6 9	1.75 B	23
		55	17	12 12 20	3.61 B	20
536.2	Very dense, gray SILTY LOAM, trace gravel --Saturated--					
	--HARD DRILLING-- *--Possible Cobbles--*	60	18	14 50/4	NP	20
532.5	Dense, gray, medium to coarse SAND --Saturated--					
		65	19	10 17 19	NP	17
526.2	Hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel					
		70	20	29 50/6	7.71 S	11
		75	21	13 19 29	9.26 B	16
516.2	Very dense, gray SILTY LOAM, trace gravel					
		80	22	50/4	NP	12

GENERAL NOTES

Begin Drilling **10-23-2013** Complete Drilling **10-29-2013**
Drilling Contractor **Wang Testing Services** Drill Rig
Driller **R&N** Logger **D. Kolpacki** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **57.00 ft**
At Completion of Drilling ▼ **77.00 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 11-RWB-03

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 592.98 ft
North: 1897903.26 ft
East: 1168859.46 ft
Station: 5129+56.29
Offset: 45.1732 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	--HARD DRILLING-- *--Possible Cobbles--*						
511.2	Very dense, gray SANDY GRAVEL, some cobbles and boulders			23	50/5	NP	
		85					
506.0	--4-inch DOLOSTONE BOULDER--						
505.5				24		NP	
		90		25	70/6	NP	9
		95					
495.0	Strong, light gray, good rock mass quality, bedded fresh DOLOSTONE, up to 30-inch beds, 11-inch joint spacing,	100			CORE		

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	horizontal and vertical joints with none to less than 0.2-inch greenish gray infilling, hard joint wall, with stylolitic surfaces, and moderately vuggy porosity.			1			
	--Run 1 - RECOVERY=100%-- --RQD=90%--						
	--3-inch thick, greenish gray SILTY - SHALE cavity infill	105					
487.0	Boring terminated at 106.00 ft						
		110					
		115					
		120					

GENERAL NOTES

Begin Drilling: **10-23-2013** Complete Drilling: **10-29-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **R&N** Logger: **D. Kolpacki** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **57.00 ft**
At Completion of Drilling: **77.00 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 VST-05

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 593.13 ft
North: 1897881.32 ft
East: 1169174.65 ft
Station: 5132+73.09
Offset: 49.755 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type (recovery)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	Loose, brown fine SAND --FILL--						
588.9	Stiff, gray SILTY CLAY, trace gravel --FILL--	5		1	5 5 3	1.56 S	16
586.4	Medium stiff to very stiff, gray SILTY CLAY, trace sand and gravel			2	3 4 6	2.78 B	23
		10					
		15		3	2 2 4	0.82 B	13
577.4							
	--In-Situ Vane Shear, 17.5 feet-- --$S_{u\ undis}$ = 1070.2 psf-- --$S_{u\ remold}$ = 480.5 psf-- --Sensitivity = 2.2--		VS	1	VS		
	--In-Situ Vane Shear, 19.5 feet--	20	VS	2	VS		
	--$S_{u\ undis}$ = 513.3 psf-- --$S_{u\ remold}$ = 349.5 psf-- --Sensitivity = 1.5--						
	--In-Situ Vane Shear, 22.0 feet-- --$S_{u\ undis}$ = 469.6 psf-- --$S_{u\ remold}$ = 267.6 psf-- --Sensitivity = 1.8--		VS	3	VS		
	--In-Situ Vane Shear, 24.5 feet-- --$S_{u\ undis}$ = 486.0 psf-- --$S_{u\ remold}$ = 267.6 psf-- --Sensitivity = 1.8--	25	VS	4	VS		
	--In-Situ Vane Shear, 27.0 feet-- --$S_{u\ undis}$ = 540.6 psf-- --$S_{u\ remold}$ = 322.2 psf-- --Sensitivity = 1.7--		VS	5	VS		
	--In-Situ Vane Shear, 29.5 feet-- --$S_{u\ undis}$ = 737.2 psf-- --$S_{u\ remold}$ = 371.3 psf-- --Sensitivity = 2.0--	30	VS	6	VS		
	--In-Situ Vane Shear, 32.0 feet-- --$S_{u\ undis}$ = 589.7 psf-- --$S_{u\ remold}$ = 404.1 psf-- --Sensitivity = 1.5--		VS	7	VS		
	--In-Situ Vane Shear, 34.5 feet-- --$S_{u\ undis}$ = 600.6 psf-- --$S_{u\ remold}$ = 447.8 psf-- --Sensitivity = 1.3--	35	VS	8	VS		
	--In-Situ Vane Shear, 37.0 feet-- --$S_{u\ undis}$ = 742.6 psf-- --$S_{u\ remold}$ = 502.4 psf-- --Sensitivity = 1.5--		VS	9	VS		
	--In-Situ Vane Shear, 39.5 feet--	40	VS	10			

GENERAL NOTES

Begin Drilling **12-03-2015** Complete Drilling **12-03-2015**
Drilling Contractor **Wang Testing Services** Drill Rig
Driller **R&N** Logger **A. Kurnia** 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 **unable to measure**
Time After Drilling **NA**
Depth to Water **NA**

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BORING LOG VST-05

WEI Job No.: 1100-04-01

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

Datum: NAVD 88
Elevation: 593.13 ft
North: 1897881.32 ft
East: 1169174.65 ft
Station: 5132+73.09
Offset: 49.755 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--$S_{u\ undis}$ = 917.3 psf-- --$S_{u\ remold}$ = 666.2 psf-- --Sensitivity = 1.4--				VS		
		--In-Situ Vane Shear, 42.0 feet-- --$S_{u\ undis}$ = 917.3 psf-- --$S_{u\ remold}$ = 567.9 psf-- --Sensitivity = 1.6--			11	VS		
	548.1	--In-Situ Vane Shear, 44.5 feet-- --$S_{u\ undis}$ = 764.5 psf-- --$S_{u\ remold}$ = 371.3 psf-- --Sensitivity = 2.1--	45		12	VS		
		Boring terminated at 45.00 ft						
			50					
			55					
			60					

GENERAL NOTES

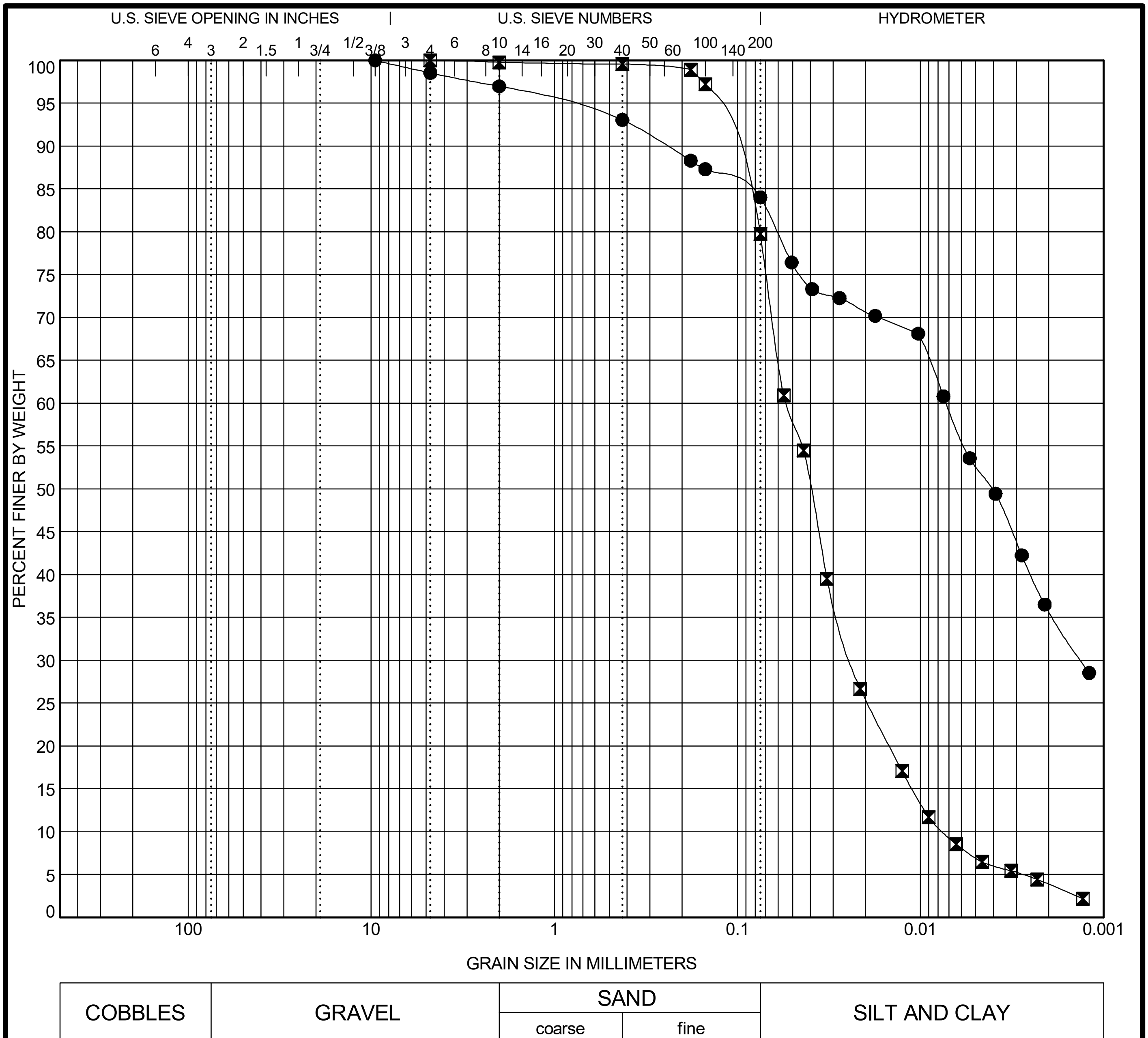
Begin Drilling **12-03-2015** Complete Drilling **12-03-2015**
Drilling Contractor **Wang Testing Services** Drill Rig
Driller **R&N** Logger **A. Kurnia** Checked by **A. Kurnia**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
At Completion of Drilling **unable to measure**
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



	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	**11-RWB-01#5**	**11.0 ft**	**Clay**	**41**	**17**	**24**		
⧗	**11-RWB-02#20**	**63.5 ft**	**Silty Loam**	**NP**	**NP**	**NP**	**1.40**	**7.21**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**11-RWB-01#5**	**11.0 ft**	**9.5**	**0.007**	**0.001**		**3.0**	**13.2**	**48.0**	**35.8**
⧗	**11-RWB-02#20**	**63.5 ft**	**4.75**	**0.054**	**0.024**	**0.007**	**0.2**	**20.9**	**75.0**	**3.9**

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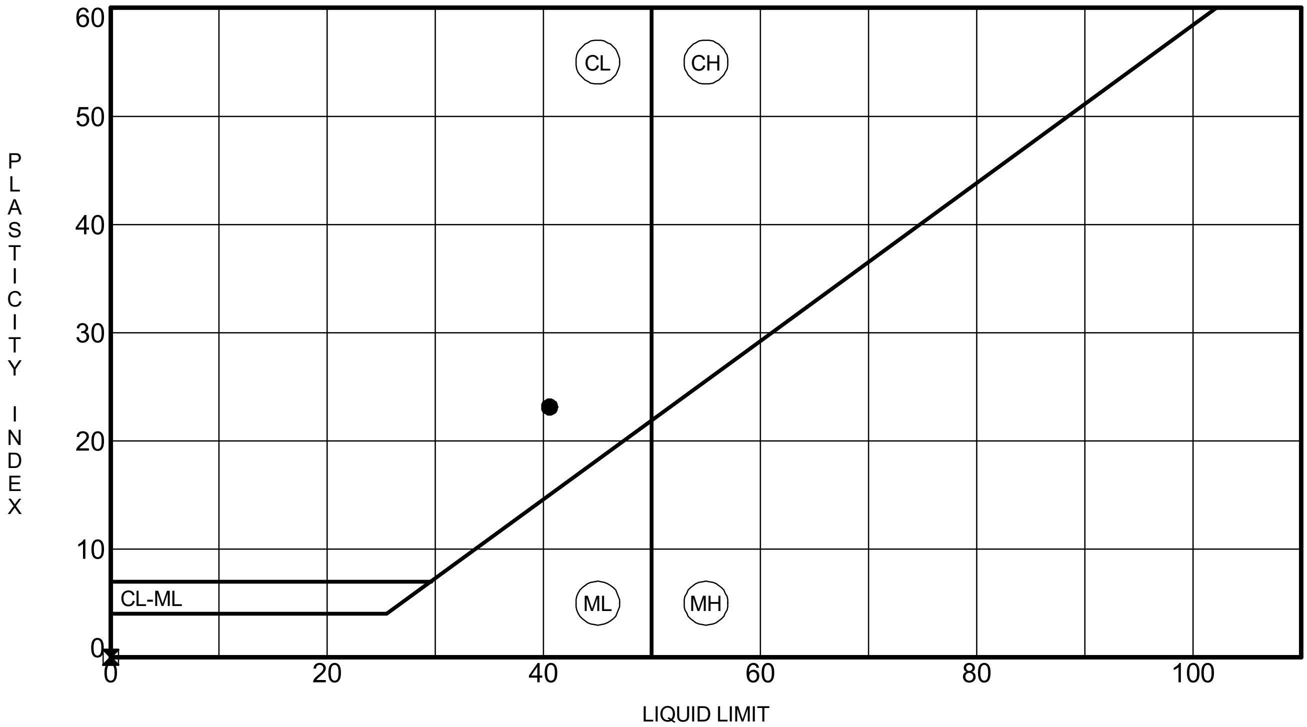
GRAIN SIZE DISTRIBUTION

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 11/7/16



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	**11-RWB-01#5**	**11.0 ft**	**41**	**17**	**24**	**84**	**Clay**
⧗	**11-RWB-02#20**	**63.5 ft**	**NP**	**NP**	**NP**	**80**	**Silty Loam**

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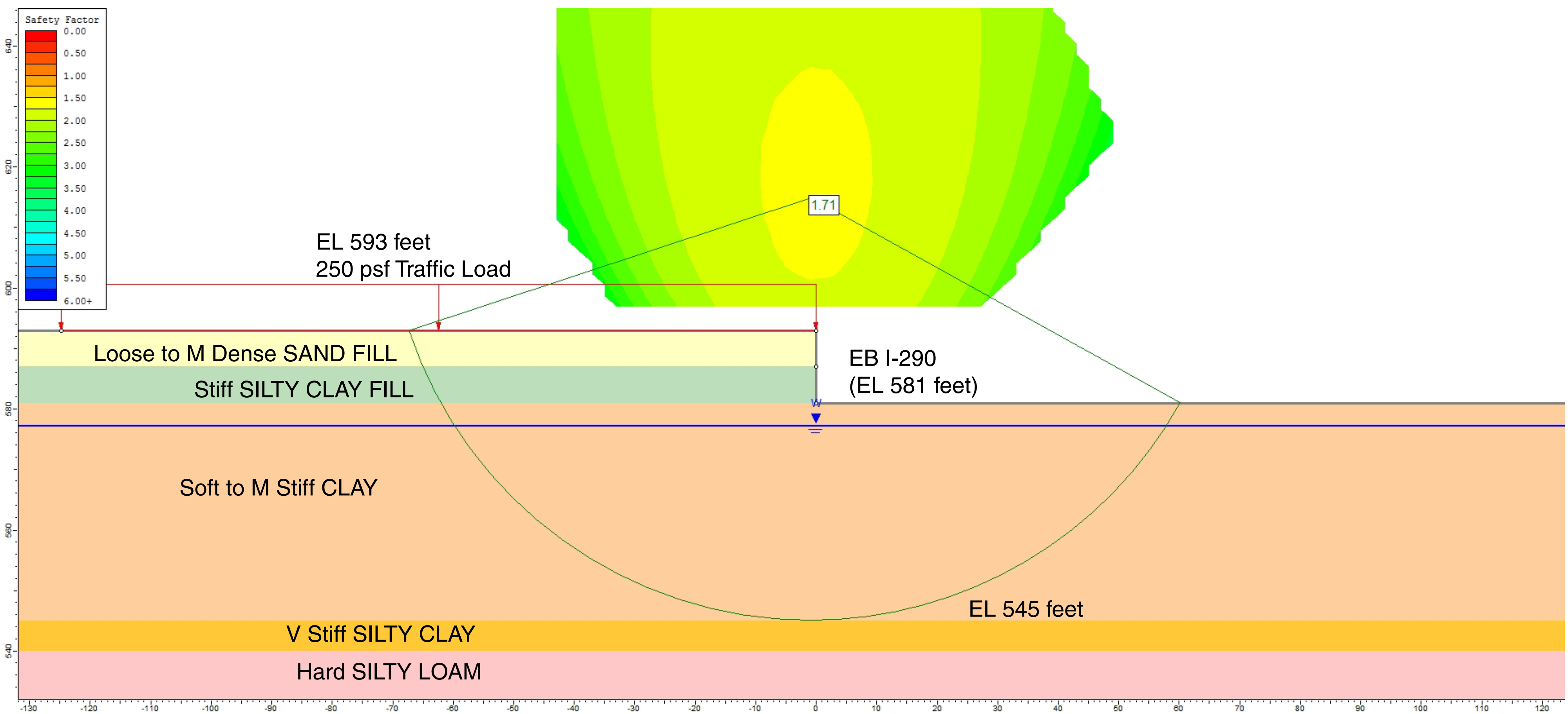
ATTERBERG LIMITS' RESULTS

Project: Circle Interchange Reconstruction

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

Number: 1100-04-01

APPENDIX C



Undrained Analysis for Wall Stability, Station 5132+58, Ref Boring 11-RWB-01, VST-05

Layer ID	Description	Total Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	SAND FILL	120	0	30
2	Stiff SI CLAY FILL	125	1500	0
3	Soft to M Stiff CLAY	120	500	0
4	V Stiff SI CLAY	125	2600	0
5	Hard SI LOAM	125	4500	38

GLOBAL STABILITY: CIRCLE INTERCHANGE RECONSTRUCTION
RETAINING WALL 11, SN 016-1800, COOK COUNTY, ILLINOIS

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

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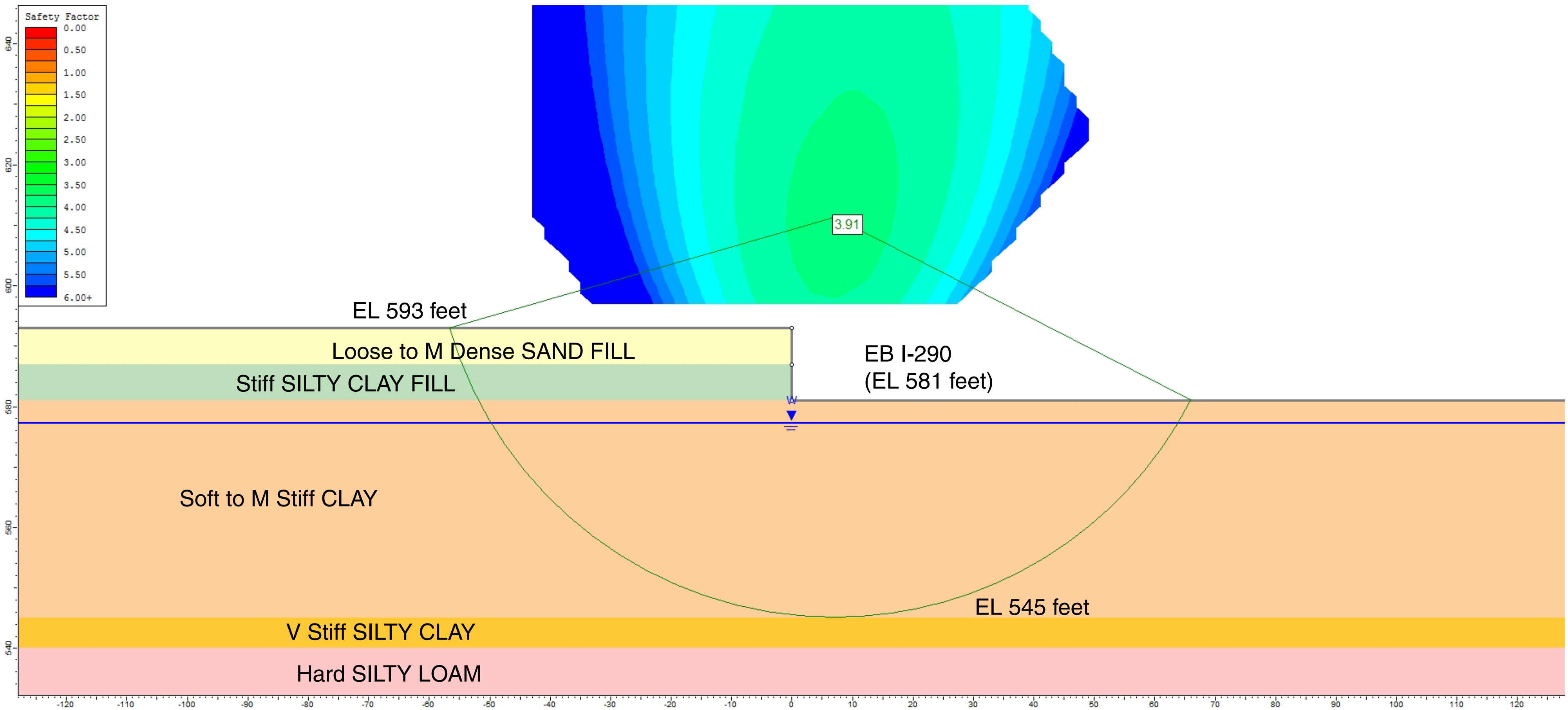

Drained Analysis for Wall Stability, Station 5132+58, Ref Boring 11-RWB-01, VST-05

Layer ID	Description	Total Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	SAND FILL	120	0	30
2	Stiff SI CLAY FILL	125	0	26
3	Soft to M Stiff CLAY	120	0	26
4	V Stiff SI CLAY	125	100	30
5	Hard SI LOAM	125	0	38

GLOBAL STABILITY: CIRCLE INTERCHANGE RECONSTRUCTION RETAINING WALL 11, SN 016-1800, COOK COUNTY, ILLINOIS		
SCALE: GRAPHICAL	APPENDIX C-2	DRAWN BY: HKB CHECKED BY: MLS
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