STRUCTURE GEOTECHNICAL REPORT
TORRENCE AVENUE
OVER GRAND CALUMET RIVER
BRIDGE
EXISTING SN 016-0934, PROPOSED SN 016-2089
IDOT PTB 163-004
COOK COUNTY, ILLINOIS

for

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11. Abstract

The existing five-span structure will be replaced with three-span structure carrying the northbound and southbound Torrence Avenue traffic. The new structure will have an overall length of 471'-0" from back-to-back of abutments with individual end spans of 146'-0" and middle span of 179'-0". This report provides geotechnical recommendations for the design of the proposed bridge foundations.

Below up to 28 feet granular and cohesive embankment fill, the foundation soils consists of 2.5 to 10 feet of very loose to dense sandy loam to gravelly sand, 5 to 16 feet of very soft to very stiff clay to silty clay lake bottom deposits, 10 to 30 feet of stiff to hard silty clay to silty loam diamicton, 17 to 27 feet of hard silty clay loam to very dense silty loam hardpan, and occasional up to 4 feet of weathered bedrock. Dolostone bedrock was encountered at elevations varying from 510.0 to 514.4 feet. The site classifies in the Seismic Class C.

The abutments could be supported on driven H-piles and piers could be supported on drilled shafts established in the very dense silty loam layer, on top of the bedrock, or socketed into bedrock. Design recommendations for the driven piles and drilled shafts are included in the report.

The bridge will be constructed in one stage.

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FOR
STV INCORPORATED

1.0 INTRODUCTION

This report presents the results of Wang Engineering, Inc. (Wang) subsurface investigation, laboratory testing, and geotechnical engineering evaluations for the proposed reconstruction of the bridge carrying Torrence Avenue (FAP 358) over Grand Calumet River in Cook County, Illinois. Torrence Avenue is oriented north-south and the crossing with the Grand Calumet River is located one mile east of I-94 (Bishop Ford Freeway) on the border of the City of Chicago and the Village of Burnham, in Thornton Township. 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 bridge foundations and approach embankments.

Wang submitted final SGR dated October 22, 2013 to STV Inc. (STV). On December 6, 2013, Wang received comments on this SGR from IDOT Bureau of Bridges and Structure (BBS), Foundation and Geotechnical Unit (FGU). Subsequently, STV revised TSL plan based on comments from and discussion with IDOT BBS and IDOT District One offices. The revised TSL plan received by Wang on July 15, 2014 showed lower profile, different span configuration, reduced total length of the bridge and abutments to be integral type. This SGR is revised based on revised TSL plan and IDOT BBS-FGU comments on previous SGR.

1.1 Proposed Structure

The proposed bridge structure will consists of a three span steel superstructure founded on reinforced concrete integral abutments and multi-column piers. The structure will have an overall length of 471'-

0" from back-to-back of abutments with individual end spans 146'-0" and center span of 179'-0". The bridge will have an out-to-out deck width of 80'-0" accommodating two travel lanes, two shoulders and two sidewalks.

Preliminary service and factored loads provided by STV, Inc. are shown in Table 1.

Table 1: Preliminary Foundation Loads

Substructure ID	Service Dead Load (kips)	Service Live Load (kips)	Combined Service Load (kips)	Estimated Total Factored Load (kips)
North Abutment	910	400	1310	1860
Pier 1	3290	820	4110	5670
Pier 2	3290	820	4110	5670
South Abutment	910	400	1310	1860

1.3 Existing Structure

The existing bridge was originally constructed in 1938, modified in 1970 and various repairs took place in 1995, 1996, 1997 and 2010. The structure length is 523'-3 5/8" measured from back-to-back of abutment. The out-to-out width of the approach spans is 63'-7" and out-to-out width of the main span is 62'-1". The bridge carries Torrence Avenue northbound and southbound with two 11-foot lanes in each direction with no median. The bridge has a sidewalk adjacent to both direction traffic. The main span crosses the Grand Calumet River. The GCR channel is blocked by a sunken barge and two boats, and thus is not navigable. The substructure consists of cast-in-place concrete spill through abutments founded on timber piles with wingwalls supported by and in line with the abutments. The four cast-in-place concrete piers are founded on timber piles.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The project area is located at the border of the Village of Burnham and the City of Chicago. On the USGS *Lake Calumet 7.5 Minute Series Quadrangle* map, the bridge is located at the intersection of four sections: the SE¼ of Section 36, Tier 37 N, Range 14 E, SW¼ of Section 31, Tier 37 N, Range 15 E, NE¼ of Section 1, Tier 36N, Range 14E, and NW¼ of Section 6, Tier 36 N, Range 15 E of the

Third Principal Meridian. The *Site Location Map* is presented as Exhibit 1.

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 bridge is situated within the eastern section of the Chicago/Calumet lacustrine plain (Chrzatowsky and Thompson 1992). The area is flat. The lakeward sloping ground moraine surface is covered by lacustrine silt and clay, and occasional offshore sand bars.

At the Torrence Avenue Bridge over the Grand Calumet River the roadway is supported by up to 25 feet of embankment and runs through its extensive floodplain. North and south of the bridge, approach elevations range between 609 and 611 feet. The Grand Calumet River channel is approximately 200 feet wide and the water elevation is approximately 577 feet.

2.2 Surficial Cover

The project area was shaped during the Wisconsinian-age glaciation. An approximately 70-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 underlined 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 a 450-foot thick Silurian-age dolostone (Leetaru et al 2004). The top of bedrock may be encountered at 510 to 530 feet elevation or 65 to 95 feet below ground surface (bgs). 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 to the proposed structure from the existing faults 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 and silt with occasional organic traces of the Equality Formation, 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 or inferred at depths ranging from 64.0 to 98.5 feet bgs or 512.3 to 515.9 feet elevation, within or close to the range predicted based on published geological data.

3.0 EXISTING GEOTECHNICAL DATA

Boring 9 was performed by Testing Service Corporation in 1996 to a depth of 66 feet below the grade elevation as was at that time. The boring was performed near the existing south pier and indicated top of bedrock at approximate elevation 516.4 feet. Existing boring log is included in Appendix A.

4.0 METHODS OF INVESTIGATION

4.1 Subsurface Investigation

Wang drilled eight bridge borings between September 4 and September 20, 2013 that were designated as BSB-01 through BSB-08. Boring RW2-02 drilled by Wang for the nearby retaining wall was used to supplement the bridge subsurface investigation. The investigated substructure, ground surface elevations, and reference boring termination depths are summarized in Tables 2. The as drilled boring locations were surveyed by Dynasty Group, Inc., and station and offset information for each boring were provided by STV Inc. 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).

Boring program was developed and performed based on original substructure locations. Originally the north abutment and Pier 2 locations were proposed to be approximately 50 feet north of the locations shown on TSL plan. Also borings for the piers could not be performed at the proposed pier locations due to insufficient river water depth for the barge drilling. Boring BSB-02 for the south abutment could not be performed at the proposed abutment location due to access problem.

Table 2: Bridge Boring Summary

Bridge Substructure	Reference Borings	Existing Grade Elevation at Boring Location (feet)	Boring Depth (feet)
South Abutment	BSB-01, BSB-02, and RW2-02	583.4 - 610.2	73.0 - 106.0
Pier 1	BSB-03 and BSB-04	577.4 - 579.9	63.0 - 84.0
Pier 2	BSB-05 and BSB-06	580.0 -584.2	67.0-89.0
North Abutment	BSB-07 and BSB-08	610.7 -610.8	99.5-108.0

Truck- and ATV-mounted drilling rigs, equipped with solid and hollow stem augers, were used to advance and maintain an open borehole up to 30 feet bgs and then mud rotary drilling technique was used to boring termination depths or to the top of bedrock. Soil sampling was performed according to AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils*." We utilized automatic SPT hammer. The soil was sampled at 2.5-foot intervals to 30 feet bgs and at 5-foot intervals to boring termination depth. Soil samples collected from each interval were placed in sealed jars and transported to Wang Geotechnical Laboratory in Lombard, Illinois for further examination and laboratory testing. Five to ten foot long bedrock cores were obtained from Borings BSB-01, BSB-04, BSB-05, and BSB-08 with an NWD4 size core barrel.

Field boring logs, prepared and maintained by a Wang soil inspector or geologist, include lithological descriptions, visual-manual soil classifications, results of Rimac and pocket penetrometer unconfined compressive strength tests, and results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration, rock cores recovery and Rock Quality Designation (RQD). 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 and at the end of drilling operations. Due to safety considerations, boreholes were backfilled with grout immediately upon completion.

4.2 Laboratory Testing

All soil samples were tested in the laboratory for moisture content (AASHTO T-265). Atterberg limits (AASHTO T 89/T 90) and particle size (AASHTO T 88) analyses were performed on selected soil samples representing the main soil layers encountered during the investigation. Unconfined compressive strength test (AASHTO 22) was performed on selected bedrock cores and the results are included in Appendix B. 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* (Exhibits 4), and in the *Laboratory Test Results* (Appendix B).

The soil and rock core samples will be retained in our laboratory for 60 days following this report submittal. The samples will be discarded unless a specific written request is received as to their disposition.

5.0 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.

5.1 Soil Conditions

For the nearby retaining walls structures, Wang drilled a total of eleven borings from which Borings RW3-SB-01 and RW3-SB-02 were drilled through the Torrence Avenue pavement structure and consists of 5- to 6-inch thick asphalt over 4- to 5-inch thick concrete over 2- to 4-inch thick granular base. The bridge borings (BSB-01 through BSB-08) were drilled either through topsoil or aggregate shoulder outside of the roadway pavement. The borings drilled through topsoil encountered 1- to 14-inch thick topsoil, whereas the borings drilled through shoulder showed up to 6 inches of aggregate.

Appendix A – *Boring Logs* show the surface condition and thickness. In descending order, the general lithologic succession encountered beneath the surface includes 1) man-made ground (fill); 2) very loose to dense sandy loam to gravelly sand; 3) soft to stiff clay to silty clay; 4) stiff to hard silty clay loam diamicton; 5) very stiff to hard silty clay loam to silty loam hardpan; and 6) dolostone bedrock.

(1) Man-made ground (fill)

Borings drilled through the approach embankment encountered up to 28-foot thick granular and cohesive fill. The granular fill consists of loose to medium dense, sandy loam to gravelly sand and has SPT N values of 4 to 23 blows/foot and moisture content values of 4 to 27%. The cohesive fill consists of very soft to very stiff clay to silty clay loam and has unconfined compressive strength (Qu) values of 0.2 to 2.5 tsf and moisture contents (MC) values of 14 to 37%.

(2) Very loose to dense sandy loam to gravelly sand

At elevations of 585.3 to 582.2 feet borings advanced through up to 2.5 to 10 feet of very loose to dense sandy loam to gravelly sand lacustrine deposits. The sand layer has SPT N values of 3 to 31 blows/foot, and MC values of 6 to 46%. At elevation 577.9 feet, Boring BSB-02 encountered a 5-foot thick organic silt and clay overlying the sand layer. The organic silt and clay has SPT N values of 1 blows/foot, Qu values of 0.41 tsf and MC values of 45 to 60%.

(3) Soft to very stiff clay to silty clay

At elevations of 579.0 to 568.5 feet, borings encountered up to 5.0 to 16.0 feet of soft to very stiff, gray clay to silty clay with Qu values of 0.5 to 2.1 tsf and MC values of 21 to 35%. Laboratory index testing on a sample from this layer shows liquid limit (L_L) value of 46% and plastic limit (P_L) value of 22%. According to the AASHTO soil classification, the subgrade soils belong mainly to the A-7-6 group.

(4) Stiff to hard silty clay to silty clay loam diamicton

At elevations of 574.0 to 553.9 feet, borings advanced through 10 to 30 feet of stiff to hard silty clay to silty loam diamicton. The diamicton has Qu values of 1.0 to 4.9 tsf and MC values of 13 to 24%. Up to 5-foot thick interbeds of more granular diamicton consists of medium dense sand with SPT N values of 17 blows/foot and MC values of 16%. Laboratory index testing on samples from this layer shows L_L values of 35 to 36% and P_L values of 18%. This soil is AASHTO classified as A-6. Less than 5-foot thick interbeds of sand and silt may be present within the silty clay to silty loam diamicton.

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

At elevations of 547.3 to 533.9 feet borings advanced through up to 27 feet of hard silty clay loam to very dense silty loam which locally is known under the generic name of "hardpan". The hardpan has Qu values of more than 4.5 tsf, SPT N values of 45 blows/foot to spoon refusal, and MC values of 10 to 15%. Laboratory index testing showed L_L values of 22 to 23% and P_L values of 16 to 17%. The soil has been AASHTO classified as A-4.

(6) Dolostone bedrock

Borings BSB-02, BSB-03, BSB-06, and BSB-07 ended with auger refusal at 514.4 to 510.0 feet elevation. Borings BSB-01, BSB-04, BSB-05, and BSB-08 encountered dolostone bedrock at 515.9 to 512.7 feet elevation. Bedrock was cored and described as strong, with poor to fair rock quality, light gray to dark gray, thinly bedded, moderately fractured, slightly vuggy. The rock recovery varies between 88 to 100% and the rock quality designation (RQD) values range from 44 to 85%. Occasionally, weathered bedrock of up to 4 feet overlies the bedrock.

5.2 Groundwater Conditions

Borings encountered groundwater and recorded the levels while drilling and at the end of drilling. During drilling the groundwater was observed at 0 to 13 feet bgs and at the completion of drilling, the groundwater levels were measured at 0 to 5.5 feet bgs. The watertable elevation varies from 577.4 feet to 576.9 feet on south side and 574.5 feet on the north side. However, water table is influenced by the river level seasonal fluctuations. The river 10-year flood elevation is 581.44 feet.

5.3 Seismic Design Considerations

The Seismic Site Class was determined using IDOT Design Guide AGMU Memo 09.01 LRFD Seismic Soil Site Class Definition dated January 7, 2009 and IDOT spreadsheet "Seismic Site Class Determination" dated December 13 2010. Based on subsurface soil profile, the site is in Seismic Site Class C for both abutments on pile foundations and piers on piles or drilled shafts foundation. The results of seismic site class determination are presented in Appendix C.

The seismic spectral acceleration parameters were determined using AASHTO computer program "Seismic Design Parameters, version 2.10" by specifying location by latitude and longitude. The location of the bridge was considered at Latitude of 41.644769 and Longitude of -87.559286. The procedure for determining seismic design data is included in 2012 AASHTO LRFD Bridge Design

Specifications. Considering seismic design spectrum values and Soil Site Class and based on Table 3.15.2-1 and Figure 2.3.10-2 in the IDOT 2012 Bridge Manual, the Seismic Performance Zone is 1. The recommended seismic design data are summarized below.

Seismic Design Parameters

Seismic Performance Zone (SPZ)	1
Design Spectral Acceleration at 1.0 sec. (S_{D1})	0.064g
Design Spectral Acceleration at 0.2 sec. (S_{DS})	0.112g
Soil Site Class	C

As per 2012 IDOT Bridge Manual, liquefaction analysis is not required for a site located in Seismic Performance Zone 1.

5.4 Scour Considerations

It is understood that the calculated scour elevation at the proposed pier 1 and pier 2 is 554.0 and 555.0 feet respectively for Q100 and 553.5 and 554.5 feet for Q500 respectively and no scour predicted at the abutments. The approximate streambed elevation is 574.6 feet, and Estimated Water Surface Elevation (EWSE) is 579.25 feet. Pier borings encountered cohesive soils at depths ranging from 8 to 13 feet bgs (elevation range of 571.9 to 568.0). Based on the existence of cohesive soils at and below the footing cap elevations; and within and below scour depths, as per IDOT 2012 Bridge Manual, Section 2.3.6.3.2, we recommend 25 percent reduction in theoretical, predicted scour depths. Therefore, we recommend design scour elevations as shown in Table 3.

Table 3: Design Scour Elevations

Event	North Abutment	Pier 1	Pier 2	South Abutment
Q100	596.72	558.10	557.90	595.86
Q500	596.72	558.10	557.90	595.86

6.0 ANALYSIS AND RECOMMENDATIONS

It is understood that the bridge structure design will be based on 2012 AASHTO LRFD Bridge Design Specifications with 2013 interims except as modified by the IDOT 2012 Bridge Manual.

The following sections include geotechnical evaluations and recommendations for the bridge approach embankments, approach slabs and foundations.

6.1 Approach Embankments and Slabs

Based on the TSL plans provided by STV Inc., Wang understand that the profile will not be raised for the bridge approach embankments. There will be no new fill behind the south abutment except in the widened areas. The embankment on the west side of the north abutment will be retained by the retaining wall. Approach slab can be supported on approach footings. IDOT standard design for the approach slab footing requires foundation soil to have a bearing pressure of 2.0 ksf. We estimate that the subgrade soils for the south approach footing will have allowable bearing pressure of 2.0 ksf based on the borings performed for the abutments and retaining walls on the roadway. The new embankment fill constructed as per IDOT Standard Specifications at the north approach slab footing is expected to provide allowable bearing pressure of 2.0 ksf.

6.2 Global Stability Analysis

A global stability analysis was performed to check that a deep soil slope failure would not occur. The analyses were performed using the computer program SLIDE Version 5. The global slope stability factor of safety (FOS) for the end and side slopes at the north abutment was determined to be greater than the IDOT required minimum FOS of 1.5. The results of the slope stability analyses are included in Exhibit 5. Based on the existing and proposed grades and subsurface soil conditions, we expect global slope stability FOS to be greater than the IDOT minimum require FOS.

6.3 Bridge Structure Foundations

Wang evaluated possible foundation type that could be considered for the support of the new bridge structure. The following foundation options were considered in the evaluation.

1. All substructures on driven piles;
2. All substructures on drilled shafts;
3. Abutments on driven piles and piers on drilled shafts

Based on the soil conditions encountered during our investigation, design loads, scour depths, and construction feasibility and cost, Wang and STV Inc. concluded that the piers should be supported on drilled shafts and abutments on driven piles. A shallow foundation consisting of spread footings will not be suitable considering the variable and low soil bearing capacity and differential settlement. Foundation design data and recommendations pertaining to construction for the preferred foundation

system are presented in subsequent sections of this report.

6.4 Abutments on Driven Piles

The abutments could be supported on driven piles. The most common types of piles used for a bridge structure are steel H-piles designed as friction piles or driven to the bedrock and concrete piles consisting of metal shell filled with concrete either 12" or 14" diameter. The steel H-piles designed as friction piles could be considered. However, by driving few more feet into the very hard to very dense soils or near top of the bedrock, the maximum allowable structural pile capacity could be considered as maximum Nominal Required Bearing (NRB). It is understood that abutments will be integral type supported on single row of H-piles. We recommend considering H-piles without pile shoes.

Based on the integral abutment feasibility analysis as per IDOT All Bridge Designers Memorandum Number 12.3, H-piles of sizes 12X84, 14X89, 14X102 or 14X117 should be used to support integral abutments.

The estimated pile lengths at each abutment for various pile sizes and capacities are shown in design tables in Appendix E. The capacities other than shown in the tables can be provided if required during the design. The estimated pile lengths were calculated using spread sheet Modified IDOT Static Method of Estimating Pile Length dated October 18, 2011. The estimated pile lengths include one foot of embedment into the pile cap.

Some portion of the proposed north and south abutments on the west side will be on exiting pier number 4 and existing south abutment respectively. Pile design and installation at this location is discussed in Section 7.3.

The most economical pile sizes should be selected. The maximum structural design capacity of the pile and the spacing should be as per IDOT 2012 Bridge Manual. One test pile at each substructure should be identified on the plans which should be installed prior to production pile installation. There is no need for a full scale load test.

Downdrag loads on driven piles

A relative settlement between pile and surrounding soils of more than 0.4 inch would result in downdrag loads. Since the settlement of the south abutment is expected to be less than 0.4 inches,

we expect no downdrag loads. There will be downdrag loads on the piles at the north abutment since the settlement is calculated to be 2 to 3 inches. The pile design tables include downdrag loads at the north abutment.

At the north abutment on the east side approximately 18 feet of new fill will be required since it will be constructed between the existing pier no. 4 and existing north abutment. We anticipate settlement of the foundation soils more than 0.4 inches developing downdrag loads on the driven piles. Therefore design tables in Appendix E include downdrag on the piles for the east side of the north abutment. For the east side of north abutment, we recommend precoring to existing grade elevation 590.0 if the embankment is constructed before pile driving. As an alternate, a sleeve can be provided from elevation 590.0 to the bottom of north abutment if the embankment is constructed after driving piles. Pile design table is also provided without precoring at the east side of north abutment.

At the north abutment on the west side, the existing pier 4 does not interfere during pile driving since precoring is required at the pile locations as discussed further in Section 7.3.

Pile Foundation Settlement

The driven pile foundations designed and constructed as recommended will undergo less than 0.5 inches of settlement.

Lateral Design Pressures

For design of abutment walls, we recommend a linearly increasing unfactored lateral pressure of 40 pounds per square foot per foot of depth below finished grade. Additional lateral load from traffic should include a surcharge of 2 feet of soil considering unit weight of 125 pounds per cubic foot as per AASHTO Specifications. A Geocomposite Wall Drain should be placed over the entire length of the back face of the abutment walls and connected to the 4” diameter perforated drain pipe in accordance with IDOT Bridge Manual.

6.5 Piers on Drilled Shafts

As mentioned earlier in the report, drilled shaft foundation is preferred to support the Pier 1 (south pier) and Pier 2 (north pier). A shallow cofferdam may be required or IDOT Pier detail P-DS may be considered without cofferdam.

Drilled shafts in soil (hardpan)

The silty loam above the bedrock with $N1_{60}$ (SPT blow count corrected for both overburden pressure and hammer efficiency) values more than 50 blows per foot could be considered as Intermediate Geo Material (IGM) as per 2012 AASHTO LRFD Bridge Design Specifications. We recommend factored unit tip resistance of 27.5 ksf considering nominal unit tip resistance of 50.0 ksf and resistance factor of 0.55 for drilled shafts established into IGM layer. Table 4A shows elevation/depth for each pier for drilled shafts established into IGM. 2012 IDOT Bridge Manual and 2012 LRFD AASHTO allow utilizing side resistance and end bearing for shafts founded in soil. Table 4B shows recommended values for the side resistance. As per 2012 IDOT Bridge Manual enlarged base (bell) of the shaft is only allowed to be considered 100 percent effective if the bell is dry, cleaned and inspected.

Table 4A: Drilled shafts into soil

Substructure	Applicable borings	Tip Elevation (feet)	Approximate Depth (feet) below grade at boring location
Pier 1	BSB-03 and BSB-04	531.0	46.4 / 48.9
Pier 2	BSB-05 and BSB-06	536.0	49.0 / 44.0

Table 4B: Drilled Shafts into soil axial side resistance

Elevation Range	Nominal Unit Side Resistance (ksf)	Factored Unit Side Resistance (ksf)
575.5 – 548.0	2.75	1.24
548.0 – 530.0	0.83	0.37

Resistance Factor = 0.45

Drilled shafts on bedrock

Straight shafts extended to top of bedrock could also be considered. Drilled shafts established at the top of bedrock should be designed based on factored unit tip resistance shown in Table 5. Estimated elevations for the top of bedrock are also shown in Table 5.

Table 5: Drilled Shafts on Top of Bedrock

Bridge Substructure	Reference Borings	Nominal Unit Tip Resistance (ksf)	Factored Unit Tip Resistance (ksf)	Estimated Tip (top of bedrock) Elevation (feet)	Approximate depth at boring location (feet)
Pier 1	BSB-03 and BSB-04	150	75	515.0	63.0 / 64.0
Pier 2	BSB-05 and BSB-06	150	75	514.0	69.0 / 67.0

Resistance Factor = 0.50

The side resistance from the overburden soils should be neglected. The weight of the shaft need not be considered an applied loading to support loadings.

Rock socketed drilled shafts

The piers could also be supported on drilled shafts socketed into bedrock. Drilled shaft socketed into bedrock can be designed considering either tip or side resistances shown in Table 6. Based on the unconfined compressive strength values, it appears that the bedrock is getting weaker with depth within 10 feet depth of coring. Therefore, we do not recommend socketing deeper than 4 feet. As per 2012 IDOT Bridge Manual drilled shafts extending into rock, in most cases, should be designed utilizing only end bearing or side resistance in rock, whichever is larger. The socket shaft diameter in the rock should be at least 6 inches less than the shaft diameter in the overburden soils.

Table 6: Rock Socked Drilled Shafts

Bridge Substructure	Reference Boring	Estimated Tip Elevation (feet)	Nominal Unit Tip Resistance (ksf)	Factored Unit Tip Resistance (ksf)	Nominal Unit Side Resistance (ksf)	Factored Unit Side Resistance (ksf)
Pier 1	BSB-03 and BSB-04	514.0	182	91	22	12
Pier 2	BSB-05 and BSB-06	513.0	266	133	22	12
Pier 1	BSB-03 and BSB-04	513.0	209	104	22	12
Pier 2	BSB-05 and BSB-06	512.0	268	134	22	12

Pier 1	BSB-03 and BSB-04	512.0	212	106	22	12
Pier 2	BSB-05 and BSB-06	511.0	274	137	22	12
Pier 1	BSB-03 and BSB-04	511.0	212	106	22	12
Pier 2	BSB-05 and BSB-06	510.0	570	285	22	12

Resistance factor for side resistance in rock = 0.55; Resistance factor for tip resistance in rock = 0.50.

The side resistance from the overburden soils should be neglected. The weight of the shaft need not be considered an applied loading to support loadings. We recommend showing estimated top of rock elevation on the TSL plan (on ELEVATION view) and final plans.

A deeper socket within rock may be required where the upper zone of rock is fractured and excessive water inflow is encountered during construction.

6.6 Resistance to Lateral Loads

Lateral loads on drilled shafts should be analyzed for maximum moments and lateral deflections. The geotechnical resistance factor of 1.0 should be used. No allowance should be made for the frictional resistance of the cap concrete on soil. Batter piles can be considered to resist the lateral loads. The required lateral capacity for the drilled shafts can be obtained by increasing shaft diameter or the embedment depth. The lateral load capacity analysis can be performed using computer program such as COMP 624P, L-pile, LATPILE or any other such program. The estimated soil parameters that may be used for the analysis of stresses and deflection under lateral loads are presented in Tables 7 through 10. Group action should be considered for piles and drilled shafts in soils in calculating total lateral load resistance of the substructures. Group action is not needed for drilled shafts on bedrock or socketed into bedrock.

The drilled shafts for the piers should be designed so that the shaft penetration after the design scour event satisfies the required axial and lateral resistance. The soil lost due to scour should not be considered in contributing the overburden stress.

Table 7: Recommended Soil Parameters for Lateral Load Pile Analysis
North Abutment (BSB-07/BSB-08)

Soil Layer Elevation Range	Effective Unit Weight, (pcf)	Shear Strength Properties			Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50}
		Undrained		Drained		
		Cohesion, Cu (psf)	Estimated Friction Angle, φ (Degree)	Estimated Friction Angle, φ' (Degree)		
Silty Clay to Silty Clay Loam Fill 596.72*-585.3	63	1500	0	32	500	0.007
Sand 585.3-570.2	53	0	33	33	60	--
Clay 570.2-553.9	53	740	0	30	98	0.011
Clay to Silty Clay Loam 553.9-528.9	58	2400	0	30	800	0.006
Silty Clay Loam to Silty Loam 528.9-512.7	58	5500	0	34	1800	0.0041

- Granular soils are classified as Sand, Silt, Sandy Loam, Silty Loam and Gravelly Sand on the boring logs.
- Boring logs show SPT values number for three consecutive 6-inch penetration. N value is the sum of the total of second and the third numbers.
- Effective unit weight and Friction Angle estimated from SPT numbers.
- *Proposed bottom of north abutment.

Table 8: Recommended Soil Parameters for Lateral Load Pile Analysis
Pier 2 (BSB-05/ BSB-06) Design Scour Elevation 558.8

Soil Layer Elevation Range	Effective Unit Weight, (pcf)	Shear Strength Properties			Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50}
		Undrained		Drained		
		Cohesion, Cu (psf)	Estimated Friction Angle, φ (Degree)	Estimated Friction Angle, φ' (Degree)		
Sand 576.5-568.0	48	0	28	28	20	--
Silty Clay to Clay 568.0-547.0	58	1300	0	31	400	0.0075
Silty Clay to Silty Clay Loam 547.0-538.2	58	2700	0	30	950	0.0055

Soil Layer Elevation Range	Effective Unit Weight, (pcf)	Shear Strength Properties			Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50}
		Undrained		Drained		
		Cohesion, Cu (psf)	Estimated Friction Angle, φ (Degree)	Estimated Friction Angle, φ' (Degree)		
Silty Clay Loam to Silty Loam 538.2-523.0	58	8400	0	32	2000	0.004
Silty Loam 523.0-513.0	58	0	36	36	125	--

- Granular soils are classified as Sand, Silt, Sandy Loam, Silty Loam and Gravelly Sand on the boring logs.
- Boring logs show SPT values number for three consecutive 6-inch penetration. N value is the sum of the total of second and the third numbers.
- Moist unit weight and Friction Angle estimated from SPT numbers.
- *Proposed bottom of substructure.

Table 9: Recommended Soil Parameters for Lateral Load Pile Analysis
Pier 1 (BSB-3/BSB-04) Design Scour Elevation 558.8

Soil Layer Elevation Range	Effective Unit Weight, (pcf)	Shear Strength Properties			Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50}
		Undrained		Drained		
		Cohesion, Cu (psf)	Estimated Friction Angle, φ (Degree)	Estimated Friction Angle, φ' (Degree)		
Sand 575.5*-569.4	48	0	28	28	20	--
Clay to Silty Clay 569.4-549.4	58	1300	0	30	400	0.0075
Silty Clay Loam 549.4-540.9	58	2900	0	30	1000	0.005
Silty Loam 540.9-515.9	58	0	36	36	125	--

- Granular soils are classified as Sand, Silt, Sandy Loam, Silty Loam and Gravelly Sand on the boring logs.
- Boring logs show SPT values number for three consecutive 6-inch penetration. N value is the sum of the total of second and the third numbers.
- Moist unit weight and Friction Angle estimated from SPT numbers.
- *Proposed bottom of substructure.

Table 10: Recommended Soil Parameters for Lateral Load Pile Analysis
South Abutment (BSB-01/BSB-02/02-RWB-02)

Soil Layer Elevation Range	Effective Unit Weight, (pcf)	Shear Strength Properties			Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50}
		Undrained		Drained		
		Cohesion, Cu (psf)	Estimated Friction Angle, φ (Degree)	Estimated Friction Angle, φ' (Degree)		
Sand 595.9*-570.4	48	0	28	28	20	--
Clay 570.4-558.5	58	1200	0	30	320	0.0075
Clay to Silty Clay 558.5-546.7	58	2000	0	30	700	0.006
Silty Loam to Silty Clay Loam 546.7-518.5	58	5300	0	34	1700	0.0042

- Granular soils are classified as Sand, Silt, Sandy Loam, Silty Loam and Gravelly Sand on the boring logs.
- Boring logs show SPT values number for three consecutive 6-inch penetration. N value is the sum of the total of second and the third numbers.
- Moist unit weight and Friction Angle estimated from SPT numbers.
- *Proposed bottom of south abutment

6.7 Stage Construction Considerations

It is understood that stage construction is not required since a full detour during construction has been proposed. Therefore, temporary sheet piling will not be required.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Excavation and Utilities

Excavations should be performed in accordance with local, State, and federal regulations including OSHA regulations. The potential effect of ground movements upon nearby utilities should be considered during construction. Any open excavation to a depth of 5 feet should have a slope of 1.5:1 (H:V) for cohesive soils and 2:1 (H:V)for granular soils or flatter. Due to the existing soil conditions, for the excavations that extend below 5 feet, a soil retention system with dewatering will be necessary.

7.2 Filling and Backfilling

Embankment fill required to attain the final design subgrade elevations should be in accordance with

Section 205 of the IDOT Standard Specifications. All fill and backfill materials should be pre-approved by the site engineer. The fill should be free of organic materials and debris. The backfill behind the abutments should be in accordance with IDOT Standard Specifications, Special Provisions and 2012 Bridge Manual. Backfill behind integral abutments should be according to IDOT Special Provision # 76 *Granular Backfill for structures*.

7.3 Piling Installation

General

Piles should be installed in accordance with Section 512 of the IDOT Standard Specifications and Special Provisions. The length of the test pile should be at least 10 feet longer than the estimated length of the piles. Two test piles should be identified on the plan for each abutment.

Piles Installation at existing substructures

Based on the TSL plan it appears that some portion of the proposed north and south abutments on the west side will be on exiting pier number 4 and existing south abutment respectively. Existing south abutment and pier number 4 are supported on 20 feet long timber piles of 20-ton capacity. There are two options available to install H-piles at these locations.

Option 1

It is possible that the timber piles of the existing pier no. 4 and south abutment will be encountered at the west end of the proposed north and south abutments respectively. The proposed north and south abutments piles should be located to miss the existing timber piles. Driving H-piles next to or though exiting timber piles will not be feasible because H-piles will get drifted and will be very difficult to penetrate through timer piles.

Removal of existing concrete substructures will require removal of portion of existing south abutment and pier no. 4 requiring excavation to an approximate elevation 575 and 563 at south abutment and pier no. 4 respectively (approximately to a depth of 30 and 23 feet below exiting grade.) This will require temporary soil retention system and backfilling. New H-piles can be driven before or after backfilling excavated area.

After removal of existing substructure concrete, existing timer piles will be exposed. So instead of extracting timber piles, new H-piles can be rearranged to miss timber piles. This will require design re-evaluation.

Option 2

West side: After removal of existing south and north substructures to the bottom of both proposed abutments, two feet diameter holes should be precored through existing substructures to the bottom of footing elevations. Precoring may involve going through counterforts at existing south abutment and the crash wall at the north abutment. After driving piles, the void space (annulus) should be backfilled with dry loose sand to the bottom of the proposed abutment footings.

New piles should be spaced to miss existing piles as much as possible. It may not be possible to drive new piles if the existing timber piles are encountered. If the driving becomes not feasible due to encountering of existing timber piles, the contractor should drill out or extract timber piles and then drive new piles.

East side: The existing substructures are not interfering with the proposed abutments. Precoring through new fill is recommended at the north abutment in order to reduce downdrag loss or downdrag loss can be included in the pile design without precoring. No precoring is required at the south abutment since no down drag load is expected.

7.4 Drilled Shafts

After a drilled shaft is completed to the required elevation, the base should be cleaned and inspected by lowering a downhole camera, the reinforcing cage placed, and the concrete discharged at the base using a tremie pipe or concrete pump. The drilled shafts should be constructed in accordance with Section 516 Drilled Shafts of 2012 or latest IDOT Standard Specifications for Road and Bridge Construction. Temporary casing or slurry method is expected. Drilling to refusal with earth auger may not be enough to reach the surface of the bedrock; drilling with rock auger for a short duration may be required.

To verify structural integrity of concrete, non-destructing integrity testing on completed drilled shafts should be performed using the Crosshole Sonic Logging (CSL) method. IDOT special provision "Crosshole Sonic Logging" dated March 9, 2010 or latest edition should be included for this inspection and testing requirements. Wang recommends providing CSL in at least one drilled shaft at each pier substructure supported on drilled shaft on top of bedrock and rock socketed drilled shafts. We recommend that drilled shaft installation procedure should be reviewed and approved by IDOT.

7.5 Cofferdam

The lowest streambed elevation is 574.6 feet and EWS Elevation is 579.25 feet. Cofferdam will not be necessary for construction of river piers supported on drilled shafts in a single row otherwise Type 2 cofferdam will be required.

8.0 QUALIFICATIONS

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

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

Respectfully Submitted,

WANG ENGINEERING, INC.

Mohammed A. Kothawala, P.E., D.GE
Senior Geotechnical Engineer 10-24-14

Jerry W.H. Wang, PhD., P.E.
QA/QC Reviewer

MOHAMMED A KOTHAWALA
062-040483
LICENSED PROFESSIONAL ENGINEER OF
ILLINOIS

License expires: 11-30-2015

REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS (2012) *LRFD Bridge Design Specifications*. United States Department of Transportation, Washington, D.C.

BAUER, R.A., CURRY, B.B., GRAESE, A.M., VAIDEN, R.C., SU, W.J., and HASEK, M.J., 1991, Geotechnical Properties of Selected Pleistocene, Silurian, and Ordovician Deposits of Northeastern Illinois: Environmental Geology 139, Illinois State Geological Survey, 69 p.

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ILLINOIS DEPARTMENT OF TRANSPORTATION (2012) *Standard Specifications for Road and Bridge Construction.* IDOT Division of Highways, Springfield, IL.

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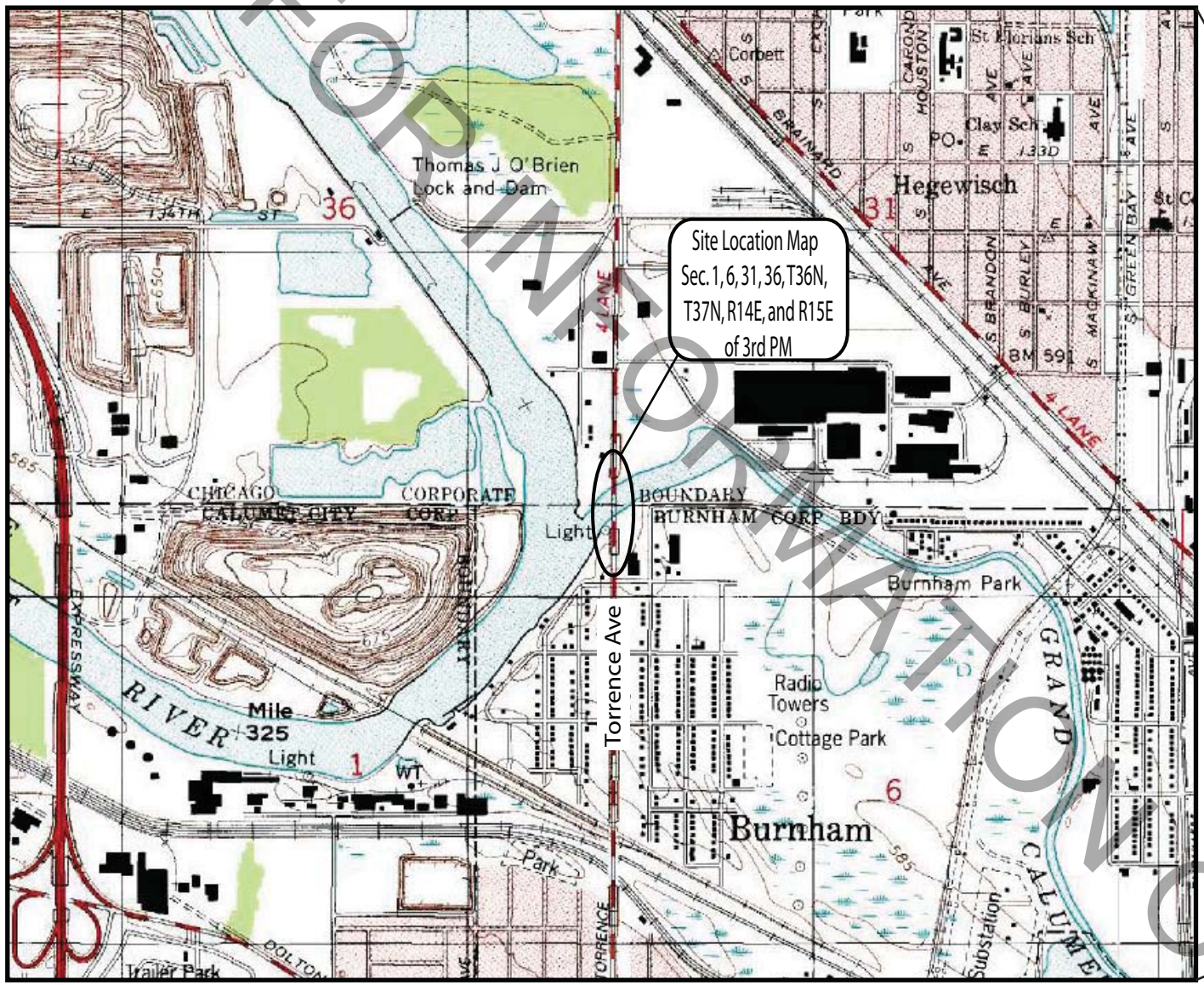
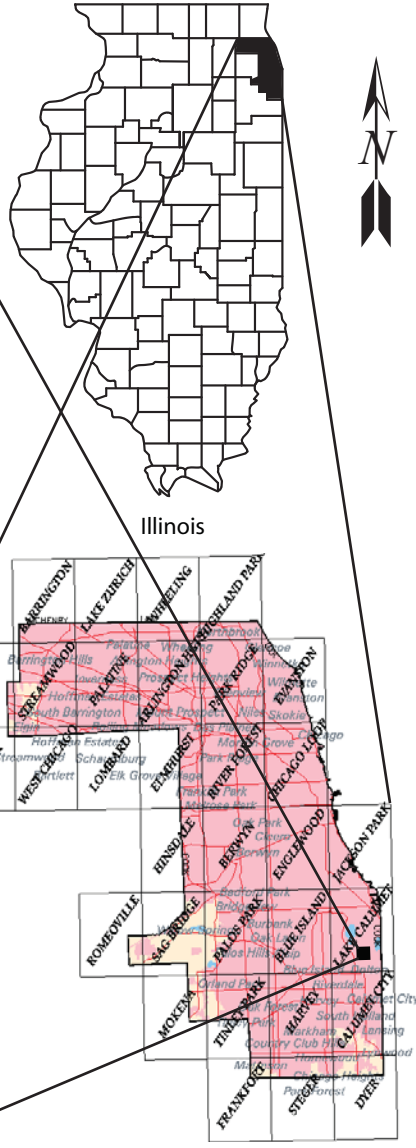
LEIGHTON, M.M., EKBLAW, G.E., and HORBERG, L. (1948) *Physiographic Divisions of Illinois.* The Journal of Geology, v. 56, p. 16-33.

EXHIBITS





0 1/4 1/2 3/4 1Miles

SITE LOCATION MAP: TORRENCE AVENUE OVER GRAND CALUMET RIVER, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL

EXHIBIT 1

DRAWN BY: A.Hamad
CHECKED BY: C.MARIN

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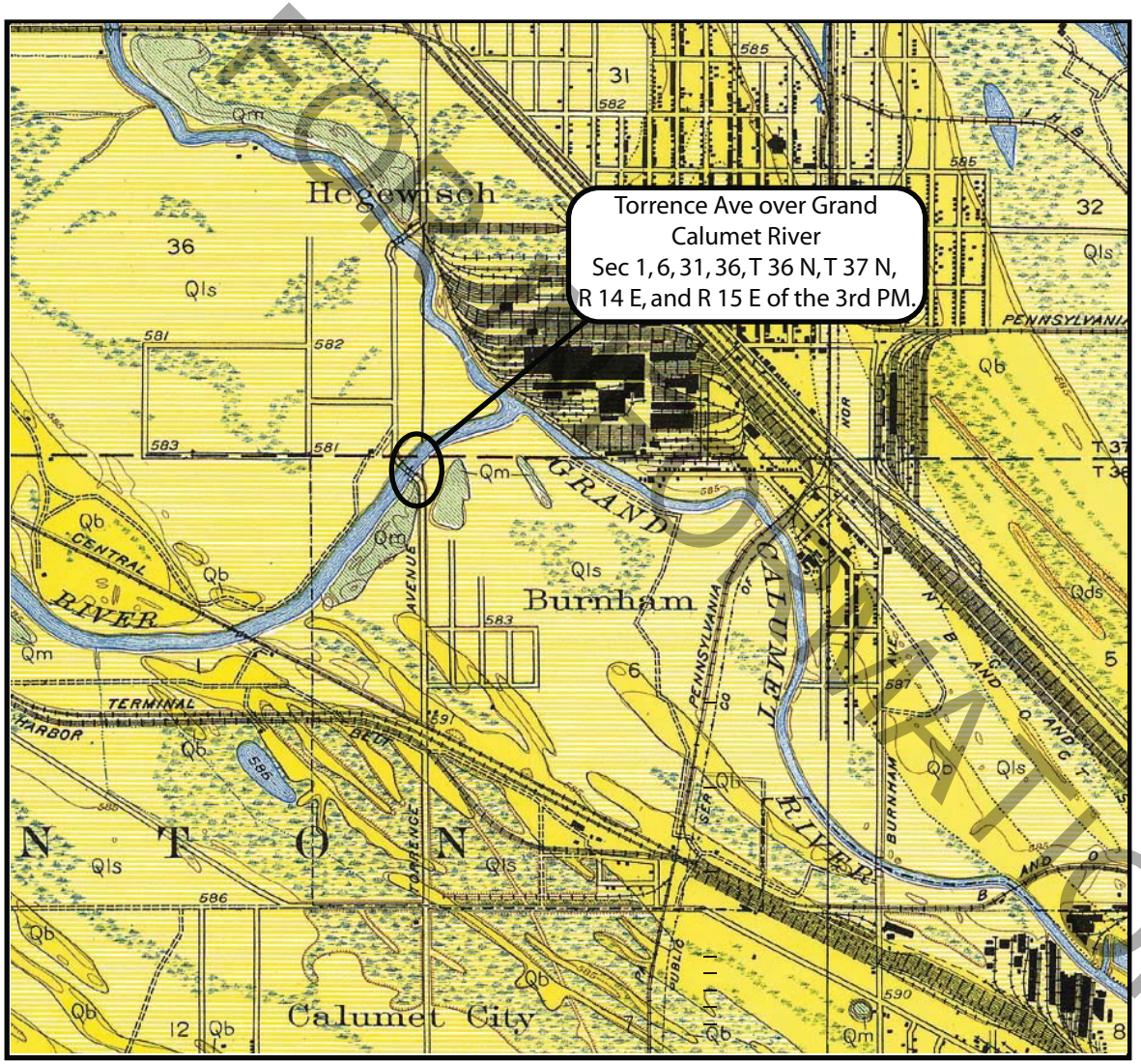
Lombard, IL 60148
www.wangeng.com

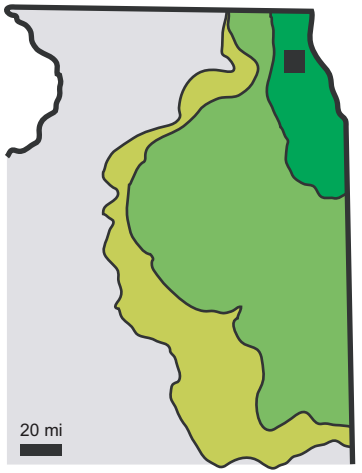
FOR STV, INC.

272-18-01



Modified after Bretz (1926)

REGIONAL GEOLOGY



Wedron Group

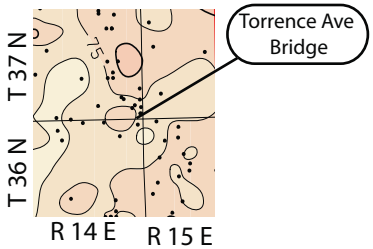
- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

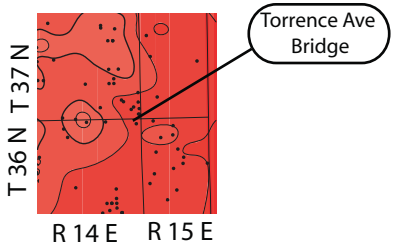
Legend

- Qm — Made Land
- Qds — Dune Sand
- Qb — Bench Ridges and related deposits of sand and gravel
- Qls — Glacial Lake Bottom

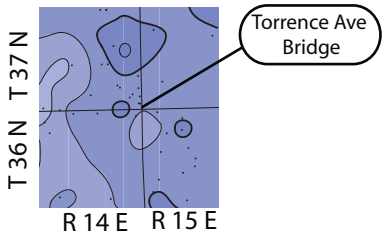
Drift Thickness



Bedrock Thickness



Bedrock Topography



Modified after Leetaru et. al. (2004)

GEOLOGY MAP: TORRENCE AVE OVER GRAND CALUMET RIVER, BURNHAM, IL

SCALE: GRAPHICAL | **Exhibit 2** | DRAWN BY: A. HAPPEL | CHECKED BY: C. MARIN

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FOR STV INC | **272-18-01**

Bench Mark: BM #5 Station 23+87.12 Offset 32.32' LT. Cut square box on top of wingwall. Elev. 611.539

BM #11 Station 18+66.04 Offset 32.11' RT. Cut square box on top easterly wingwall. Elev. 611.589

Existing Structure: Structure No. 016-0934, built in 1938, consists of a Pennsylvania (Petit) Through Truss main span and four simply supported precast prestressed concrete (PPC) box beam approach spans. The substructure consists of cast-in-place concrete spill through abutments founded on timber piles with wingwalls supported by and inline with the abutment. The four cast-in-place concrete piers are founded on timber piles. The back to back of abutments dimension measures 523'-3 5/8" and the out-to-out width of the approach spans is 63'-7" and the out-to-out width of the main span is 62'-1". The reinforced concrete approach slabs on each end of the bridge are 40'-0" long by 40'-0" wide.

Traffic is to be detoured during removal and replacement of the existing structure.

Salvage: No Salvage

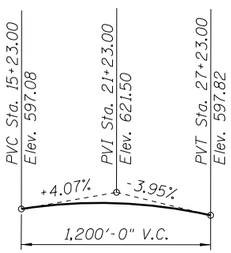
DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	South Abut.	Pier 1	Pier 2	North Abut.
Q100	595.86	558.10	557.90	596.72
Q500	595.86	558.10	557.90	596.72

WATERWAY INFORMATION

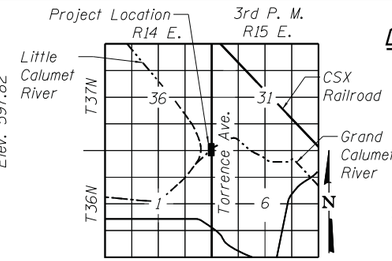
Drainage Area =Unknown, >7.3 sq. mi. Exist. Low Grade Elev. 610.79 @ Sta. - 23+88 Prop. Low Grade Elev. 610.00 @ Sta. - 18+70

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	N/A	1,248	1,279	581.44	*	*	*	*
Design	50	N/A	1,521	1,569	582.57	-	-	-	-
Base	100	N/A	1,556	1,605	582.71	-	-	-	-
Overtop	>500	N/A	-	-	-	-	-	-	-
Max. Calc.	500	N/A	1,669	1,720	583.15	-	-	-	-



PROFILE GRADE

(Along ℄ Roadway)



LOCATION SKETCH

DESIGN SPECIFICATIONS

AASHTO LRFD Bridge Design Specifications, 6th Edition with 2013 interim Revision

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi
fy = 50,000 psi (M270 Grade 50W)

LOADING HL-93

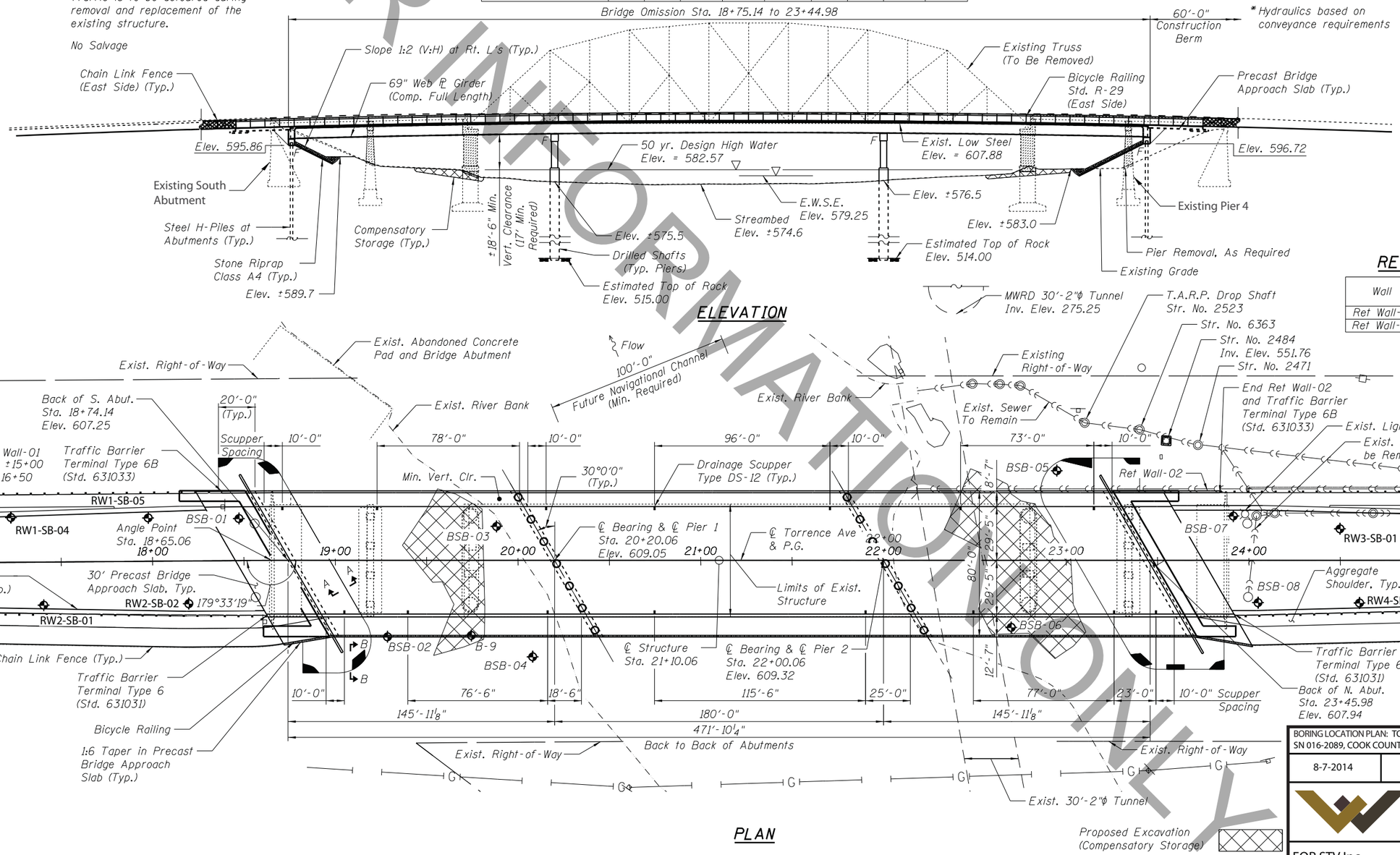
Allow 50#/sq. ft. for future wearing surface

HIGHWAY CLASSIFICATION

F.A.P. Route 358 (Torrence Avenue)
Functional Class: Other Principal Arterial
A.D.T.: 12,700 (2010), 13,081 (2032)
A.D.T.T.: 508 (2010), 523 (2032)
D.H.V.: 1,270 (2010), 1,308 (2032)
Design Speed: 40 M.P.H.
Posted Speed: 40 M.P.H.

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.064g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.112g
Soil Site Class = C



ELEVATION

PLAN

RETAINING WALL SCHEDULE

Wall	Location	Length (ft)	Max. Exposed Height (ft)
Ret Wall-01	SW	±150	±4'-6"
Ret Wall-02	NW	±65	±6'-11"

BORING LOCATION PLAN: TORRENCE AVENUE OVER GRAND CALUMET RIVER, SN 016-2089, COOK COUNTY, ILLINOIS

8-7-2014 | EXHIBIT 3 | DRAWN BY: N. Boddy | CHECKED BY: M. Kothawala

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Lombard, IL 60148
www.wangeng.com

FOR STV Inc. | 272-18-01

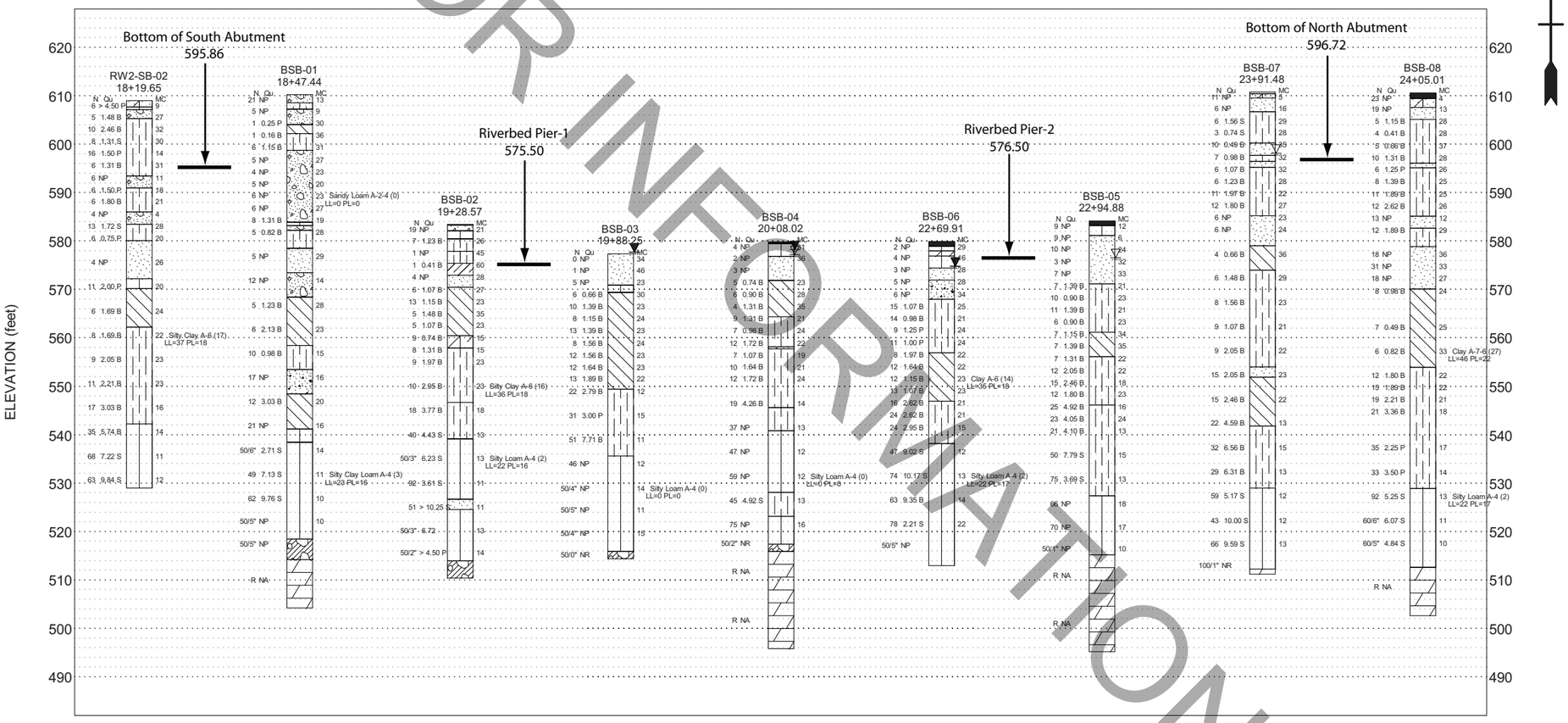
STV

USER NAME =	DESIGNED - KDH	REVISED	
	CHECKED - RDW	REVISED	
PLOT SCALE =	DRAWN - JMP	REVISED	
PLOT DATE =	CHECKED - RDW	REVISED	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

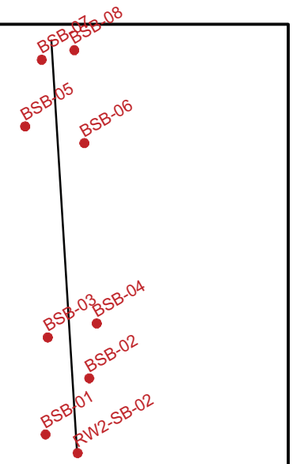
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
358	1112.IB-R	COOK	2	1
	SN. 016-2089	CONTRACT NO. 60R95		
	ILLINOIS FED. AID PROJECT			



DISTANCE ALONG PROFILE (feet)

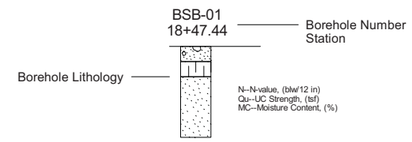
Lithology Graphics

- Gravelly sand, sandy gravel
- Coarse sand
- Topsoil
- IDH Clay Loam
- IDH Silty Clay, Silty Clay Loam
- IDH Silt, Silty Loam
- Crushed stone
- IDH Loam
- IDH Clay
- Weathered bedrock
- USCS Low Plasticity Organic silt or clay
- IDH Sand, Sandy Loam
- Dolomite or Dolomitic Limestone
- USCS High Plasticity Organic silt or clay



Site Map Scale 1 inch equals 220 feet

Explanation:



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

0 60

Horizontal Scale (feet)

Vertical Exaggeration: 2.5x

Wang Engineering
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Soil Profile
Torrence Ave. over Grand Calumet River
SN 016-2089

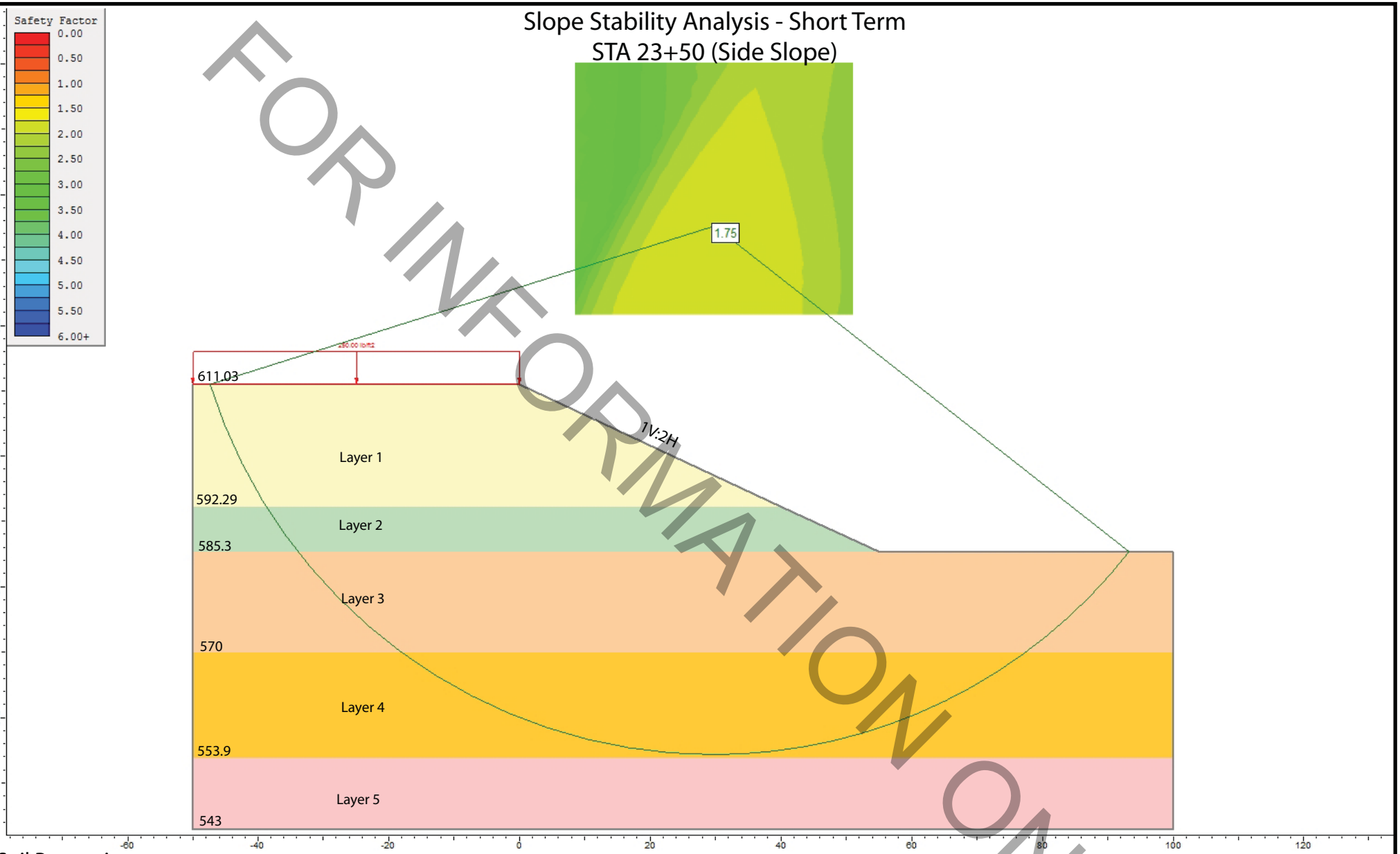
WEI SINCE 1982

Torrence Ave over Grand Calumet River - Phase II
Cook County, IL

JOB NUMBER	PLATE NUMBER
272-18-01	EXHIBIT 4

WEI 11X17 272180I.GPJ WANGENG.GDT 10/10/13

Slope Stability Analysis - Short Term
STA 23+50 (Side Slope)



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Undrained Parameter C_u (psf)	Undrained Parameter ϕ (deg.)
1	Cohesive FILL	125	1000	0
2	Stiff SILTYCLAY	120	1410	0
3	Medium Dense SAND	115	0	33
4	Medium Stiff CLAY	115	800	0
5	Very Stiff SILTY CLAY	120	2315	0

SLOPE STABILITY ANALYSIS: TORRENCE AVENUE OVER GRAND CALUMET RIVER, BURHAM, ILLINOIS

SCALE: GRAPHIC | EXHIBIT 5-A | DRAWN BY: A. Hamad | CHECKED BY: M. Kothawala

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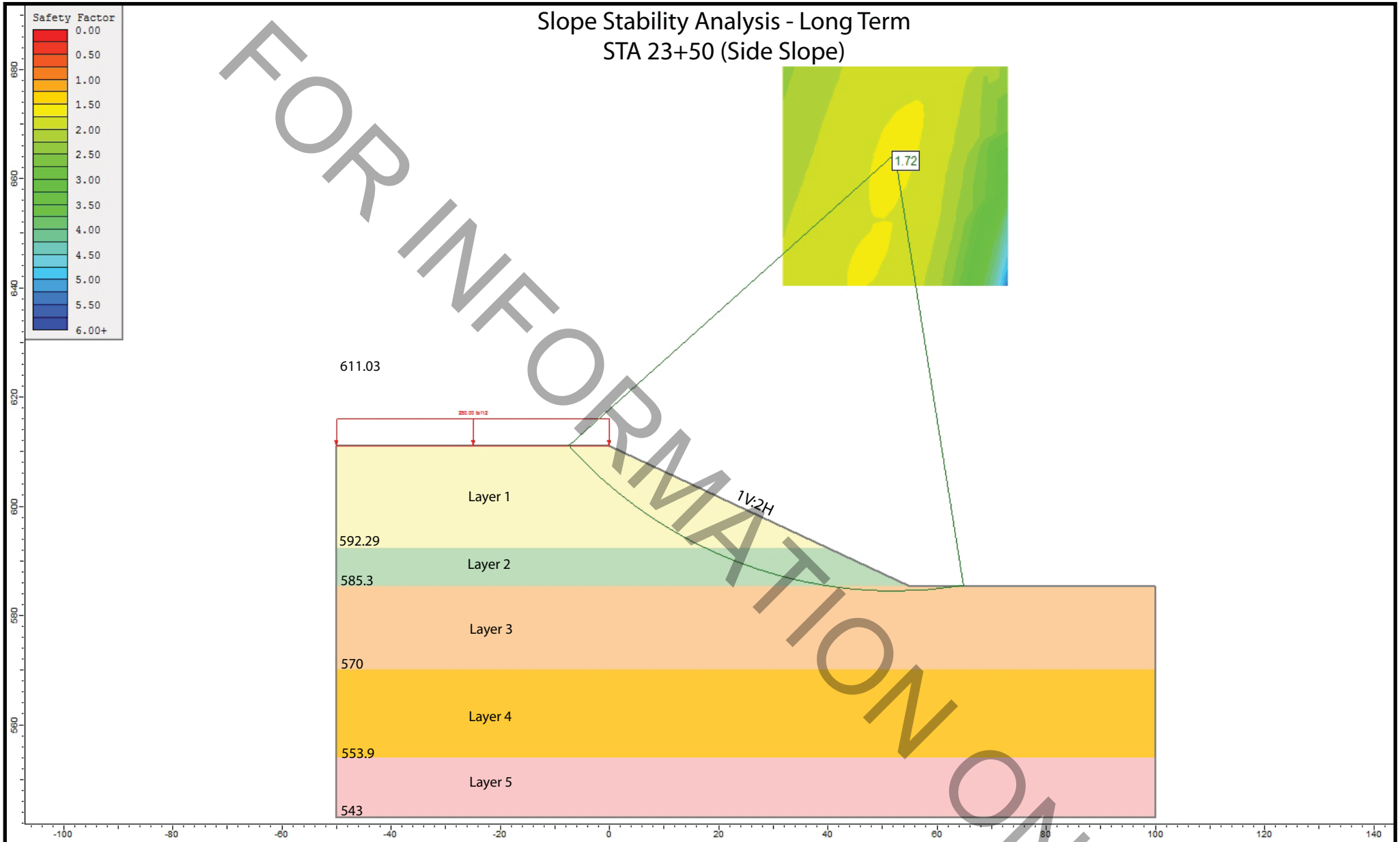
Slope Stability Analysis - Long Term
STA 23+50 (Side Slope)



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Drained Parameter C' (psf)	Drained Parameter ϕ' (deg.)
1	Cohesive FILL	125	100	32
2	Stiff SILTY CLAY	120	100	30
3	Medium Dense SAND	115	0	33
4	Medium Stiff CLAY	115	50	30
5	Very Stiff SILTY CLAY	120	100	30

SLOPE STABILITY ANALYSIS: TORRENCE AVENUE OVER GRAND CALUMET RIVER, BURHAM, ILLINOIS

SCALE: GRAPHIC | EXHIBIT 5-B | DRAWN BY: A. Hamad | CHECKED BY: M. Kothawala

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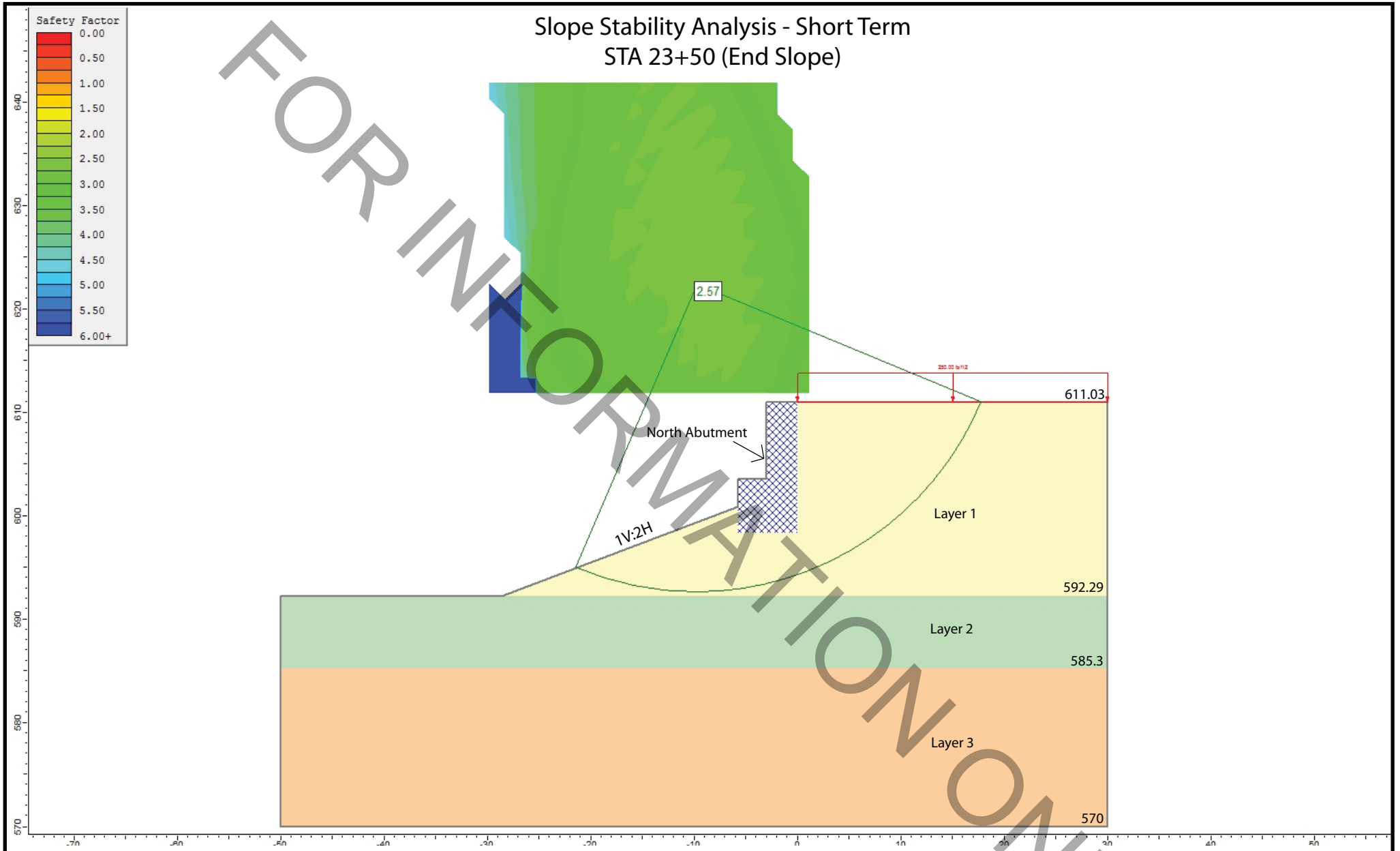
Slope Stability Analysis - Short Term
STA 23+50 (End Slope)



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Undrained Parameter C_u (psf)	Undrained Parameter ϕ (deg.)
1	Cohesive FILL	125	1000	0
2	Stiff SILTY CLAY	120	1410	0
3	Medium Dense SAND	115	0	33

SLOPE STABILITY ANALYSIS: TORRENCE AVENUE OVER GRAND CALUMET RIVER, BURHAM, ILLINOIS

SCALE: GRAPHIC | EXHIBIT 5-C | DRAWN BY: A. Hamad | CHECKED BY: M. Kothawala

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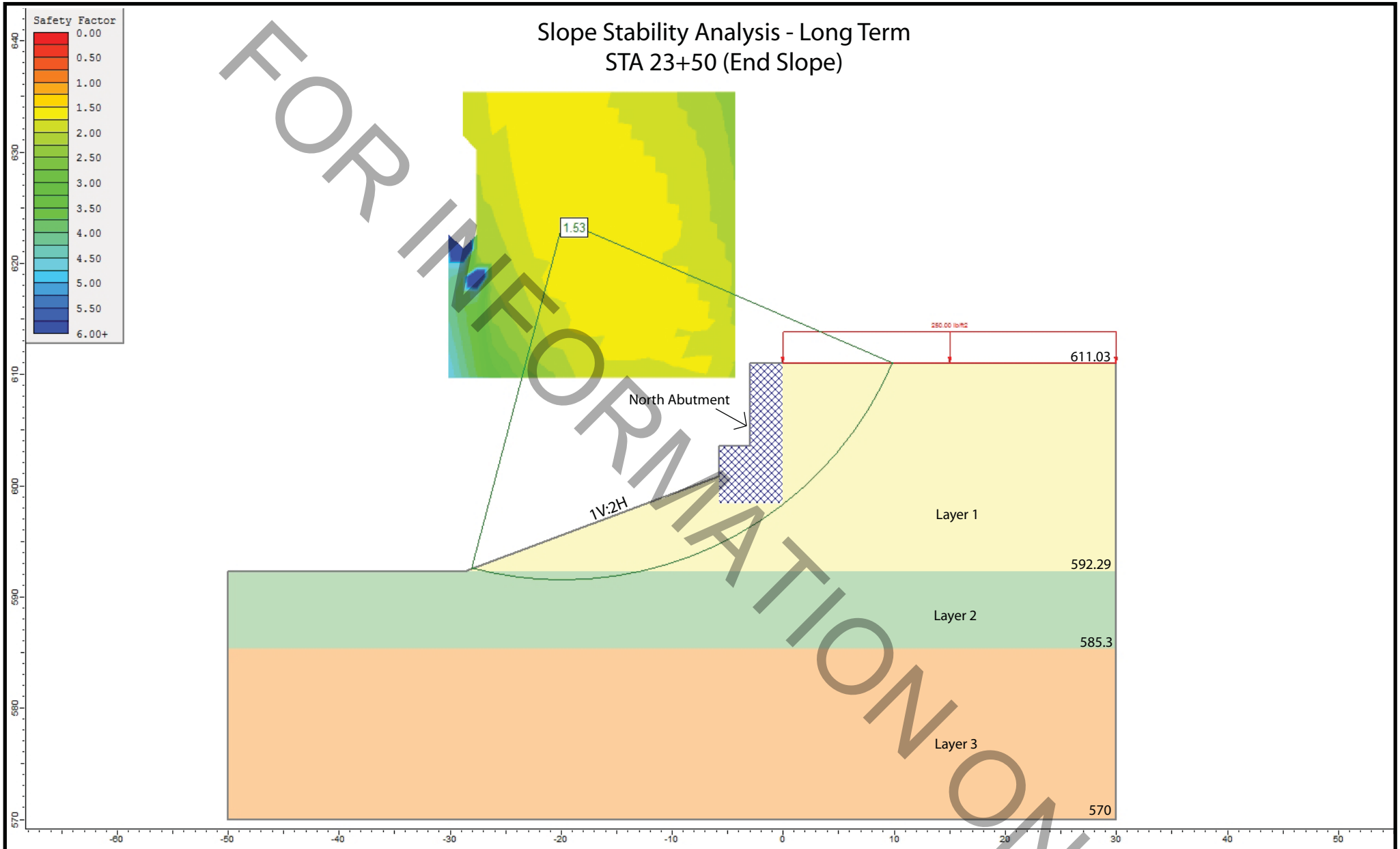
Slope Stability Analysis - Long Term
STA 23+50 (End Slope)



Soil Properties:

Layer ID	Soil Type	Unit Weight (pcf)	Drained Parameter C' (psf)	Drained Parameter ϕ (deg.)
1	Cohesive FILL	125	100	32
2	Stiff SILTY CLAY	120	100	30
3	Medium Dense SAND	115	0	33

SLOPE STABILITY ANALYSIS: TORRENCE AVENUE OVER GRAND CALUMET RIVER, BURHAM, ILLINOIS

SCALE: GRAPHIC | EXHIBIT 5-D | DRAWN BY: A. Hamad | CHECKED BY: M. Kothawala

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FOR STV, INC. | 272-18-01

APPENDIX A

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BORING LOG BSB-01

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.23 ft
North: 1813804.16 ft
East: 1195784.13 ft
Station: 18+47.44
Offset: 23.01 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		20-inch thick, white and brown GRAVELLY SAND						
	608.6	--FILL--						
		Very stiff, brown SILTY CLAY LOAM			1	6 13 8	NP	13
	607.2	--FILL--						
		Loose, brown GRAVELLY SAND, trace slag and shells			2	2 3 2	NP	9
		--Gravel >3"--	5					
	604.1	Very soft, brown and gray CLAY			3	2 0 1	0.25 P	30
		--FILL--						
	602.2	Very soft, black SILTY CLAY, trace gravel						
		--FILL--			4	0 0 1	0.16 B	36
			10					
	598.7	Loose, black GRAVELLY SAND to SANDY LOAM, trace slag, cinders and crushed stone			5	2 2 4	1.15 B	31
		--FILL--						
					6	3 2 3	NP	27
			15					
					7	2 2 2	NP	23
					8	2 2 3	NP	20
			20					
		--%Gravel=12.9--						
		--%Sand=65.2--			9	3 4 2	NP	23
		--%Silt=20.6--						
		--%Clay=1.4--						
		--A-2-4 (0)--						
					10	8 4 2	NP	27
		--2-in medium stiff, gray CLAY	25					
	583.9	Stiff, brown SILTY CLAY--FILL--						
	583.2	GRAVELLY SAND			11	5 3 5	1.31 B	19
	582.2	--FILL--						
		Medium stiff, gray SILTY CLAY LOAM, trace shells			12	2 2 3	0.82 B	28
			30					
	578.5	Loose, gray, fine SAND, trace shells						
					13	3 2 3	NP	29
			35					
	573.5	Medium dense, gray GRAVELLY SAND, trace shells						
					14	4 5 7	NP	14
			40					
	568.5	Stiff to very stiff, gray CLAY						
		--2-inch thick, gray SILT--			15	2 2 3	1.23 B	28
			45					
					16	3 2 4	2.13 B	23
			50					

GENERAL NOTES

Begin Drilling **09-09-2013** Complete Drilling **09-09-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 30', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

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BORING LOG BSB-01

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.23 ft
North: 1813804.16 ft
East: 1195784.13 ft
Station: 18+47.44
Offset: 23.01 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	558.5	Medium stiff, gray SILT CLAY, trace gravel						
			55		17	4 4 6	0.98 B	15
	553.5	Medium dense, gray, medium SAND						
			60		18	7 7 10	NP	16
	548.5	Very stiff, gray SILTY CLAY, trace gravel						
			65		19	3 5 7	3.03 B	20
	541.2	Medium dense, gray SILT						
			70		20	7 9 12	NP	16
	538.5	Very stiff to hard, SILTY LOAM to SILTY CLAY LOAM, trace gravel						
			75		21	39 42 50/6"	2.71 S	14
		--L_L(%)=23, P_L(%)=16-- --%Gravel=3.3-- --%Sand=20.3-- --%Silt=57.0-- --%Clay=19.3-- --A-4 (3)--	80		22	20 19 30	7.13 S	11
			85		23	25 32 30	9.76 S	10
			90		24	46 50/5"	NP	10
	518.5	--HARD DRILLING-- --Possible Cobbles- Very dense, gray SILTY CLAY, trace gravel, weathered dolostone fragments --WEATHERED BEDROCK--	95		25	50/5"	NP	
	514.2	Medium to strong, white, light gray, and dark gray, poor rock quality, horizontally bedded DOLOSTONE, thin bedded (<1" to 12"), joint spacing <0.5" to 12", slightly weathered joints with >0.2" non-cohesive infilling,	100		CORE			

GENERAL NOTES

Begin Drilling **09-09-2013** Complete Drilling **09-09-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 30', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

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BORING LOG BSB-01

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.23 ft
North: 1813804.16 ft
East: 1195784.13 ft
Station: 18+47.44
Offset: 23.01 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		moderately fragmented, vuggy and cherty			1			
		--Run 1: 96.0-106.0 ft--						
		--RECOVERY= 100%--						
		--RQD= 50%--	105					
	504.2	Boring terminated at 106.00 ft						
			110					
			115					
			120					
			125					

GENERAL NOTES

Begin Drilling **09-09-2013** Complete Drilling **09-09-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 30', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

0 3 6 9 12 inches

Run #1, 96' to 106', RECOVERY = 100% , RQD = 50%

BEDROCK CORE: TORRENCE AVENUE OVER GRAND CALUMET RIVER COOK COUNTY, ILLINOIS		
SCALE : GRAPHIC	BSB-01	DRAWN BY: A. Hamad CHECKED BY: C. Marin
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR STV, INC.		272-18-01

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BORING LOG BSB-02

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 583.44 ft
North: 1813885.75 ft
East: 1195847.64 ft
Station: 19+28.57
Offset: 41.87 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
583.3	Black LOAM, with plant matter --TOPSOIL--						
582.2	CRUSHED STONE --FILL--			1	8 11 8	NP	21
580.4	Medium dense, black and brown, SILTY LOAM, trace slag and brick --FILL--			2	3 4 3	1.23 B	26
	Stiff, brown SILTY CLAY --FILL--	5					
577.9	Very loose, black ORGANIC SILT, little plants and shells			3	1 0 1	NP	45
575.4	Soft, dark brown ORGANIC CLAY	10		4	1 0 1	0.41 B	60
572.9	Loose, black SANDY LOAM, trace gravel, little organic matter, shells			5	1 2 2	NP	28
570.4	Stiff, gray CLAY, some SILT laminations	15		6	2 2 4	1.07 B	27
				7	3 6 7	1.15 B	23
		20		8	2 2 3	1.48 B	35
				9	2 2 3	1.07 B	23
560.4	Medium stiff, dark gray GRAVELLY CLAY LOAM	25		10	2 4 5	0.74 B	15

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
557.9	Stiff to very stiff, gray CLAY to SILTY CLAY, trace gravel			11	3 3 5	1.31 B	15
		30		12	3 4 5	1.97 B	23
	--L_L(%)=36, P_L(%)=18-- --%Gravel=1.1-- --%Sand=7.4-- --%Silt=51.0-- --%Clay=40.5-- --A-6 (16)--	35		13	4 4 6	2.95 B	23
546.7	Very stiff, gray SILTY CLAY LOAM, trace gravel	40		14	6 6 12	3.77 B	18
539.2	Very dense, gray SILTY LOAM, trace gravel	45		15	10 17 23	4.43 S	13
	--L_L(%)=22, P_L(%)=16-- --%Gravel=3.3-- --%Sand=20.4-- --%Silt=62.4-- --%Clay=13.9-- --A-4 (2)--	50		16	25 23 50/3"	6.23 S	13

GENERAL NOTES

Begin Drilling **09-04-2013** Complete Drilling **09-04-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

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BORING LOG BSB-02

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 583.44 ft
North: 1813885.75 ft
East: 1195847.64 ft
Station: 19+28.57
Offset: 41.87 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 50-50.5 ft-- --Possible Cobbles--						
		55		17	25 45 47	3.61 S	11
526.7	Gray, SANDY LOAM						
524.6	Very dense, gray SILTY LOAM, trace gravel	60		18	20 23 28	> 10.25 S	11
		65		19	23 45 50/3"	6.72	13
	--HARD DRILLING 65-67 ft-- --Possible Cobbles--						
				20	50/2"	> 4.50 P	14
513.9	--HARD DRILLING at 69.5-- --Possible WEATHERED BEDROCK-- --Hard Drilling 69.5-71 ft--	70					
510.4	Boring terminated at 73.00 ft	75					

GENERAL NOTES

Begin Drilling **09-04-2013** Complete Drilling **09-04-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

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BORING LOG BSB-03

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 577.39 ft
North: 1813945.02 ft
East: 1195787.34 ft
Station: 19+88.25
Offset: 18.56 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Very dense, dark gray SANDY LOAM. trace organic matter			1	0 0 0	NP	34
			5		2	0 0 1	NP	46
	570.9	Loose, gray SILT			3	3 2 3	NP	23
	569.4	Stiff, gray CLAY to SILTY CLAY, trace gravel	10		4	3 2 4	0.66 B	30
					5	0 4 6	1.39 B	23
			15		6	2 3 5	1.15 B	24
					7	5 6 7	1.39 B	23
			20		8	2 3 5	1.56 B	24
					9	3 5 7	1.56 B	23
			25		10	3 5 7	1.64 B	23
	549.4	Very stiff to hard, gray SILTY CLAY LOAM, trace gravel			11	5 6 7	1.89 B	22
			30		12	5 10 12	2.79 B	12
			35		13	11 13 18	3.00 P	15
			40		14	11 22 29	7.71 B	11
	535.6	Dense to very dense, gray SILTY LOAM, trace gravel			15	12 19 27	NP	12
		--%Gravel=5.8-- --%Sand=20.4-- --%Silt=63.7--	50		16	35 45 50/4"	NP	14

GENERAL NOTES

Begin Drilling **09-20-2013** Complete Drilling **09-20-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 ATV**
Driller **K&K** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **0.00 ft**
At Completion of Drilling ▼ **0.00 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.

WANGENGINC 2721801.GPJ WANGENG.GDT 10/21/13

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BORING LOG BSB-03

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 577.39 ft
North: 1813945.02 ft
East: 1195787.34 ft
Station: 19+88.25
Offset: 18.56 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--%Clay=10.2-- --A-4 (0)--						
					17	5 50/5"	NP	11
			55					
					18	50/4"	NP	15
			60					
	515.9	Slow, hard drilling from 61.5' to 63.0'						
	514.4	Possible bedrock, weathered dolostone fragments in cuttings			19	50/0"	NR	
		Boring terminated at 63.00 ft						
			65					
			70					
			75					

GENERAL NOTES

Begin Drilling **09-20-2013** Complete Drilling **09-20-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 ATV**
Driller **K&K** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **0.00 ft**
At Completion of Drilling ▼ **0.00 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

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BORING LOG BSB-04

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 579.88 ft
North: 1813965.31 ft
East: 1195858.55 ft
Station: 20+08.02
Offset: 52.79 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
579.5	5-inch thick, brown SILTY LOAM --TOPSOIL--						
	Loose, brown, SILTY LOAM			1	1 2 2	NP	31
576.9	Very loose, gray, fine SAND						
		5		2	1 1 1	NP	36
	-- 12-inches of black WOOD fragments--			3	1 1 2	NP	
571.9	Medium stiff to stiff, gray CLAY, trace silt laminations						
		10		4	1 2 3	0.74 B	23
				5	2 2 4	0.90 B	28
		15		6	2 2 2	1.31 B	35
564.4	Stiff, gray SILTY CLAY, trace gravel						
				7	2 4 5	1.31 B	21
		20		8	3 3 4	0.98 B	24
558.2							
557.8	Gray, coarse SAND			9	4 6 6	1.72 B	22
	Stiff, gray SILTY CLAY, trace gravel						
		25		10	1 2 5	1.07 B	19

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		30		11	3 4 6	1.64 B	21
				12	3 5 7	1.72 B	24
545.6	Hard, gray SILTY CLAY LOAM, trace gravel	35		13	4 6 13	4.26 B	14
540.9	Dense to very dense, SILTY LOAM, trace gravel	40		14	9 18 19	NP	13
		45		15	17 23 24	NP	12
	--%Gravel=4.7-- --%Sand=16.7-- --%Silt=63.0--	50		16	22 27 32	NP	12

GENERAL NOTES

Begin Drilling **09-19-2013** Complete Drilling **09-19-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 ATV**
Driller **K&K** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **3.00 ft**
At Completion of Drilling ▼ **2.00 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.

WANGENGINC 2721801.GPJ WANGENG.GDT 10/21/13

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BORING LOG BSB-04

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 579.88 ft
North: 1813965.31 ft
East: 1195858.55 ft
Station: 20+08.02
Offset: 52.79 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	--%Clay=15.7-- --A-4 (0)--						
528.1	Hard, gray SILTY LOAM to SILTY CLAY LOAM, trace gravel						
		55		17	18 22 23	4.92 S	13
523.1	Very dense, gray SILT						
		60		18	31 32 43	NP	16
517.4	--HARD DRILLING 62.5'-63.5'-- --WEATHERED BEDROCK--			19	50/2"	NR	
515.9	Medium to strong, white, light gray, and dark gray, poor to fair rock quality, horizontally bedded DOLOSTONE, thin bedded (<1" to 24"), joint spacing <0.5" to 24", slightly weathered joints with >0.2" non-cohesive infilling, moderately fragmented, vuggy and cherty	65		1	CORE		
	--Run 1 - RECOVERY= 98%-- --RQD= 44%--	70					
	Qu = 8,010 psi (at 65') Qu = 6,980 psi (at 67.5')						
	Qu = 7,650 psi (at 72')						
	--Run 2 - RECOVERY= 93%-- --RQD= 70%--	75			C		
	Qu = 7,250 psi (at 75')	80		2	CORE		
495.9	Boring terminated at 84.00 ft	85					
		90					
		95					
		100					

GENERAL NOTES

Begin Drilling **09-19-2013** Complete Drilling **09-19-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 ATV**
Driller **K&K** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **3.00 ft**
At Completion of Drilling ▼ **2.00 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.

0 3 6 9 12 inches

Boring BSB-04:
Run #1, 64' to 74', RECOVERY = 98%, RQD = 44%
Run #2, 74' to 84', RECOVERY = 97%, RQD = 70%

BEDROCK CORE: TORRENCE AVENUE OVER GRAND CALUMET RIVER, COOK COUNTY, ILLINOIS		
SCALE : GRAPHIC	BSB-04	DRAWN BY: A. Hamad CHECKED BY: C. Marin
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FOR STV, INC.		272-18-01

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BORING LOG BSB-05

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 584.19 ft
North: 1814251.41 ft
East: 1195754.59 ft
Station: 22+94.88
Offset: 49.05 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	583.2	Brown, SILTY LOAM, little gravel --TOPSOIL--						
	581.2	Loose, brown SILTY LOAM, trace roots and gravel			1	4 4 5	NP	12
		Very loose to medium dense, brown, medium SAND	5		2	4 4 5	NP	6
					3	5 5 5	NP	24
			10		4	1 1 2	NP	32
					5	5 4 3	NP	33
	571.2	Medium stiff to stiff, gray SILTY CLAY	15		6	3 2 5	1.39 B	21
					7	4 4 6	0.90 B	23
			20		8	4 5 6	1.39 B	21
					9	2 3 3	0.90 B	23
	561.2	Stiff, gray CLAY, little silt laminations	25		10	3 3 4	1.15 B	34
	556.2				11	7 3 4	1.39 B	35
		Stiff to very stiff, gray SILTY CLAY, trace gravel	30		12	3 3 4	1.31 B	22
					13	3 5 7	2.05 B	22
			35		14	4 7 8	2.46 B	18
					15	4 5 7	1.80 B	23
	546.2	Very stiff to hard, gray SILTY CLAY LOAM to SILTY LOAM, trace gravel	40		16	9 11 14	4.92 B	16
					17	5 9 14	4.05 B	24
			45		18	6 8 13	4.10 B	13
		--L_L(%)=27, P_L(%)=16-- --%Gravel=2.7-- --%Sand=19.5--	50		19	12 19 31	7.79 S	15

GENERAL NOTES

Begin Drilling **09-17-2013** Complete Drilling **09-17-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV**
Driller **P&N** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" HSA to 15', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **8.00 ft**
At Completion of Drilling ▼ **NA**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

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BORING LOG BSB-05

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 584.19 ft
North: 1814251.41 ft
East: 1195754.59 ft
Station: 22+94.88
Offset: 49.05 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--%Silt=55.4-- --%Clay=22.5-- --A-6 (6)--						
	532.4	Very dense, gray SILTY LOAM, trace gravel						
		--L_L(%)=23, P_L(%)=17-- --%Gravel=2.0-- --%Sand=18.1-- --%Silt=65.9-- --%Clay=14.1-- --A-4 (3)--	55		20	12 31 44	3.69 S	13
			60		21	22 32 34	NP	18
			65		22	26 31 39	NP	17
	515.2				23	50/1" CORE	NP	10
		Strong, white, light gray, and dark gray, fair rock quality, horizontally bedded DOLOSTONE, thin bedded (<1" to 12"), joint spacing <0.5" to 12", slightly weathered joints with >0.2" non-cohesive infilling, slightly fragmented, laminated, vuggy and cherty, trace stylolites.	70					
		--Run 1 - RECOVERY= 88%--	75		1			
		--RQD= 68%--						
		Qu = 9,120 psi (at 69.5')						
		Qu = 6,370 psi (at 75')						
		Qu = 4,990 psi (at 78')						
			80			CORE		
		--Run 2 - RECOVERY= 98%--						
		--RQD= 85%--						
			85		2			
	495.2	Boring terminated at 89.00 ft						
			90					
			95					
			100					

GENERAL NOTES

Begin Drilling **09-17-2013** Complete Drilling **09-17-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV**
Driller **P&N** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" HSA to 15', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **8.00 ft**
At Completion of Drilling ▼ **NA**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

Boring BSB-05:
Run #1, 69' to 79', RECOVERY = 88%, RQD = 68%
Run #2, 79' to 89', RECOVERY = 98%, RQD = 85%

BEDROCK CORE: TORRENCE AVENUE OVER GRAND CALUMET RIVER, COOK COUNTY, ILLINOIS		
SCALE : GRAPHIC	BSB-05	DRAWN BY: A. Hamad CHECKED BY: C. Marin
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FOR STV, INC.		272-18-01

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BORING LOG BSB-06

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 579.96 ft
North: 1814227.08 ft
East: 1195840.54 ft
Station: 22+69.91
Offset: 36.72 RT

Elevation (ft)	Depth (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
579.0	0	12-inch thick, black SILTY LOAM --TOPSOIL--					
578.0		Brown and gray, SILTY LOAM, trace gravel		1	1 1 1	NP	29
577.0		Medium stiff, gray CLAY LOAM					
		Loose, brown SILTY LOAM, trace roots		2	2 1 3	NP	16
574.5	5						
		Very loose, gray SANDY LOAM, trace roots		3	2 1 2	NP	28
572.0							
		Loose, gray and brown, medium SAND		4	5 2 3	NP	28
	10			5	2 2 4	NP	34
568.0		Medium stiff to stiff, gray and brown, SILTY CLAY, trace gravel		6	5 4 11	1.07 B	25
	15			7	5 7 7	0.98 B	21
				8	3 4 5	1.25 P	24
	20			9	4 4 7	1.00 P	24
557.0		Stiff, gray CLAY, trace gravel					
				10	2 3 5	1.97 B	22
	25						

Elevation (ft)	Depth (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
				11	4 5 7	1.64 B	22
		--L_L(%)=35, P_L(%)=18-- --%Gravel=2.6--		12	3 5 7	1.15 B	23
	30	--%Sand=11.9-- --%Silt=47.1-- --%Clay=38.5-- --A-6 (14)--		13	3 5 8	1.07 B	23
547.0		Very stiff, gray SILTY CLAY, trace gravel		14	4 6 10	2.62 B	21
	35			15	7 10 14	2.62 B	21
				16	8 10 14	2.95 B	15
	40						
538.2		Hard, gray SILTY LOAM, trace gravel		17	17 23 24	9.02 S	12
	45						
		--L_L(%)=22, P_L(%)=17-- --%Gravel=1.6-- --%Sand=15.1-- --%Silt=69.6-- --%Clay=13.6-- --A-4 (2)--		18	15 29 45	10.17 S	13
	50						

GENERAL NOTES

Begin Drilling **09-16-2013** Complete Drilling **09-16-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV**
Driller **P&N** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" HSA to 15', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **5.50 ft**
At Completion of Drilling ▼ **5.50 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

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BORING LOG BSB-06

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 579.96 ft
North: 1814227.08 ft
East: 1195840.54 ft
Station: 22+69.91
Offset: 36.72 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			55		19	26 26 37	9.35 B	14
			60		20	29 42 36	2.21 S	22
		--Hard Drilling-- --Possible Cobbles--			21	50/5"	NP	
	513.0	--Bedrock at 67'-- Boring terminated at 67.00 ft	65					
			70					
			75					

GENERAL NOTES

Begin Drilling **09-16-2013** Complete Drilling **09-16-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV**
Driller **P&N** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.25" HSA to 15', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **5.50 ft**
At Completion of Drilling ▼ **5.50 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

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BORING LOG BSB-07

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.77 ft
North: 1814348.20 ft
East: 1195778.70 ft
Station: 23+91.48
Offset: 24.23 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
610.4	4-inch thick, white CRUSHED STONE						
609.6	--FILL--						
	Brown GRAVELLY LOAM			1	4 5 6	NP	5
	--FILL--						
	Medium dense, brown, fine SAND						
606.8	--FILL--			2	4 3 3	NP	16
	Medium stiff to stiff, brown SILTY CLAY, trace gravel, roots and organic matter	5					
	--FILL--			3	2 3 3	1.56 S	29
				4	2 1 2	0.74 S	28
		10					
600.3	Brown, fine SAND						
	--FILL--			5	2 5 5	0.49 B	35
597.7							
	Medium stiff, gray SILTY CLAY, trace shells			6	2 3 4	0.98 B	32
596.5	--FILL--	15					
	Brown, fine SAND						
595.3	--FILL--						
	Stiff, gray SILTY CLAY, trace gravel, organic matter and sand lenses			7	2 3 3	1.07 B	32
	--FILL--						
				8	2 2 4	1.23 B	28
		20					
				9	3 4 7	1.97 B	22
				10	3 5 7	1.80 B	27
		25					

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
585.3	Loose, brown, fine SAND						
				1	3 3 3	NP	23
				12	3 3 3	NP	24
		30					
579.0	Medium stiff, gray CLAY						
				13	0 3 1	0.66 B	36
		35					
574.0	Very stiff, gray SILTY CLAY, trace gravel						
				14	8 3 3	1.48 B	29
		40					
				15	3 4 4	1.56 B	23
		45					
				16	4 4 5	1.07 B	21
		50					

GENERAL NOTES

Begin Drilling **09-16-2013** Complete Drilling **09-16-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 25', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **13.00 ft**
At Completion of Drilling ▼ **NA**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

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BORING LOG BSB-07

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.77 ft
North: 1814348.20 ft
East: 1195778.70 ft
Station: 23+91.48
Offset: 24.23 LT

Depth (ft)	SOIL AND ROCK DESCRIPTION	Elevation (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
55			17		4 4 5	2.05 B	22
	Medium dense, gray, fine SAND	554.0					
	Stiff to very stiff, gray CLAY, trace gravel	551.9					
60			18		4 6 9	2.05 B	23
65			19		6 6 9	2.46 B	22
	Hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel	541.9					
70			20		6 8 14	4.59 B	13
75			21		13 12 20	6.56 B	15
80			22		13 14 15	6.31 B	13
	Very dense, gray SILTY LOAM, trace gravel	529.0					
85			23		29 25 34	5.17 S	12
90			24		17 19 24	10.00 S	12
95			25		20 27 39	9.59 S	13
	--Hard Drilling--	512.3	26		100/1"	NR	
	Possible BEDROCK						
	Boring terminated at 99.50 ft	511.3					
100							

GENERAL NOTES

Begin Drilling **09-16-2013** Complete Drilling **09-16-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 25', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

While Drilling ▽ **13.00 ft**
At Completion of Drilling ▼ **NA**
Time After Drilling **NA**
Depth to Water ▼ **NA**

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

WANGENGINC 2721801.GPJ WANGENG.GDT 10/21/13

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BORING LOG BSB-08

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.66 ft
North: 1814362.07 ft
East: 1195826.00 ft
Station: 24+05.01
Offset: 23.17 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	609.5	Brown LOAM, with roots and trace gravel --TOPSOIL--						
	607.7	Medium dense, brown GRAVELLY LOAM --FILL--			1	6 12 11	NP	4
	605.2	Medium dense, brown SANDY LOAM, trace gravel, concrete and slag --FILL--	5		2	4 13 6	NP	13
		Soft to stiff, dark gray SILTY CLAY, trace gravel --FILL--			3	1 2 3	1.15 B	28
			10		4	2 1 3	0.41 B	28
					5	2 2 3	0.66 B	37
	596.2	Dark gray, medium SAND	15		6	3 3 7	1.31 B	28
	595.2	--FILL--						
		Stiff to very stiff, dark gray SILTY CLAY LOAM, trace gravel, shell fragments and organic matter --FILL--			7	3 2 4	1.25 P	26
			20		8	3 3 5	1.39 B	25
					9	3 4 7	1.89 B	25
			25		10	4 4 8	2.62 B	26
	585.2	Medium dense, gray, fine SAND						
	582.7	Stiff, gray SILTY CLAY LOAM, trace plants and gravel			11	4 6 7	NP	12
			30		12	3 6 6	1.89 B	29
	578.9	Medium dense to dense, gray, fine SAND, trace organic matter						
			35		13	5 7 11	NP	36
					14	11 14 17	NP	33
			40		15	7 10 8	NP	27
	570.2	Soft to stiff, gray CLAY						
					16	3 3 5	0.98 B	24
			45					
			50		17	3 3 4	0.49 B	25

GENERAL NOTES

Begin Drilling **09-17-2013** Complete Drilling **09-18-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

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BORING LOG BSB-08

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.66 ft
North: 1814362.07 ft
East: 1195826.00 ft
Station: 24+05.01
Offset: 23.17 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--L_L(%)=46, P_L(%)=22-- --%Gravel=0.0-- --%Sand=0.2-- --%Silt=38.7-- --%Clay=61.2-- --A-7-6 (27)--			18	2 3 3	0.82 B	33
	553.9	Stiff to very stiff, gray SILTY CLAY to SILTY CLAY LOAM, little gravel	55					
			60		19	4 4 8	1.80 B	22
					20	3 6 9	1.89 B	22
			65		21	4 9 10	2.21 B	21
					22	5 7 14	3.36 B	18
			70					
			75		23	7 17 18	2.25 P	17
	528.9	Very dense, gray SILTY LOAM, trace gravel	80		24	18 15 18	3.50 P	14
		--L_L(%)=22, P_L(%)=17-- --%Gravel=6.1-- --%Sand=15.6-- --%Silt=66.5-- --%Clay=11.8-- --A-4 (2)--	85		25	34 48 44	5.25 S	13
			90		26	31 60/6"	6.07 S	11
			95		27	47 60/5"	4.84 S	10
		--Hard Drilling--						
	512.7	Strong, white, light gray, and dark gray, fair rock quality, horizontally bedded DOLOSTONE with shale partings, thin bedded (<1" to	100			CORE		

GENERAL NOTES

Begin Drilling **09-17-2013** Complete Drilling **09-18-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

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BORING LOG BSB-08

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 610.66 ft
North: 1814362.07 ft
East: 1195826.00 ft
Station: 24+05.01
Offset: 23.17 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		11"), joint spacing <0.5" to 11", slightly weathered joints with >0.2" non-cohesive infilling, slightly fragmented, laminated, vuggy and cherty, trace stylolites and cemented brecciated shale and dolostone contact.			1			
		--Run 1: 98.0-108.0 ft--						
		--RECOVERY= 100%--	105					
		--RQD= 58%--						
	502.7	Boring terminated at 108.00 ft						
			110					
			115					
			120					
			125					

GENERAL NOTES

Begin Drilling **09-17-2013** Complete Drilling **09-18-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

0 3 6 9 12 inches

Run #1, 98' to 108', RECOVERY = 100% , RQD = 58%

BEDROCK CORE: TORRENCE AVENUE OVER GRAND CALUMET RIVER
COOK COUNTY, ILLINOIS

SCALE : GRAPHIC	BSB-08	DRAWN BY: A. Hamad CHECKED BY: C. Marin

Wang Engineering
1145 N. Main Street
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FOR STV, INC. 272-18-01

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BORING LOG RW2-SB-02

WEI Job No.: 272-18-01

Client: **STV Incorporated**
Project: **Torrence Ave over Grand Calumet River - Phase II**
Location: **Cook County, IL**

Datum: NAVD88
Elevation: 609.01 ft
North: 1813777.10 ft
East: 1195830.76 ft
Station: 18+19.65
Offset: 23.38 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Brown LOAM, trace gravel --FILL--						
	607.7							
	607.2	Hard, brown, SILTY CLAY LOAM, trace gravel --FILL--			1	8 4 2	> 4.50 P	9
	605.3	Black SANDY GRAVEL, trace slag and cinders --FILL--			2	2 2 3	1.48 B	27
		Stiff to very stiff, black and gray, SILTY CLAY, trace roots, gravel and slag --FILL--	5		3	2 4 6	2.46 B	32
			10		4	2 4 4	1.31 S	30
		--2 inch, tan, medium SAND--			5	9 6 10	1.50 P	14
			15		6	2 2 4	1.31 B	31
	593.5	Loose, black SANDY GRAVEL, trace slag, bricks and cinders --FILL--			7	3 3 3	NP	11
	591.0	Stiff, brown and gray, SILTY CLAY LOAM, trace brick, slag, cinders, gravel and roots --FILL--	20		8	3 3 3	1.50 P	18
					9	3 2 4	1.80 B	21
	586.0	Loose, white and tan, SANDY GRAVEL --FILL--	25		10	3 2 2	NP	4
	583.5	Stiff to medium stiff, gray SILTY CLAY, trace wood, shells and roots			11	3 5 8	1.72 S	28
	580.1	Loose, brown and gray, medium SAND, trace shell fragments	30		12	3 3 3	0.75 P	20
			35		13	3 2 2	NP	26
	572.3	Gray SILT						
	570.2	Stiff to very stiff, gray CLAY, trace silt lenses	40		14	6 6 5	2.00 P	20
			45		15	3 3 3	1.69 B	24
	562.3	Stiff to hard, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel --L_L(%)=37, P_L(%)=18-- --%Gravel=1.2-- --%Sand=7.5--	50		16	4 3 5	1.69 B	22

GENERAL NOTES

Begin Drilling: **09-13-2013** Complete Drilling: **09-13-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR**
Driller: **R&J** Logger: **A.Tomaras** Checked by: **C. Marin**
Drilling Method: **2.25" HSA to 27.5', mud rotary thereafter, boring grouted upon completion**

WATER LEVEL DATA

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

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

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BORING LOG RW2-SB-02

WEI Job No.: 272-18-01

Client **STV Incorporated**
Project **Torrence Ave over Grand Calumet River - Phase II**
Location **Cook County, IL**

Datum: NAVD88
Elevation: 609.01 ft
North: 1813777.10 ft
East: 1195830.76 ft
Station: 18+19.65
Offset: 23.38 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--%Silt=51.7-- --%Clay=39.6-- --A-6 (14)--						
			55		17	4 5 4	2.05 B	23
			60		18	3 5 6	2.21 B	23
			65		19	5 7 10	3.03 B	16
	542.3	Hard, gray SILTY LOAM, trace gravel						
			70		20	10 11 24	5.74 B	14
			75		21	20 31 37	7.22 S	11
	529.0	Boring terminated at 80.00 ft	80		22	20 31 32	9.84 S	12
			85					
			90					
			95					
			100					

GENERAL NOTES

Begin Drilling **09-13-2013** Complete Drilling **09-13-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **A.Tomaras** Checked by **C. Marin**
Drilling Method **2.25" HSA to 27.5', mud rotary thereafter, boring grouted upon completion**

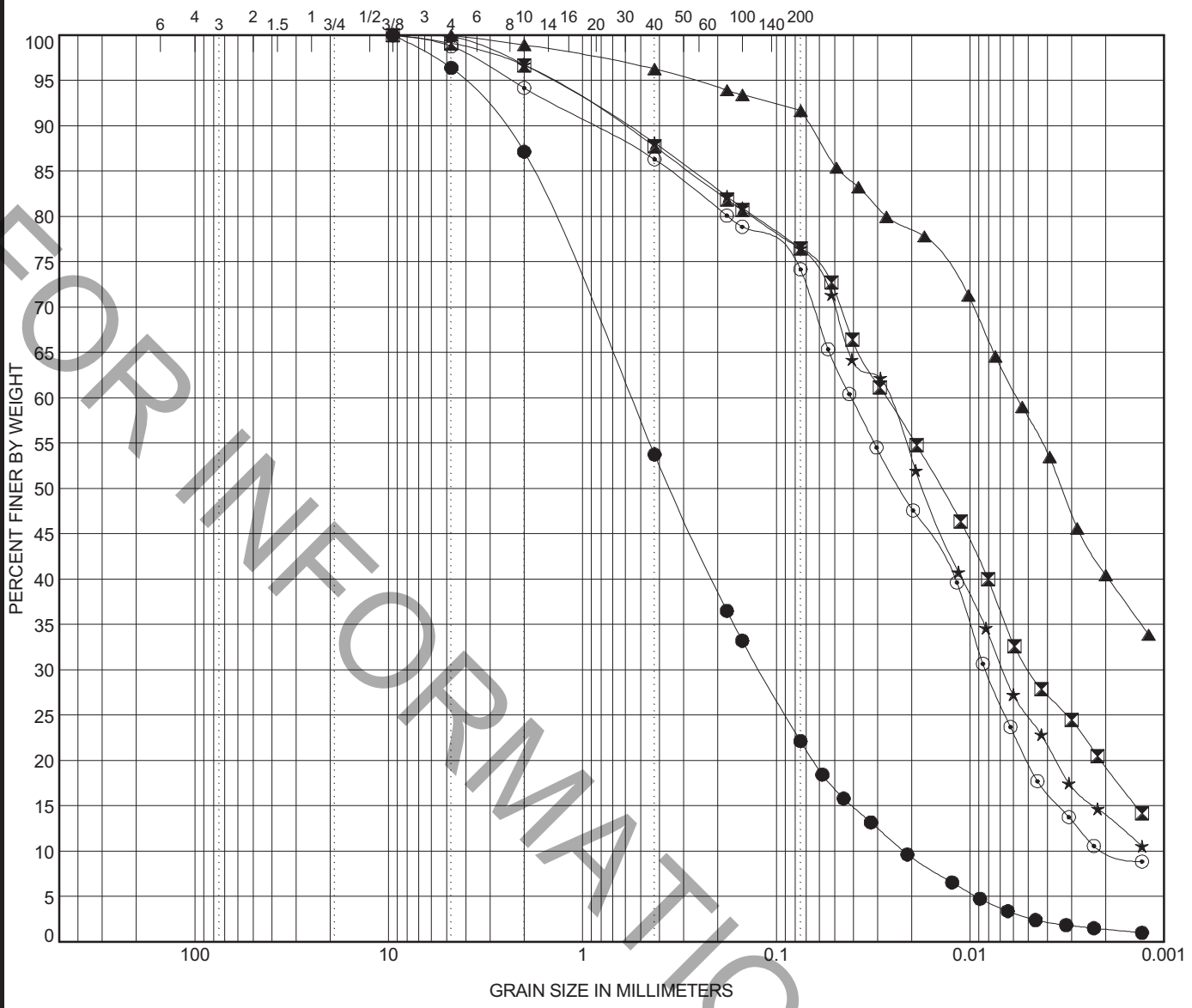
WATER LEVEL DATA

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

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

WANGENGINC 2721801.GPJ WANGENG.GDT 10/21/13

APPENDIX B



Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
● BSB-01#9	21.0 ft	**Sandy Loam**	**NP**	**NP**	**NP**	**1.20**	**25.77**
⊠ BSB-01#22	78.5 ft	**Silty Clay Loam**	**23**	**16**	**7**		
▲ BSB-02#13	33.5 ft	**Silty Clay**	**36**	**18**	**18**		
★ BSB-02#16	48.5 ft	**Silty Loam**	**22**	**16**	**6**		
⊙ BSB-03#16	48.5 ft	**Silty Loam**	**NP**	**NP**	**NP**	**0.89**	**21.58**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● BSB-01#9	21.0 ft	**9.5**	**0.568**	**0.123**	**0.022**	**12.9**	**65.2**	**20.6**	**1.4**
⊠ BSB-01#22	78.5 ft	**9.5**	**0.027**	**0.005**		**3.3**	**20.3**	**57.0**	**19.3**
▲ BSB-02#13	33.5 ft	**4.75**	**0.006**			**1.1**	**7.4**	**51.0**	**40.5**
★ BSB-02#16	48.5 ft	**9.5**	**0.027**	**0.007**		**3.3**	**20.4**	**62.4**	**13.9**
⊙ BSB-03#16	48.5 ft	**9.5**	**0.041**	**0.008**	**0.002**	**5.8**	**20.4**	**63.7**	**10.2**

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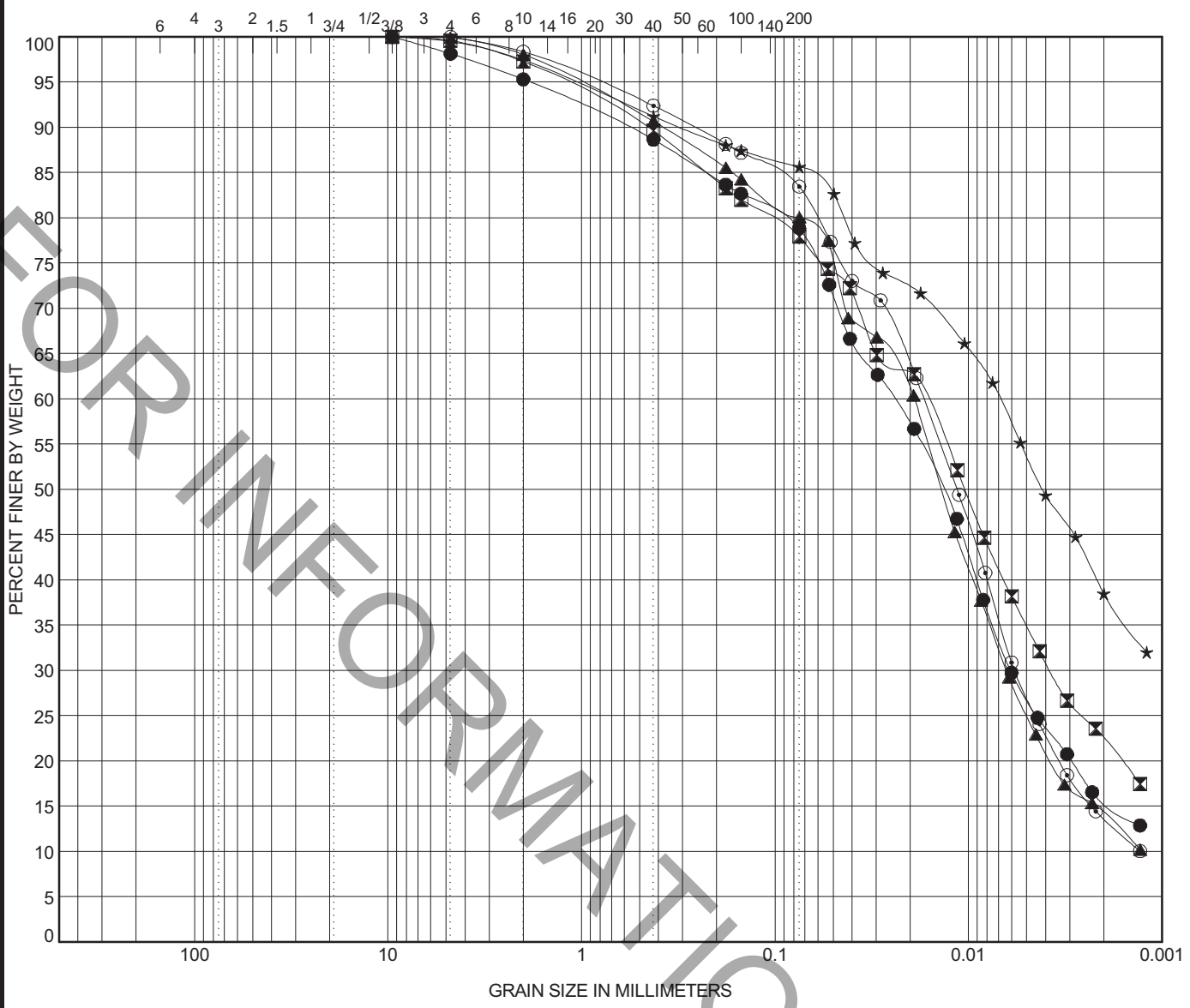
GRAIN SIZE DISTRIBUTION

Project: Torrence Ave over Grand Calumet River - Phase I

Location: Cook County, IL

Number: 272-18-01



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	BSB-04#16	48.5 ft	Silty Loam	NP	NP	NP		
⊠	BSB-05#19	48.5 ft	Silty Clay Loam	27	16	11		
▲	BSB-05#20	53.5 ft	Silty Loam	23	17	6		
★	BSB-06#12	28.5 ft	Clay	35	18	17		
⊙	BSB-06#18	48.5 ft	Silty Loam	22	17	5		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BSB-04#16	48.5 ft	9.5	0.024	0.006		4.7	16.7	63.0	15.7
⊠	BSB-05#19	48.5 ft	9.5	0.017	0.004		2.7	19.5	55.4	22.5
▲	BSB-05#20	53.5 ft	9.5	0.019	0.006		2.0	18.1	65.9	14.1
★	BSB-06#12	28.5 ft	9.5	0.007			2.6	11.9	47.1	38.5
⊙	BSB-06#18	48.5 ft	4.75	0.017	0.006		1.6	15.1	69.6	13.6

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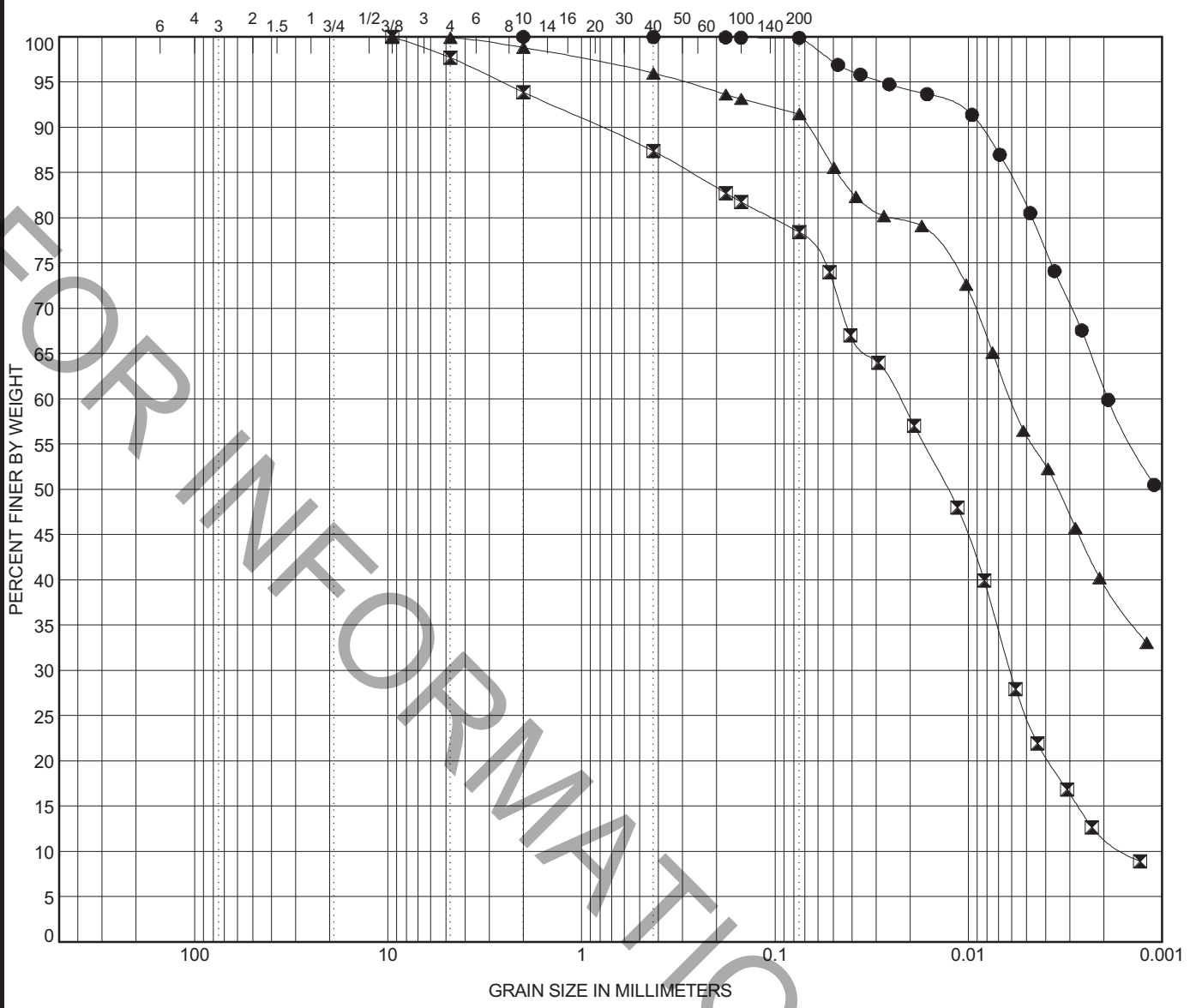
GRAIN SIZE DISTRIBUTION

Project: Torrence Ave over Grand Calumet River - Phase I

Location: Cook County, IL

Number: 272-18-01



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	BSB-08#18	53.5 ft	Clay	46	22	24		
⊠	BSB-08#25	83.5 ft	Silty Loam	22	17	5	1.06	14.99
▲	RW2-SB-02#16	48.5 ft	Silty Clay	37	18	19		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BSB-08#18	53.5 ft	2	0.002			0.0	0.2	38.7	61.2
⊠	BSB-08#25	83.5 ft	9.5	0.023	0.006	0.002	6.1	15.6	66.5	11.8
▲	RW2-SB-02#16	48.5 ft	9.5	0.006			1.2	7.5	51.7	39.6

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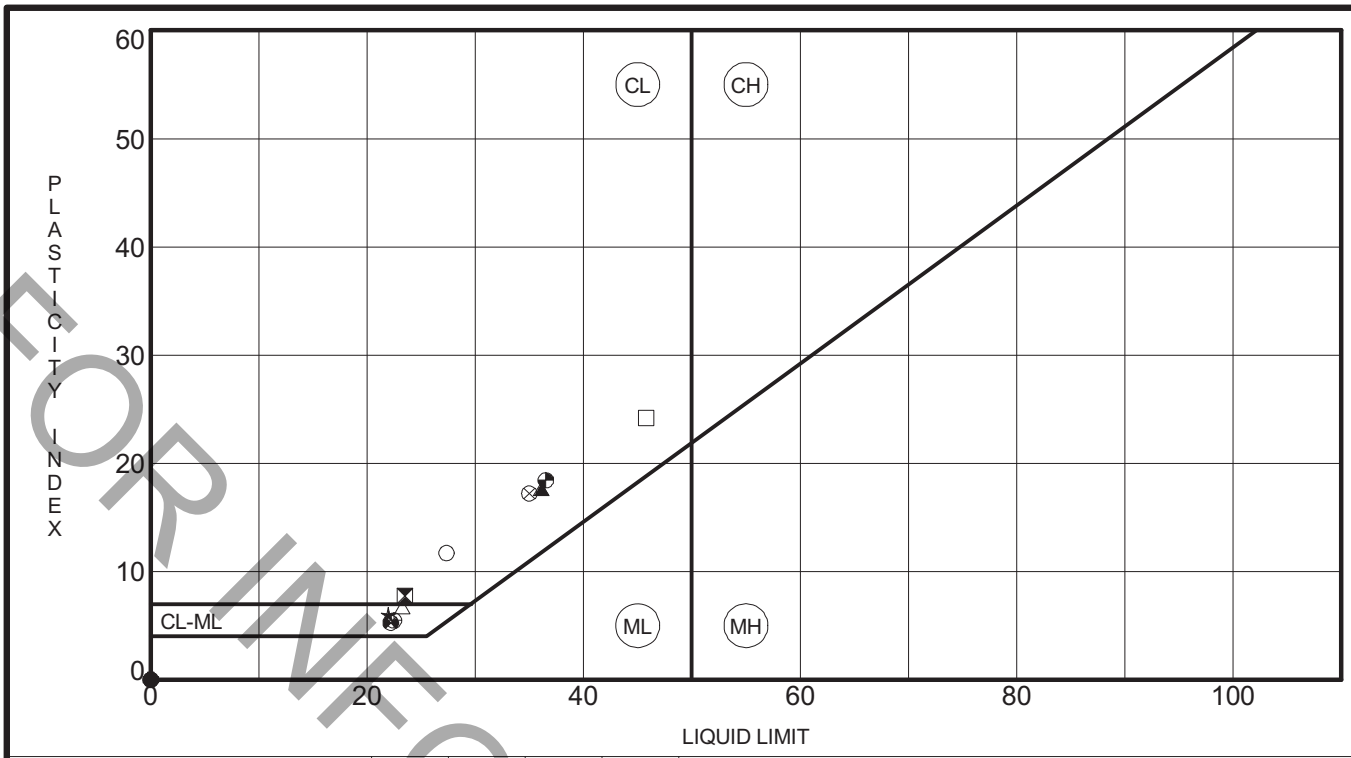
GRAIN SIZE DISTRIBUTION

Project: Torrence Ave over Grand Calumet River - Phase I

Location: Cook County, IL

Number: 272-18-01



Specimen Identification			LL	PL	PI	Fines	IDH Classification
●	BSB-01#9	21.0 ft	NP	NP	NP	22	Sandy Loam
⊠	BSB-01#22	78.5 ft	23	16	7	76	Silty Clay Loam
▲	BSB-02#13	33.5 ft	36	18	18	92	Silty Clay
★	BSB-02#16	48.5 ft	22	16	6	76	Silty Loam
⊙	BSB-03#16	48.5 ft	NP	NP	NP	74	Silty Loam
✿	BSB-04#16	48.5 ft	NP	NP	NP	79	Silty Loam
○	BSB-05#19	48.5 ft	27	16	11	78	Silty Clay Loam
△	BSB-05#20	53.5 ft	23	17	6	80	Silty Loam
⊗	BSB-06#12	28.5 ft	35	18	17	86	Clay
⊕	BSB-06#18	48.5 ft	22	17	5	83	Silty Loam
□	BSB-08#18	53.5 ft	46	22	24	100	Clay
⊛	BSB-08#25	83.5 ft	22	17	5	78	Silty Loam
◕	RW2-SB-02#16	48.5 ft	37	18	19	91	Silty Clay

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ATTERBERG LIMITS' RESULTS

Project: Torrence Ave over Grand Calumet River - Phase I

Location: Cook County, IL

Number: 272-18-01

APPENDIX C

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE=====

Substructure 1

Base of Substruct. Elev. (or ground surf for bents	595.86 ft.
Pile or Shaft Dia.	14 inches
Boring Number	BSB-01
Top of Boring Elev.	610.2 ft.
Approximate Fixity Elev.	588.86 ft.

Individual Site Class Definition:

N (bar): 15 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 30 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 2.35 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	607.2	3.00	21		B
	604.0	3.20	5		B
	602.2	1.80	1	0.25	
	600.2	2.00	1	0.16	
	598.7	1.50	6	1.15	B
	597.2	1.50	6		
	594.7	2.50	5		
	592.2	2.50	4		
	589.7	2.50	5		
1.7	587.2	2.50	6		
3.5	585.4	1.80	6		B
5.3	583.6	1.80	8		B
6.0	582.9	0.70	8	1.31	B
10.5	578.4	4.50	5	0.82	B
15.5	573.4	5.00	5		
20.5	568.4	5.00	12		
25.5	563.4	5.00	5	1.23	
30.5	558.4	5.00	6	2.13	B
35.5	553.4	5.00	10	0.98	B
40.5	548.4	5.00	17		B
47.8	541.1	7.30	12	3.03	B
50.5	538.4	2.70	21		B
55.5	533.4	5.00	92	2.71	
60.5	528.4	5.00	49	7.19	
65.5	523.4	5.00	62	9.76	B
70.5	518.4	5.00	100		B
100.0	488.9	29.50	100	5.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents	595.86 ft.
Pile or Shaft Dia.	14 inches
Boring Number	BSB-02
Top of Boring Elev.	590 ft.
Approximate Fixity Elev.	588.86 ft.

Individual Site Class Definition:

N (bar): 10 (Blows/ft.) Soil Site Class E
N_{ch} (bar): NA (Blows/ft.) NA
s_u (bar): 2.1 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
6.7	582.2	7.80		1.00	B
8.5	580.4	1.80	19		B
11.0	577.9	2.50	7	1.23	B
13.5	575.4	2.50	1		B
16.0	572.9	2.50	1	0.41	B
18.5	570.4	2.50	4		B
21.0	567.9	2.50	6	1.07	
23.5	565.4	2.50	13	1.15	
26.0	562.9	2.50	5	1.48	
28.5	560.4	2.50	5	1.07	B
31.0	557.9	2.50	9	0.74	B
33.5	555.4	2.50	8	1.31	B
37.2	551.7	3.75	9	1.97	
42.2	546.7	5.00	10	2.95	B
47.2	541.7	5.00	18	3.77	
52.2	536.7	5.00	40	4.43	
57.2	531.7	5.00	100	6.23	
62.2	526.7	5.00	92	3.61	
67.2	521.7	5.00	51	9.99	
72.2	516.7	5.00	100	6.72	
75.0	513.9	2.75	100	4.50	B
100.0	488.9	25.00	100	5.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents	575.5 ft.
Pile or Shaft Dia.	36 inches
Boring Number	BSB-03
Top of Boring Elev.	584.6 ft.
Approximate Fixity Elev.	557.5 ft.

Individual Site Class Definition:

N (bar): 71 (Blows/ft.) Soil Site Class C
N_{ch} (bar): 96 (Blows/ft.) Soil Site Class C
s_u (bar): 4.51 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	581.6	3.00	0		
	578.1	3.50	1		B
	576.6	1.50	5		B
	574.1	2.50	6	0.66	
	571.6	2.50	10	1.39	
	569.1	2.50	8	1.15	
	566.6	2.50	13	1.39	
	564.1	2.50	8	1.56	
	561.6	2.50	12	1.56	
	559.1	2.50	12	1.64	
0.9	556.6	2.50	13	1.89	B
4.6	552.9	3.75	22	2.79	
9.6	547.9	5.00	31	3.00	
14.7	542.9	5.00	51	7.71	B
19.7	537.9	5.00	46		
24.7	532.9	5.00	100		
29.2	528.4	4.50	100		
34.4	523.1	5.25	100		B
82.9	474.6	48.50	100	5.00	R

Substructure 4

Base of Substruct. Elev. (or ground surf for bents	575.5 ft.
Pile or Shaft Dia.	36 inches
Boring Number	BSB-04
Top of Boring Elev.	585 ft.
Approximate Fixity Elev.	557.5 ft.

Individual Site Class Definition:

N (bar): 47 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 81 (Blows/ft.) Soil Site Class C <----Controls
s_u (bar): 4.25 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	582.0	3.00	4		B
	579.5	2.50	2		
	577.5	2.00	3		B
	574.5	3.00	5	0.74	
	572.0	2.50	6	0.90	
	569.5	2.50	4	1.31	
	567.0	2.50	9	1.31	
	564.5	2.50	7	0.98	B
	562.0	2.50	12	1.72	
	559.5	2.50	7	1.07	B
0.5	557.0	2.50	10	1.64	
6.8	550.8	6.25	12	1.72	
11.5	546.0	4.75	19	4.26	B
14.3	543.3	2.75	37		
19.3	538.3	5.00	47		
24.3	533.3	5.00	59		B
29.3	528.3	5.00	45	4.92	B
35.0	522.5	5.75	75		B
82.5	475.0	47.50	100	5.00	R

Global Site Class Definition: Substructures 1 through 8

N (bar): 33 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 53 (Blows/ft.) Soil Site Class C <----Controls
s_u (bar): 2.96 (ksf) Soil Site Class C

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE=====

Substructure 5

Base of Substruct. Elev. (or ground surf for bents	576.5	ft.
Pile or Shaft Dia.	36	inches
Boring Number	BSB-05	
Top of Boring Elev.	584.19	ft.
Approximate Fixity Elev.	558.5	ft.

Individual Site Class Definition:

N (bar): 37 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 49 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 3.06 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	581.2	3.00	9		B
	578.7	2.50	9		
	576.2	2.50	10		
	573.7	2.50	3		
	571.2	2.50	7		B
	568.7	2.50	7	1.39	
	566.2	2.50	10	0.90	B
	563.7	2.50	11	1.39	
	561.2	2.50	6	0.90	B
	558.7	2.50	7	1.15	
3.0	555.5	3.20	7	1.39	B
4.8	553.7	1.80	9		
8.5	550.0	3.70	10		B
9.8	548.7	1.30	10	0.25	B
12.3	546.2	2.50	13		B
14.8	543.7	2.50	14	2.54	
17.3	541.2	2.50	13	2.54	B
21.1	537.4	3.75	27		B
26.1	532.4	5.00	50	7.79	
31.1	527.4	5.00	75	3.69	B
36.1	522.4	5.00	66		B
41.1	517.4	5.00	70	3.69	B
43.3	515.2	2.25	100		B
100.0	458.5	56.70	100	5.00	R

Substructure 6

Base of Substruct. Elev. (or ground surf for bents	576.5	ft.
Pile or Shaft Dia.	36	inches
Boring Number	BSB-06	
Top of Boring Elev.	579.96	ft.
Approximate Fixity Elev.	558.5	ft.

Individual Site Class Definition:

N (bar): 46 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 47 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 3.81 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	577.0	3.00	2		
	574.5	2.50	4		B
	572.0	2.50	3		
	569.5	2.50	5		
	568.0	1.50	6		B
	564.5	3.50	15	1.07	
	562.0	2.50	14	0.98	
	559.5	2.50	9	1.25	B
1.5	557.0	2.50	11		B
3.0	555.5	1.50	8	0.41	B
6.5	552.0	3.50	10		
10.3	548.2	3.75	9		
15.3	543.2	5.00	12		
20.3	538.2	5.00	40		B
25.3	533.2	5.00	47	9.02	
30.3	528.2	5.00	74	10.17	
33.0	525.5	2.75	63	9.35	B
35.3	523.2	2.25	63		B
40.3	518.2	5.00	78	2.21	B
45.5	513.0	5.25	100		B
100.0	458.5	54.50	100	5.00	R

Substructure 7

Base of Substruct. Elev. (or ground surf for bents	596.72	ft.
Pile or Shaft Dia.	14	inches
Boring Number	BSB-07	
Top of Boring Elev.	610.77	ft.
Approximate Fixity Elev.	589.72	ft.

Individual Site Class Definition:

N (bar): 15 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 22 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 2.41 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	608.8	2.00		1.00	B
	606.8	2.00	6		B
	602.8	4.00	6	1.56	
	599.8	3.00	3	0.74	B
	597.7	2.10	10		B
	596.5	1.20	7	0.98	B
	595.3	1.20	7		B
	592.8	2.50	6	1.07	
	590.3	2.50	6	1.23	
2.0	587.8	2.50	11	1.97	
4.5	585.3	2.50	11	1.80	B
7.0	582.8	2.50	6		
10.7	579.0	3.75	6		B
15.7	574.0	5.00	4	0.66	
20.7	569.0	5.00	6	1.48	
25.7	564.0	5.00	8	1.56	
30.7	559.0	5.00	9	1.07	
35.7	554.0	5.00	9	2.05	B
37.7	552.0	2.00	15		B
40.7	549.0	3.00	15	2.05	
47.8	541.9	7.10	15	2.46	B
50.7	539.0	2.90	22	4.59	
55.7	534.0	5.00	32	6.56	
60.7	529.0	5.00	29	6.31	B
65.7	524.0	5.00	59	5.17	B
70.7	519.0	5.00	43	9.90	
77.5	512.3	6.75	66	9.59	B
100.0	489.8	22.50	100	5.00	R

Substructure 8

Base of Substruct. Elev. (or ground surf for bents	598.7	ft.
Pile or Shaft Dia.	14	inches
Boring Number	BSB-08	
Top of Boring Elev.	610.66	ft.
Approximate Fixity Elev.	591.7	ft.

Individual Site Class Definition:

N (bar): 19 (Blows/ft.) Soil Site Class D
N_{ch} (bar): 40 (Blows/ft.) Soil Site Class D <----Controls
s_u (bar): 2.16 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	607.7	3.00	23		B
	605.2	2.50	19		B
	602.7	2.50	5	1.15	
	600.2	2.50	4	0.41	
	597.7	2.50	5	0.66	B
	596.2	1.50	10	1.31	B
	595.2	1.00	10		B
	592.7	2.50	6	1.25	
1.5	590.2	2.50	8	1.39	
4.0	587.7	2.50	11	1.89	
6.5	585.2	2.50	12	2.62	B
9.0	582.7	2.50	13		B
12.8	578.9	3.75	12	1.89	B
16.5	575.2	3.75	18		
19.0	572.7	2.50	31		
21.5	570.2	2.50	18		B
26.5	565.2	5.00	8	0.98	
32.8	558.9	6.25	7	0.49	
37.8	553.9	5.00	6	0.82	
41.5	550.2	3.75	12	1.80	B
44.0	547.7	2.50	15	1.89	
46.5	545.2	2.50	19	2.21	
51.5	540.2	5.00	21	3.36	
57.8	533.9	6.25	35	2.25	
62.8	528.9	5.00	33	3.50	
67.8	523.9	5.00	72	5.25	B
72.8	518.9	5.00	100	6.07	B
79.0	512.7	6.25	100	4.84	B
100.0	491.7	21.00	100	5.00	R

APPENDIX D

Bench Mark: BM #5 Station 23+87.12 Offset 32.32' LT. Cut square box on top of wingwall. Elev. 611.539

BM #11 Station 18+66.04 Offset 32.11' RT. Cut square box on top easterly wingwall. Elev. 611.589

Existing Structure: Structure No. 016-0934, built in 1938, consists of a Pennsylvania (Petit) Through Truss main span and four simply supported precast prestressed concrete (PPC) box beam approach spans. The substructure consists of cast-in-place concrete spill through abutments founded on timber piles with wingwalls supported by and inline with the abutment. The four cast-in-place concrete piers are founded on timber piles. The back to back of abutments dimension measures 523'-3 5/8" and the out-to-out width of the approach spans is 63'-7" and the out-to-out width of the main span is 62'-1". The reinforced concrete approach slabs on each end of the bridge are 40'-0" long by 40'-0" wide.

Traffic is to be detoured during removal and replacement of the existing structure.

Salvage: No Salvage

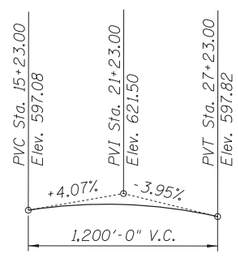
DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	South Abut.	Pier 1	Pier 2	North Abut.
Q100	595.86	558.10	557.90	596.72
Q500	595.86	558.10	557.90	596.72

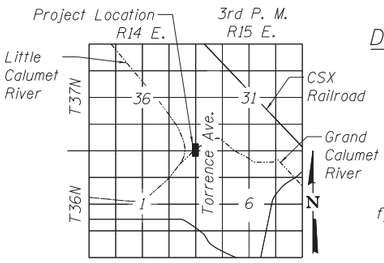
WATERWAY INFORMATION

Drainage Area =Unknown, >7.3 sq. mi. Exist. Low Grade Elev. 610.79 @ Sta. - 23+88
Prop. Low Grade Elev. 610.00 @ Sta. - 18+70

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	N/A	1,248	1,279	581.44	*	*	*	*
Design	50	N/A	1,521	1,569	582.57	-	-	-	-
Base	100	N/A	1,556	1,605	582.71	-	-	-	-
Overtop	>500	N/A	-	-	-	-	-	-	-
Max. Calc.	500	N/A	1,669	1,720	583.15	-	-	-	-



PROFILE GRADE
(Along ℄ Roadway)



LOCATION SKETCH

DESIGN SPECIFICATIONS

AASHTO LRFD Bridge Design Specifications, 6th Edition with 2013 interim Revision

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi
fy = 50,000 psi (M270 Grade 50W)

LOADING HL-93

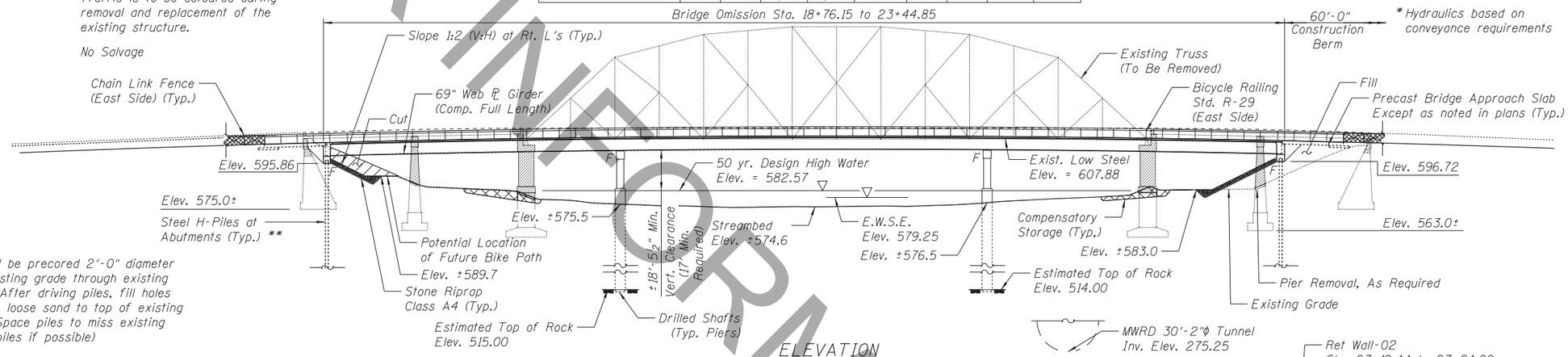
Allow 50#/sq. ft. for future wearing surface

HIGHWAY CLASSIFICATION

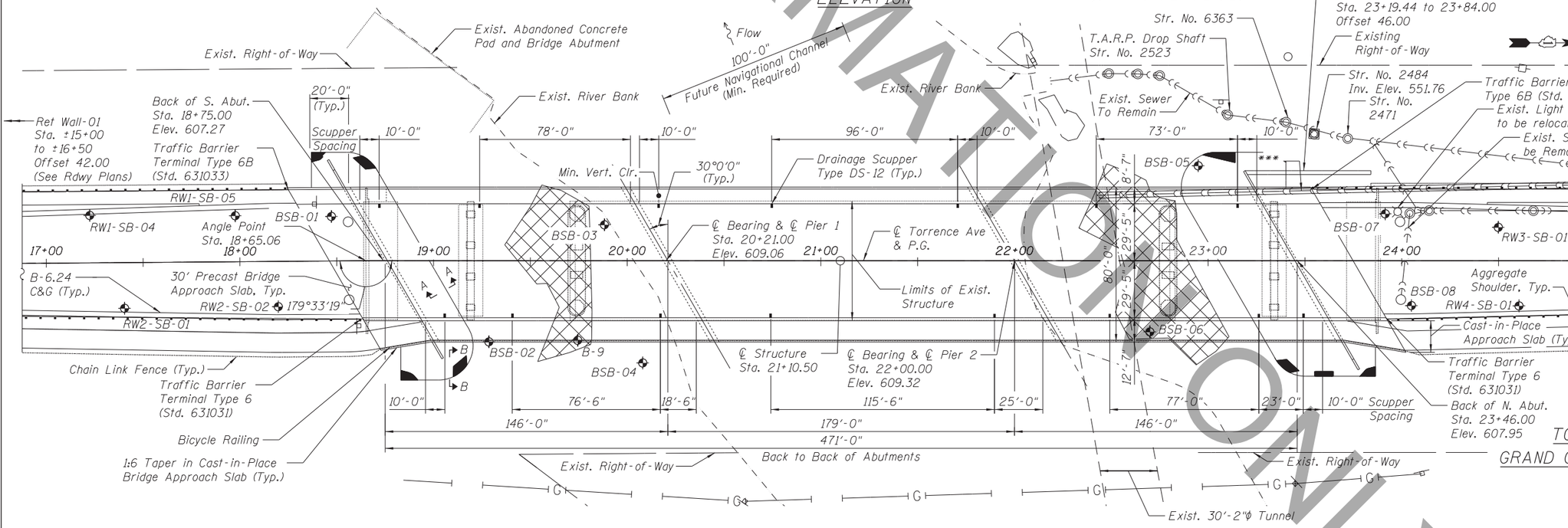
F.A.P. Route 358 (Torrence Avenue)
Functional Class: Other Principal Arterial
A.D.T.: 12,700 (2010), 22,000 (2040)
A.D.T.T.: 508 (2010), 1,320 (2040)
D.H.V.: 1,270 (2010), 2,200 (2040)
Design Speed: 40 M.P.H.
Posted Speed: 40 M.P.H.

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.064g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.112g
Soil Site Class = C



ELEVATION



PLAN

GENERAL PLAN
TORRENCE AVENUE OVER
GRAND CALUMET RIVER (Public Water)
F.A.P. ROUTE 358
Section 1112.1B-R
COOK COUNTY
STATION 21+10.50
SN 016-2089

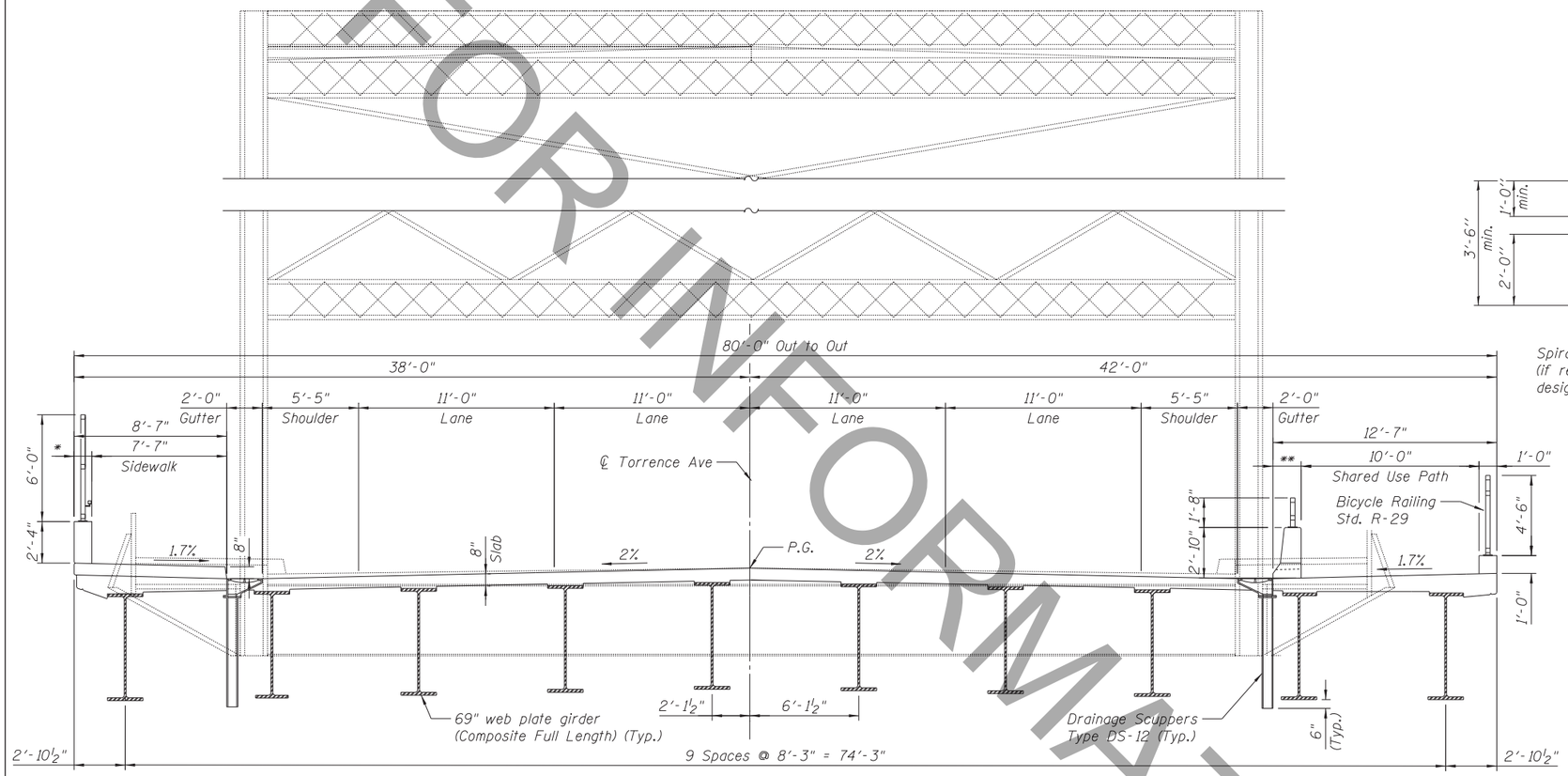
STV

USER NAME =	DESIGNED - KDH	REVISED	
	CHECKED - RDW	REVISED	
PLOT SCALE =	DRAWN - JMP	REVISED	
PLOT DATE =	CHECKED - RDW	REVISED	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 3 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
358	1112.1B-R	COOK	3	1
	SN. 016-2089	CONTRACT NO. 60R95		
	ILLINOIS FED. AID PROJECT			

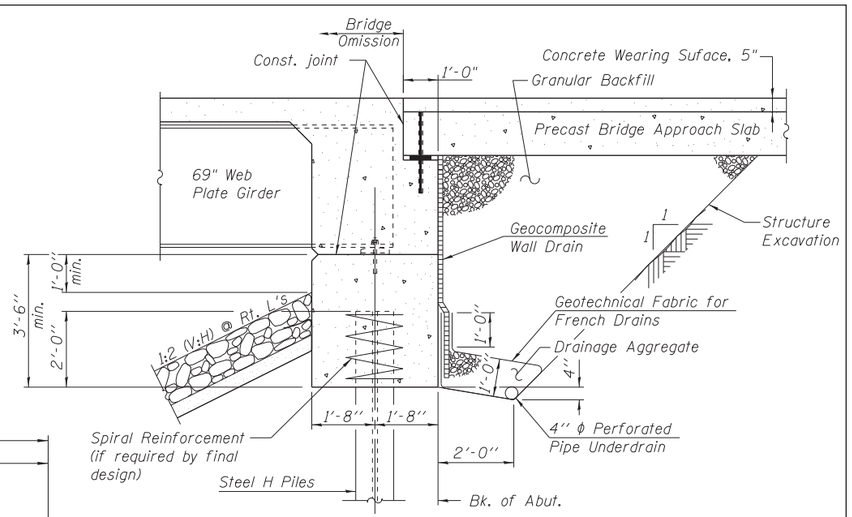


CROSS SECTION
(Looking North)

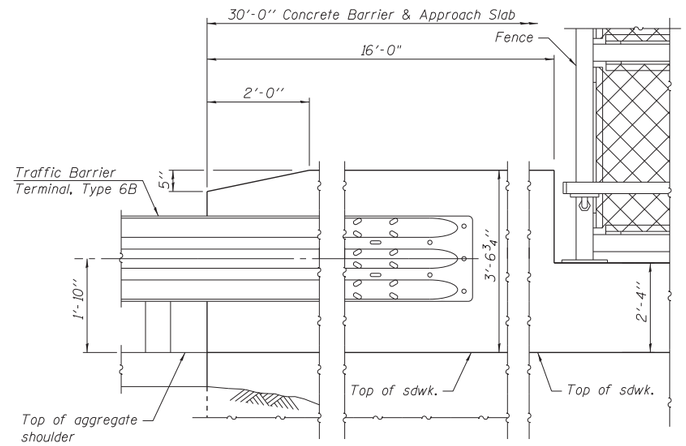
* 1'-0" Conc. Barrier w/ Parapet Railing (Std. R-28)

** Conc. Barrier w/ Parapet Railing (Std. R-29) and 6"x3" Drain Slot @ 6'-0"

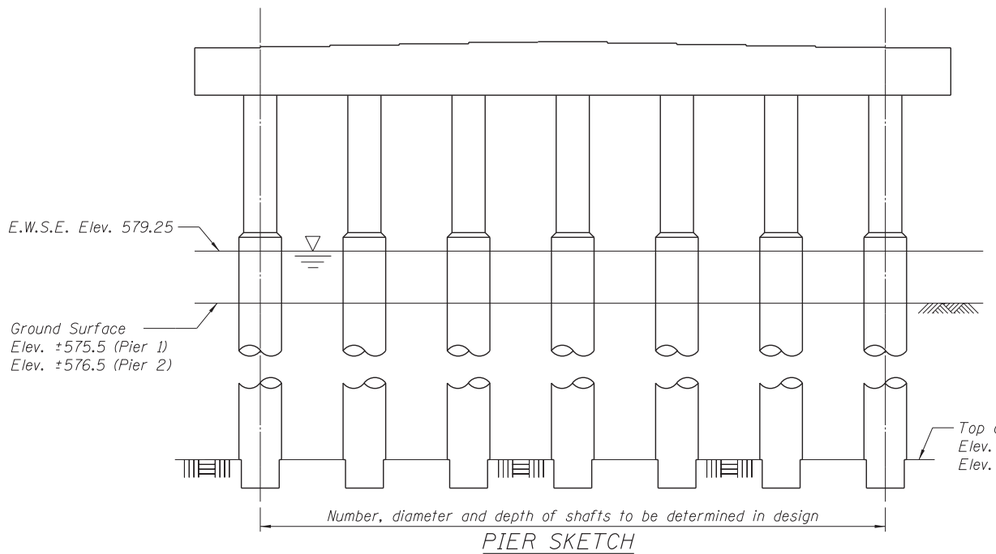
Note:
Traffic lanes shown are for proposed interim traffic condition. Future condition may include a painted median and reduced shoulder widths.



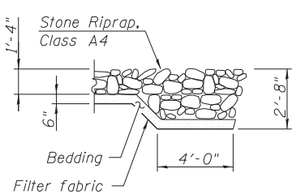
SECTION THRU INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. L's)



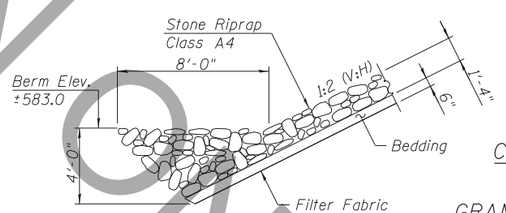
TYPE 6B TERMINAL FOR SOUTHWEST & NORTHWEST PARAPET



PIER SKETCH



SECTION B-B



SECTION A-A

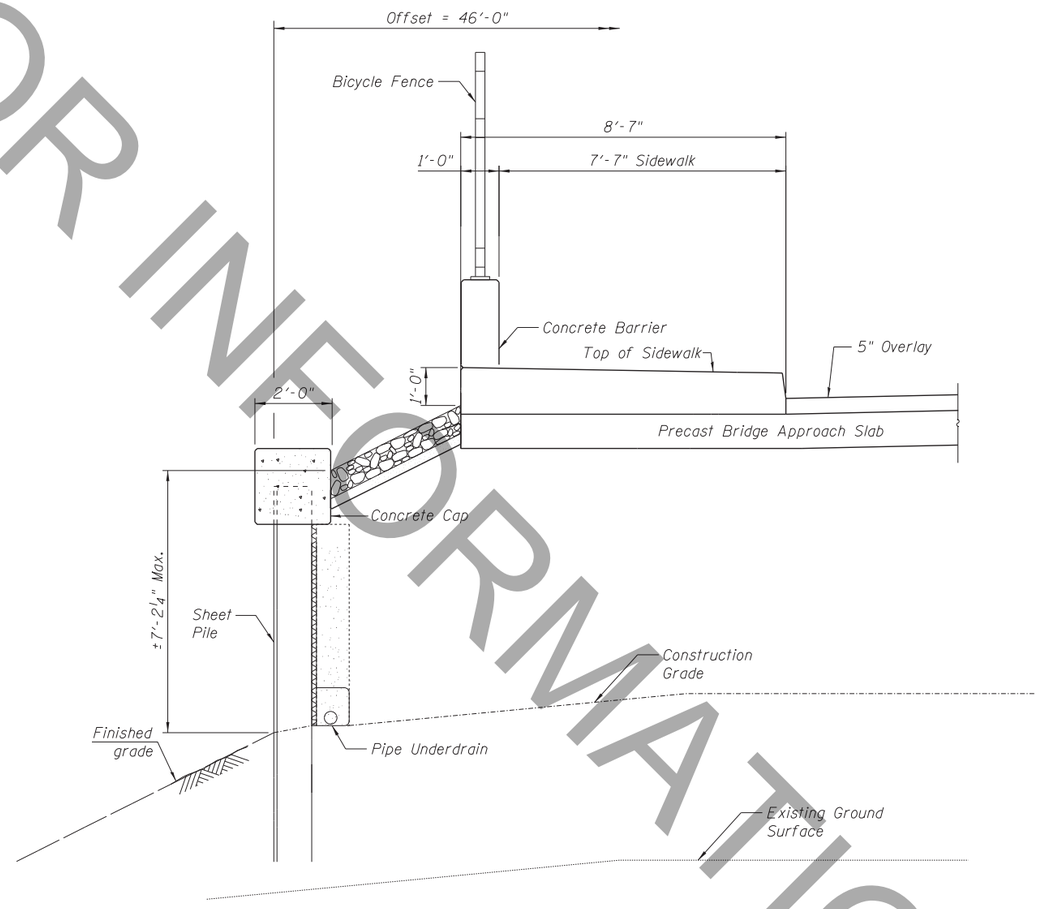
CROSS SECTION AND DETAILS
TORRENCE AVENUE OVER
GRAND CALUMET RIVER (Public Water)
F.A.P. ROUTE 358
SECTION 1112.1B-R
COOK COUNTY
STATION 21+10.50
SN 016-2089

STV	USER NAME =	DESIGNED - KDH	REVISED
		CHECKED - RDW	REVISED
	PLOT SCALE =	DRAWN - JMP	REVISED
	PLOT DATE =	CHECKED - RDW	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 3 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
358	1112.1B-R	COOK	2	3
	SN. 016-2089	CONTRACT NO. 60R95		
	ILLINOIS	FED. AID PROJECT		



TYPICAL SECTION THRU RET WALL-02

RETAINING WALL DETAILS
TORRENCE AVENUE OVER
GRAND CALUMET RIVER (Public Water)
F.A.P. ROUTE 358
SECTION 1112.1B-R
COOK COUNTY
STATION 21+10.50
SN 016-2089

STV

USER NAME =	DESIGNED - KDH	REVISED
	CHECKED - RDW	REVISED
PLOT SCALE =	DRAWN - JMP	REVISED
PLOT DATE =	CHECKED - RDW	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 3 OF 3 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
358	1112.1B-R	COOK	3	3
	SN. 016-2089	CONTRACT NO. 60R95		
	ILLINOIS FED. AID PROJECT			

APPENDIX E

Estimated Pile Lengths and Tip Elevations
West Side of North Abutment
Bottom of Footing Elevation: 596.72 feet
Precore Through Existing Substructure to Elevation 563.0 feet
Borings BSB-07

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 12X84 Maximum NRB allowed by IDOT is 664 kips	127	0	0	70	52	544.7
	164	0	0	90	56	540.7
	200	0	0	110	62	534.7
	236	0	0	130	65	531.7
	273	0	0	150	68	528.7
	309	0	0	170	78	518.7
	345	0	0	190	83	513.7
	382	0	0	210	85	511.7*
HP 14X89 Maximum NRB allowed by IDOT is 705 kips	127	0	0	70	51	545.7
	164	0	0	90	54	542.7
	200	0	0	110	56	540.7
	236	0	0	130	60	536.7
	273	0	0	150	65	531.7
	309	0	0	170	67	529.7
	345	0	0	190	75	521.7
	382	0	0	210	83	513.7
	418	0	0	230	84	512.7
	455	0	0	250	85	511.7*
HP 14X102 Maximum NRB allowed by IDOT is 810 kips	127	0	0	70	50	546.7
	164	0	0	90	54	542.7
	182	0	0	110	56	540.7
	236	0	0	130	60	536.7
	273	0	0	150	65	531.7
	309	0	0	170	67	529.7
	345	0	0	190	75	521.7
	382	0	0	210	83	513.7
	418	0	0	230	84	512.7
	455	0	0	250	85	511.7*

*Boring Termination Depth

Estimated Pile Lengths and Tip Elevations
West Side of North Abutment
Bottom of Footing Elevation: 596.72 feet
Precore Through Existing Substructure to Elevation 563.0 feet
Borings BSB-07

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 14X117 Maximum NRB allowed by IDOT is 929 kips	127	0	0	70	50	546.7
	164	0	0	90	54	542.7
	200	0	0	110	56	540.7
	236	0	0	130	60	536.7
	273	0	0	150	65	531.7
	309	0	0	170	67	529.7
	345	0	0	190	75	521.7
	382	0	0	210	80	516.7
	418	0	0	230	83	513.7
	455	0	0	250	84	512.7
	473	0	0	260	85	511.7*

*Boring Termination Depth

Estimated Pile Lengths and Tip Elevations
East Side of North Abutment
Bottom of Footing Elevation: 596.72 feet
Downdrag to Elevation of 574.0 feet, Precore Through New Fill to Elevation 590.0 feet
Borings BSB-08

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 12X84 Maximum NRB allowed by IDOT is 664 kips	287	29	59	70	66	530.7
	324	29	59	90	67	529.7
	360	29	59	110	70	526.7
	397	29	59	130	73	523.7
	434	29	59	150	76	520.7
	469	29	59	170	79	517.7
	505	29	59	190	81	515.7
	543	29	59	210	84	512.7*
	579	29	59	230	85	511.7
	664	29	59	277	86	510.7
HP 14X89 Maximum NRB allowed by IDOT is 705 kips	313	34	68	70	61	535.7
	349	34	68	90	67	529.7
	386	34	68	110	68	528.7
	422	34	68	130	70	526.7
	458	34	68	150	72	524.7
	494	34	68	170	75	521.7
	531	34	68	190	77	519.7
	567	34	68	210	80	516.7
	603	34	68	230	82	514.7
	640	34	68	250	84	512.7*
	651	34	68	270	85	511.7
	705	34	68	286	86	510.7
HP 14X102 Maximum NRB allowed by IDOT is 810 kips	314	34	69	70	61	535.7
	350	34	69	90	66	529.7
	388	34	69	110	68	528.7
	424	34	69	130	70	526.7

*Approximate top of bedrock

Estimated Pile Lengths and Tip Elevations
East Side of North Abutment
Bottom of Footing Elevation: 596.72 feet
Downdrag to Elevation of 574.0 feet, Precore Through New Fill to Elevation 590.0 feet
Borings BSB-08

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
	459	34	69	150	72	524.7
	497	34	69	170	75	521.7
	533	34	69	190	77	519.7
	569	34	69	210	80	516.7
	606	34	69	230	82	514.7
	642	34	69	250	83	513.7
	677	34	69	270	84	512.7*
	810	34	69	342	86	510.7
HP 14X117 Maximum NRB allowed by IDOT is 929 kips	317	35	70	70	61	535.7
	353	35	70	90	66	530.7
	389	35	70	110	68	528.7
	426	35	70	130	70	526.7
	462	35	70	150	72	524.7
	498	35	70	170	74	522.7
	535	35	70	190	77	519.7
	572	35	70	210	80	516.7
	607	35	70	230	82	514.7
	644	35	70	250	83	513.7
	678	35	70	270	84	512.7*
	859	35	70	370	86	510.7
	929	35	70	511	87	509.7

*Approximate top of bedrock

Estimated Pile Lengths and Tip Elevations
East Side of North Abutment
Bottom of Footing Elevation: 596.72 feet
Downdrag to Elevation of 574.0 feet, Without Precoring
Borings BSB-08

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 12X84 Maximum NRB allowed by IDOT is 664 kips	334	38	76	70	61	535.7
	378	38	76	90	64	532.7
	408	38	76	110	67	529.7
	444	38	76	130	70	526.7
	481	38	76	150	73	523.7
	517	38	76	170	76	520.7
	553	38	76	190	78	518.7
	664	38	76	250	79	517.7
HP 14X89 Maximum NRB allowed by IDOT is 705 kips	368	44	88	70	60	536.7
	405	44	88	90	62	534.7
	441	44	88	110	64	532.7
	477	44	88	130	67	529.7
	514	44	88	150	69	527.7
	550	44	88	170	72	524.7
	587	44	88	190	74	522.7
	623	44	88	210	76	520.7
	659	44	88	230	78	518.7
	705	44	88	255	79	517.7
HP 14X102 Maximum NRB allowed by IDOT is 810 kips	371	45	89	70	60	536.7
	407	45	89	90	62	534.7
	443	45	89	110	64	532.7
	479	45	89	130	67	529.7
	516	45	89	150	69	527.7
	553	45	89	170	72	524.7
	589	45	89	190	74	522.7
	626	45	89	210	76	520.7

*Approximate top of bedrock

Estimated Pile Lengths and Tip Elevations
East Side of North Abutment
Bottom of Footing Elevation: 596.72 feet
Downdrag to Elevation of 574.0 feet, Without Precoring
Borings BSB-08

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 14X117 Maximum NRB allowed by IDOT is 929 kips	661	45	89	230	78	518.7
	810	45	89	312	79	517.7
	374	45	90	70	60	536.7
	409	45	90	90	62	534.7
	445	45	90	110	64	532.7
	482	45	90	130	67	529.7
	518	45	90	150	69	527.7
	555	45	90	170	72	524.7
	592	45	90	190	74	522.7
	628	45	90	210	76	520.7
	700	45	90	250	78	518.7
	792	45	90	300	79	517.7
	929	45	90	376	80	516.7

*Approximate top of bedrock

Estimated Pile Lengths and Tip Elevations
East Side of South Abutment
Bottom of Footing Elevation: 595.86, No Precoring Required
Borings BSB-02

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 12X84 Maximum NRB allowed by IDOT is 664 kips	127	0	0	70	44	552.9
	164	0	0	90	51	545.9
	200	0	0	110	54	542.9
	236	0	0	130	56	540.9
	273	0	0	150	62	534.9
	309	0	0	170	66	530.9
	345	0	0	190	75	521.9
	382	0	0	210	76	520.9
	455	0	0	250	82	514.9
	491	0	0	270	84	512.9
	527	0	0	290	85	511.9
	600	0	0	330	86	510.9*
HP 14X89 Maximum NRB allowed by IDOT is 705 kips	127	0	0	70	43	553.9
	164	0	0	90	46	550.9
	200	0	0	110	50	546.9
	236	0	0	130	54	542.9
	273	0	0	150	57	539.9
	309	0	0	170	60	536.9
	382	0	0	210	68	528.9
	418	0	0	230	75	521.9
	455	0	0	250	76	520.9
	491	0	0	270	79	517.9
	564	0	0	310	83	513.9
	636	0	0	350	85	511.9
	705	0	0	388	86	510.9*

*Boring Termination Depth

Estimated Pile Lengths and Tip Elevations
East Side of South Abutment
Bottom of Footing Elevation: 595.86, No Precoring Required
Borings BSB-02

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 14X102 Maximum NRB allowed by IDOT is 810 kips	127	0	0	70	43	553.9
	164	0	0	90	46	550.9
	200	0	0	110	50	546.9
	236	0	0	130	54	542.9
	273	0	0	150	57	539.9
	309	0	0	170	60	536.9
	382	0	0	210	67	529.9
	418	0	0	230	73	523.9
	455	0	0	250	76	520.9
	491	0	0	270	79	517.9
	545	0	0	300	83	513.9
	600	0	0	330	84	512.9
	636	0	0	350	85	511.9
	673	0	0	370	86	510.9*
HP 14X117 Maximum NRB allowed by IDOT is 929 kips	127	0	0	70	42	554.9
	164	0	0	90	46	550.9
	200	0	0	110	50	546.9
	236	0	0	130	54	542.9
	273	0	0	150	57	539.9
	309	0	0	170	59	538.9
	345	0	0	190	64	532.9
	382	0	0	210	67	529.9
	418	0	0	230	73	523.9
	455	0	0	250	76	520.9
	491	0	0	270	79	517.9
	545	0	0	300	82	514.9
	600	0	0	330	84	512.9
	636	0	0	350	85	511.9
	673	0	0	370	86	510.9*

*Boring Termination Depth

Estimated Pile Lengths and Tip Elevations
West Side of South Abutment
Bottom of Footing Elevation: 595.86 feet, Precore Through Existing Substructure to 575.0 feet
Borings BSB-01

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 12X84 Maximum NRB allowed by IDOT is 664 kips	127	0	0	70	51	545.9
	164	0	0	90	61	535.9
	200	0	0	110	63	533.9
	236	0	0	130	69	527.9
	273	0	0	150	74	522.9
	309	0	0	170	76	520.9
	345	0	0	190	78	518.9
	382	0	0	210	79	517.9
	418	0	0	230	80	516.9
	455	0	0	250	81	515.9
	491	0	0	270	82	514.9
	545	0	0	300	83	513.9*
HP 14X89 Maximum NRB allowed by IDOT is 705 kips	127	0	0	70	49	547.9
	164	0	0	90	53	543.9
	200	0	0	110	61	535.9
	236	0	0	130	63	533.9
	273	0	0	150	68	528.9
	309	0	0	170	72	524.9
	345	0	0	190	75	521.9
	382	0	0	210	77	519.9
	418	0	0	230	78	518.9
	455	0	0	250	80	516.9
	491	0	0	270	81	515.9
	545	0	0	300	82	514.9
	636	0	0	350	83	513.9*

*Approximate top of bedrock

Estimated Pile Lengths and Tip Elevations
West Side of South Abutment
Bottom of Footing Elevation: 595.86 feet, Precore Through Existing Substructure to 575.0 feet
Borings BSB-01

Pile Size	Nominal Required Bearing, (kips)	Factored Geotechnical Loss from Downdrag (kips)	Factored Geotechnical Loss Load from Downdrag (kips)	Factored Resistance Available, (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
HP 14X102 Maximum NRB allowed by IDOT is 810 kips	127	0	0	70	49	547.9
	164	0	0	90	53	543.9
	200	0	0	110	61	535.9
	236	0	0	130	63	533.9
	273	0	0	150	68	528.9
	309	0	0	170	72	524.9
	345	0	0	190	75	521.9
	382	0	0	210	77	519.9
	455	0	0	250	79	517.9
	491	0	0	270	80	516.9
	545	0	0	300	81	515.9
	600	0	0	330	82	514.9
	636	0	0	350	83	513.9*
HP 14X117 Maximum NRB allowed by IDOT is 929 kips	127	0	0	70	49	547.9
	164	0	0	90	53	543.9
	200	0	0	110	61	535.9
	236	0	0	130	63	533.9
	273	0	0	150	68	528.9
	309	0	0	170	72	524.9
	345	0	0	190	75	521.9
	382	0	0	210	77	519.9
	455	0	0	250	78	518.9
	491	0	0	270	79	517.9
	545	0	0	300	80	516.9
	600	0	0	330	81	515.9
	636	0	0	350	82	514.9
	727	0	0	400	83	513.9*

*Approximate top of bedrock