STRUCTURE GEOTECHNICAL REPORT
RETAINING WALL (SN 016-Z032)
STATION 98+60 TO STATION 100+85
IL RTE 59 AND US RTE 20 INTERCHANGE
FAP ROUTE 345 & 338, SECTION 7k-1(12)
IDOT D-91-012-13, PTB 165/ITEM 08
COOK COUNTY, ILLINOIS

For

Bowman, Barrett & Associates, Inc.

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Submitted by

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Revised: December 9, 2015

Technical Report Documentation Page

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4. Route / Section / County FAP345 & 338/7k-1(12) / Cook		**5. IDOT Job/ Contract No.** D-91-012-13
6. PTB / Item No. 165/08	**7. Existing Structure Number(s)** None	**8. Proposed Structure Number(s)** SN 016-Z032
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11. Abstract

A new retaining wall will be constructed along northbound IL59 under the existing US20/IL59 Bridge to retain the proposed 8-foot wide multi-use path. The wall will extend from Station 98+60 to Station 100+85 at 54.25 feet right offset. The wall is 225-foot long with a maximum retained height of 8.5 feet.

The soil conditions encountered along the wall alignment include up to 10 feet of very stiff to hard silty clay loam fill overlying stiff to very stiff silty clay and medium dense to very dense sand to gravelly sandy loam, extending to depths of 37 to 42 feet below ground surface (bgs). Below the granular layer, very stiff to hard clay loam to silty clay loam was encountered to the boring termination depth of 50 feet bgs. Sand lenses were present intermittently. The site classifies in the Seismic Site Class D and lies in the Seismic Performance Zone 1.

The proposed retaining wall is a cast-in-place cantilever concrete (T-type) wall. Alternatively, drilled soldier pile wall may also be used. The final wall type should be selected based on a wall type study including cost analyses.

Based on our bearing capacity and settlement analyses, we recommend the wall be designed based on a maximum factored soil bearing resistance of 3.0 ksf. Under this pressure, our settlement evaluations show the foundation soils will undergo long-term settlement of less than 1.0 inches which is acceptable. As indicated in the report, some areas will require treatment by removal and replacement in order to achieve the bearing and settlement requirements. Global stability analyses showed satisfactory factors of safety against slope failure.

Construction recommendations are also provided in the report.

12. Path to archived file
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IDOT D-91-012-13, PTB 165/ITEM 08
COOK COUNTY, ILLINOIS
FOR
BOWMAN, BARRETT & ASSOCIATES, INC.

1.0 INTRODUCTION

This report presents the results of Wang Engineering, Inc. (Wang) subsurface investigation, laboratory testing, and geotechnical engineering evaluations for a new retaining wall along northbound IL Route 59 at the existing US 20/IL 59 Bridge in Cook County, Illinois. On the USGS *Streamwood Quadrangle 7.5 Minute Series* map, the retaining wall will be located in the W of Section 27 and E of Section 28, Tier 41 N, Range 9 E of the Third Principal Meridian. A *Site Location Map* is presented as Exhibit 1.

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

2.0 PROPOSED AND EXISTING STRUCTURES

The proposed retaining wall is part of the proposed widening and reconstruction work for the US 20/IL 59 Interchange area and is required to accommodate an 8-foot wide proposed multi-use path under the existing bridge adjacent to the east abutment wall with a slopewall.

The proposed retaining wall will be 225-foot long measured along the wall's front face and will extend from Station 98+60 to Station 100+85 at 54.25 feet right offset. The maximum retained height will be 8.5 feet near Station 99+75. The existing slopewall will be removed and replaced. There is no existing retaining wall at this location. A type, size and location (TSL) plan approved on August 13, 2015 is included in Appendix D.

3.0 METHODS OF INVESTIGATION

The following sections outline our subsurface and laboratory investigations.

3.1 Subsurface Investigation

Three structure borings, designated as RWB-03, RWB-03-HA, and RWB-04, were drilled by Wang between December 22, 2014 and January 29, 2015, along the proposed wall alignment. The borings were drilled from elevations of 783.8 to 784.3 feet to a depth of 10 to 50 feet below the ground surface (bgs). The as-drilled northings, eastings, and elevations were acquired with a mapping-grade GPS unit. Stations and offsets were determined from design drawings provided by Bowman, Barrett & Associates, Inc. (BBA). The as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 2) and the boring location information is included in the *Boring Logs* (Appendix A).

An ATV drilling rig, equipped with hollow stem augers, was used to advance and maintain an open borehole. Soil sampling was performed according to AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils*" at 2.5-foot intervals to 30 feet bgs and at 5-foot intervals, thereafter. At each boring location, the boreholes were backfilled upon completion with soil cuttings and bentonite chips. Boring RWB-03-HA was drilled with a Jack hammer geoprope sampler, with continuous sampling of soils.

Field boring logs, prepared and maintained by a Wang field engineer, included lithological descriptions, visual-manual soil classifications, pocket penetrometer and Rimac unconfined compressive strength tests, and results of field standard penetration test (SPT) results recorded as blows per 6 inches of penetration. Groundwater levels were measured while drilling and at completion of each boring. Samples collected from each sampling interval were placed in sealed glass jars and transported daily to Wang's in house laboratory in Lombard, Illinois.

3.2 Laboratory Testing

Soil samples were tested in our laboratory for moisture content (AASHTO T 265). Particle size analyses (AASHTO T 88) and Atterberg limits (AASHTO T 89/T 90) were performed on selected samples. Field visual descriptions of soil samples were verified in the laboratory and index tested soils were classified according to the IDH Soil Classification System. The laboratory test results are shown in the *Boring Logs* (Appendix A) and *Laboratory Test Results* (Appendix B).

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 3). Please note that strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical directions.

4.1 Soil Conditions

The borings surface consists of 3-inch thick, black silty loam topsoil. In descending order, the general lithological succession encountered beneath the topsoil includes: 1) man-made ground (fill); 2) soft to hard silty clay to silty clay loam; 3) medium dense to very dense sand to gravelly sandy loam; and 4) very stiff to hard clay loam to silty clay loam

(1) Man-made ground (fill)

Underneath the topsoil, borings RWB-03-HA and RWB-04 encountered about 2.8 to 10.0 feet of stiff to hard, brown and gray silty clay loam fill. The fill is characterized by unconfined compressive strength (Qu) values ranging from 1.5 to 5.7 tsf with an average of 3.4 tsf and moisture content (MC) values from 15 to 28% with an average of 19%. Fill was not encountered in Boring RWB-03.

(2) Soft to hard silty clay to silty clay loam

Borings RWB-03-HA and RWB-03 revealed 5.9 and 12.8 feet of natural soft to hard, black, brown and gray silty clay to silty clay loam separated by 1.0 and 2.5 feet of sandy loam to gravelly sandy loam at elevations of 775.3 and 775.5 feet. Above the interbedded granular layer, there are 3.4 and 6.3 feet of soft to very stiff silty clay with trace organics having Qu values ranging from 0.25 to 2.2 tsf with an average of 1.4 tsf and MC values from 23 to 31% with an average of 28%. Laboratory index testing on the sample taken from this cohesive soil layer revealed liquid limit (L_L) value of 52 % and plastic limit (P_L) value of 18%. According to the AASHTO soil classification system, the soil belongs to A-7-6 (33) group. Whereas the remaining 2.5 and 6.5 feet below the sandy loam to gravelly sandy loam layer consists of stiff to hard silty clay to silty clay loam with Qu values ranging from 1.2 to more than 4.5 tsf with an average of more than 2.4 tsf and MC values from 17 to 19 % with an average of 18%. This layer was not encountered in Boring RWB-04.

(3) Medium dense to very dense sand to gravelly sandy loam

Below fill or natural silty clay, the borings advanced through medium dense to very dense, brown to gray loam, sand, gravelly sand, and gravelly sandy loam from elevations 768.3 to 773.8 feet (10.5 to 15.5 feet bgs). The granular soil has SPT N-values ranging from 15 to more than 50 blows/foot and MC values from 8 to 21% with an average of 11%. A particle size analysis of the granular materials in Boring RW-04 at 16.0 feet bgs revealed gravel, sand, silt and clay contents of 33.0, 37.6, 26.4 and 3.0%, respectively and belongs to A-2-4(0) group.

(4) Very stiff to hard clay loam to silty clay loam

Below the granular soils, borings advanced through very stiff to hard, gray clay loam to silty clay loam to the boring termination depth. This soil has Qu values ranging from 3.4 to 5.4 tsf with an average of 4.5 tsf and MC values from 13 to 16% with an average of 15%.

4.2 Groundwater Conditions

Groundwater was encountered while drilling at elevations of 760.8 to 777.4 feet (6.5 to 23.0 feet bgs). At completion of drilling the groundwater was measured at elevations of 759.8 to 781.9 (2.0 to 24.0 feet bgs).

4.3 Seismic Design Considerations

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

5.0 WALL TYPE ANALYSIS AND RECOMMENDATIONS

Based on the approved TSL plan provided by BBA, the proposed retaining wall will support the reconstructed slopewall and to accommodate the new 8-foot wide multi-use path under the US 20 Bridge over IL 59. The wall will have a maximum retained height of approximately 8.5 feet. Due to the restricted access under the bridge, a cast-in-place cantilever concrete (T-type) wall appears to be the most suitable wall type as shown on the TSL plan. Also, a drilled soldier pile wall is a feasible option for this project. The drilled soldier pile option will not require a Temporary Soil Retention System (TSRS) since it will be a cut wall, top down construction.

However, the final wall type should be selected based on a wall type study including cost analyses. The following sections present the results of our engineering analyses and recommendations for the wall type selection and design.

5.1 Foundation Soil Treatment

Our subsurface investigation revealed generally competent foundation soils underlying the proposed bottom of footing elevation estimated to be at about 779.2 feet elevation with the exception of borings RWB-03 and RWB-03-HA which encountered cohesive soils with Qu values of 0.25 and 1.0 tsf, and with high moisture content values of 28 and 31% below the bottom of footing elevation. This layer also revealed a high liquid limit (L_L) value of 52 % which may be expansive thus unacceptable as foundation soil (IDOT, 1999). Therefore, to increase the bearing resistance and reduce the possible consolidation settlements or expansion, foundation treatment will be necessary in some areas. We recommend removing this soil and replacing with compacted structural fill as described in Section 6.3. The limit of removal and replacement are summarized in Table 1.

Table 1: Summary of Subgrade Treatment Recommendations

Limits Station to Station	Proposed Footing Elevations (feet)	Treatment Type	Treatment Depths Below Footing (inch)	Reference Borings
098+60.00 to 098+95.00	779.2	Compacted Structural Fill	23	RWB-03
098+95.00 to 099+30.00	779.2	Compacted Structural Fill	20	RWB-03-HA

The final treatment requirements must be determined based on actual soils encountered during construction.

5.2 Bearing Resistance

Wang recommends the foundation for the retaining wall to be established at a minimum of 4.0 feet below the finished grade at front of the wall for frost protection. After the foundation treatment, the wall footing can be designed using factored bearing resistance of 3.0 ksf based on nominal bearing resistance of 5.5 ksf and resistance factor of 0.55 (AASHTO 2014) for less than one inch settlement. The estimated friction angle between the base and the underlying silty clay is 22°, and the corresponding ultimate friction coefficient is 0.40 (NAVFAC, 1986). To increase the sliding resistance, a 6-inch thick layer of CA-7 be placed under the footing achieving friction factor of 0.5.

5.3 Settlement Analysis

We evaluated the potential consolidation settlements after treatment of foundation soils for the retaining wall. Soil consolidation parameters were obtained by correlations to water content and Atterberg limits. Our evaluations show the foundation soils will undergo long-term settlement of less than 1.0 inch, if designed for a maximum factored bearing resistance of 3 ksf.

5.4 Global Stability

The global stability of the proposed wall was analyzed based on the soil profile and the information provided in the TSL. The minimum required factor of safety (FOS) for both short-term (undrained) and long- term (drained) soil conditions is 1.5 (IDOT, 1999). At Station 99+75 where the highest wall is proposed, Wang estimates the wall has FOS of 3.7 and 1.8 for short-term and long-term soil conditions, respectively, satisfying the minimum criteria. *Slide v5* computer software evaluation exhibits are shown in Appendix C.

5.5 Drilled Soldier Pile Wall

If drilled soldier pile option is selected, we recommend placing the soldier piles within prebored holes with diameters of at least 36 inches and the combination of soldier piles and shafts should be designed for both lateral earth pressure and lateral deformation.

The design embedment depth of the wall sections should include a minimum FOS of 1.5 against earth pressure failure for walls in the long-term (drained) condition using the soil parameters as shown in Table 2. The design of the wall should ignore 3 feet of soil in front of the wall measured from the finished ground surface elevation in providing passive pressure due to excavation required for installation of concrete facing, drainage system and frost-heave condition. In developing the design lateral pressure, the lateral pressure due to construction equipment surcharge load should be added to the lateral earth pressure. Drainage behind the wall and underdrain should be as per 2012 IDOT Bridge Manual (IDOT, 2012B). The water pressure should be added to the earth pressure if drainage is not provided. The simplified earth pressure distributions shown in 2014 AASHTO LRFD Bridge Design Specifications should be used.

Table 2: Earth Pressure Parameters for Design of Soldier Pile Wall (Reference Boring: RWB-03)

Layer Elevations/ Soil Description	Unit Weight (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients[(2)]	
		Cohesion (psf)	Friction Angle[(3)] φ' (Degree)	Active Pressure	Passive Pressure
783.83 to 781.33 V Stiff SI CL	120	100	30	0.54	1.49
781.33 to 770.83 Stiff SI CL	115	100	28	0.65	1.23
770.83 to 768.30 V Stiff SI CL	120	100	30	0.54	1.49
768.30 to 755.83 M Dense GR SANDY LOAM	120	0	33	0.43	1.84
755.83 to 752.10 Dense GR SANDY LOAM	125	0	36	0.36	2.22
752.10 to 742.10 M Dense SAND	120	0	34	0.41	1.97
742.10 to 737.08 V Stiff CL LOAM	120	100	30	0.54	1.49
737.08 to 733.80[(1)] Hard CL LOAM	125	100	31	0.50	1.61

[(1)] Boring termination depths. [(2)] For inclined backfill of 26.6 degree. [(3)]Based on SPT N-values or PI values for selected soil samples

Design considerations should include deflection control at the top of the wall. The lateral deformation of the wall should be designed using the parameters shown in Table 3 via p-y curve (LPILE or COMP624) method.

Table 3: Geotechnical Parameters for Lateral Load Analysis-Soldier Pile Wall (Ref. Boring: RWB-04)

Layer Elevations (CCD)/ Soil Description	Moist Unit Weight (pcf)	Shear Strength Properties			Estimated Lateral Soil Modulus Parameter k (pci)[(2)]	Estimated Soil Strain Parameter, ε_{50}
		Short Term		Long Term		
		Cohesion Cu (psf)	Friction Angle[(3)] φ (Degree)	Friction Angle[(3)] φ' (Degree)		
784.28 to 781.78 V Stiff SI CL LOAM	120	3280	0	30	1000	0.005
781.78 to 776.28 Hard SI CL LOAM	125	5500	0	31	2000	0.004
776.28 to 773.80 V Stiff SI CL LOAM	120	2710	0	30	1000	0.005
773.80 to 763.78 M Dense GR SANDY LOAM	120	0	34	34	25	--

763.78 to 761.30 Dense GR SANDY LOAM	125	0	36	36	50	--
761.30 to 756.30 Dense to V Dense LOAM	125	0	34	34	50	--
756.30 to 752.53 V Dense GR SAND	125	0	38	38	60	--
752.53 to 747.50 M Dense GR SAND	120	0	35	35	25	--
747.50 to 734.30(1) Hard CL LOAM	125	4920	0	31	2000	0.004

(1)Boring termination depth. (2)Assumed submerged condition for granular soil.
(3)Based on SPT N-values or PI values for selected soil samples

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

All vegetation, surface topsoil, pavement, and debris should be cleared and stripped where the wall will be placed. The exposed subgrade should be proofrolled. To aid in locating unstable and unsuitable materials, the proofrolling should be observed by a qualified engineer. Any unstable or unsuitable materials should be removed and replaced with compacted structural fill as described in Section 6.3. Precipitation run-off should be diverted away from excavations as part of the site preparation.

6.2 Excavation, Dewatering and Utilities

Excavations should be performed in accordance with local, state, and federal regulations including current OSHA regulations. The actual soil conditions encountered during construction may vary from one location to another thus the contractor shall adapt the slope to actual soil conditions encountered. The potential effect of ground movements upon nearby bridge embankment, roadways and utilities should also be taken into consideration.

The Contractor should ensure proper surface grading to prevent the pooling of runoff into open excavations. Special dewatering might not be necessary since we expect the anticipated excavations to be above the groundwater table. Any water entering the excavations should be removed with a conventional sump and pump system.

6.3 Filling and Backfilling

Fill material to attain the final design elevations should be structural fill material. Coarse aggregate of IDOT gradation CA-6 or pre-approved, compacted, cohesive or granular soil conforming to IDOT Section 204 would be acceptable as structural fill (IDOT, 2012b). The fill material should be free of organic matter and debris. Structural fill should be placed in lifts and compacted according to Section 205, *Embankment* (IDOT, 2012b). Estimated design parameters for granular backfill materials are presented in Table 4.

Table 4: Estimated Granular Backfill Parameters

Soil Description	Granular Material Backfill
Unit Weight	125 pcf
Angle of Effective Internal Friction	30°
Active Earth Pressure Coefficient	0.54[1]
Passive Earth Pressure Coefficient	1.49[1]
At-Rest Earth Pressure Coefficient	0.5

[1]Includes a backfill slope of 26.6 degree (2H:1V)

6.4 Wall Construction

The cast-in-place retaining wall should be installed according to the current IDOT Standard Specifications for Road and Bridge Construction.

As shown the approved TSL, the temporary 1H:1V excavation slopes to construct the retaining wall could expose and undermine the existing 36-inch diameter storm sewer, therefore, a Temporary Soil Retention System (TSRS) should be constructed to provide lateral support to the existing sewer. The TSRS may be avoided if the existing soil conditions allow for steeper slopes or benching or other ways of temporarily supporting the existing sewer.

6.5 Construction Monitoring

There is no need for a special construction monitoring for the retaining wall except normally required by the IDOT Standard Specifications.

7.0 QUALIFICATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings drilled by Wang at the locations shown on Exhibit 2 and boring logs in Appendix A. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of the wall are planned, we should be timely informed so that changes can be reviewed, modified, and approved in writing by the geotechnical engineer.

It has been a pleasure to assist Bowman, Barrett & Associates, 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.

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exp. 11/30/2017

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REFERENCES

AASHTO 2014. AASHTO LRFD Bridge Design Specifications. American Association of State Highway and Transportation Officials, Inc., Washington, D.C.

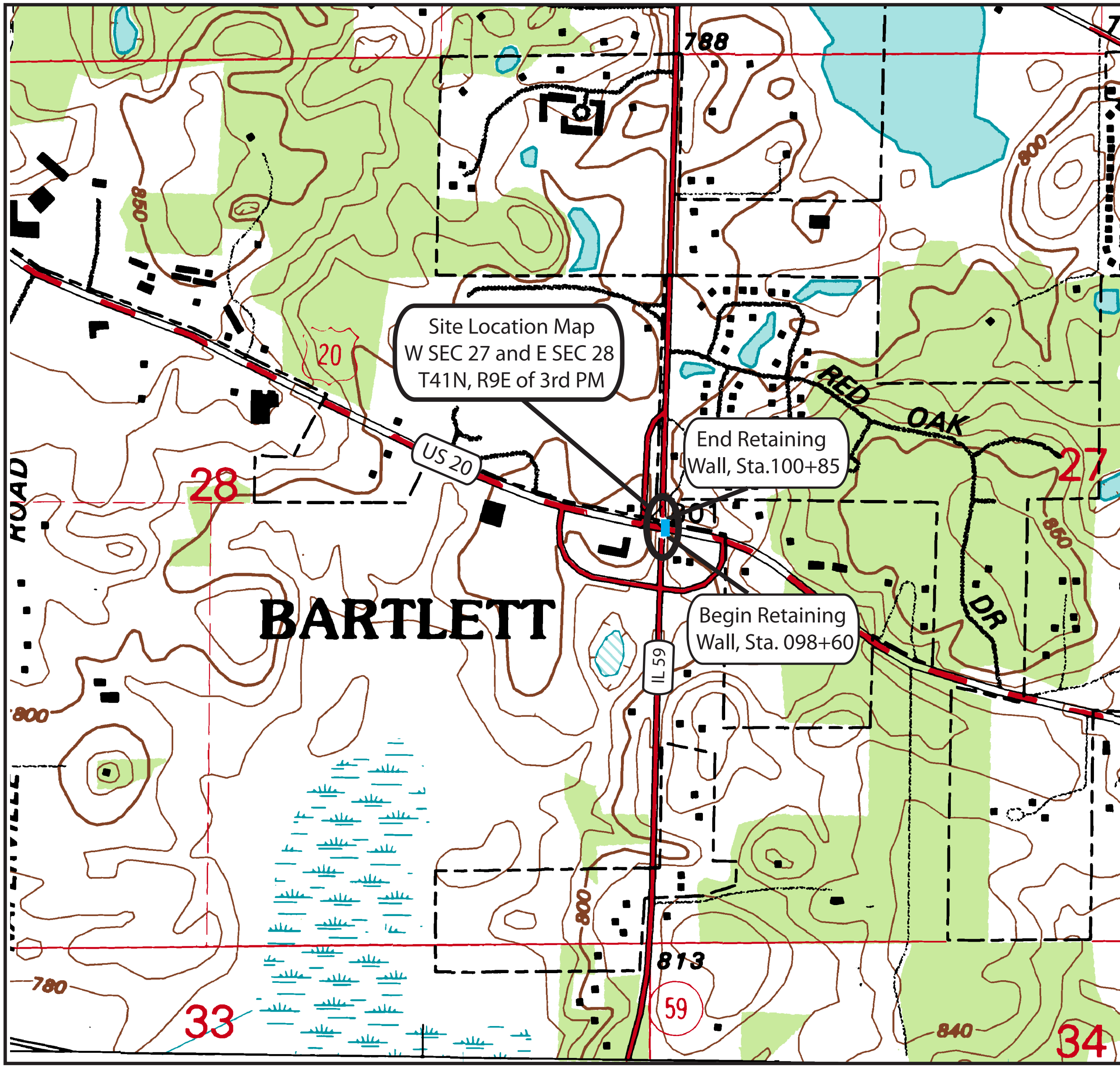
IDOT 1999. *Geotechnical Manual*. Illinois Department of Transportation.

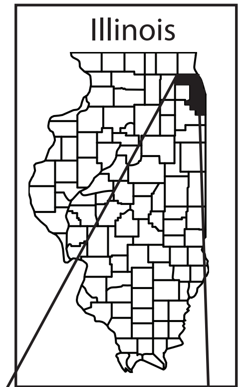
IDOT 2012. *Bridge Manual.* Illinois Department of Transportation.

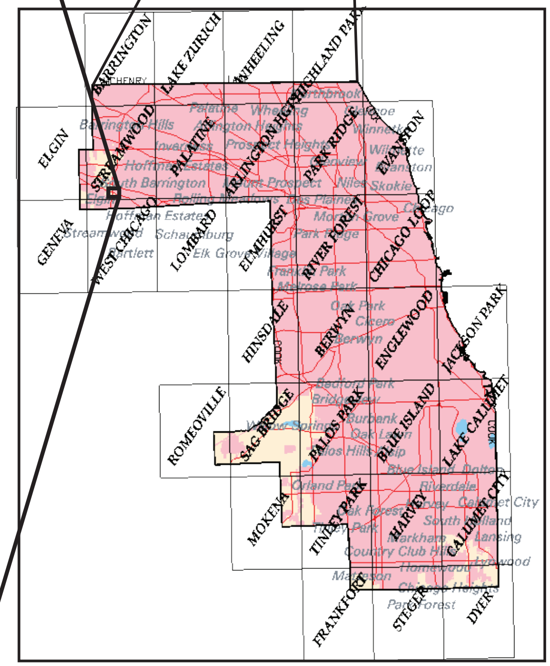
IDOT 2012b. *Standard Specifications for Road and Bridge Construction*. Illinois Department of Transportation.

NAVFAC 1986. DM-7.02 Foundation and Earth Structured, Naval Facilities Engineering Command.

EXHIBITS





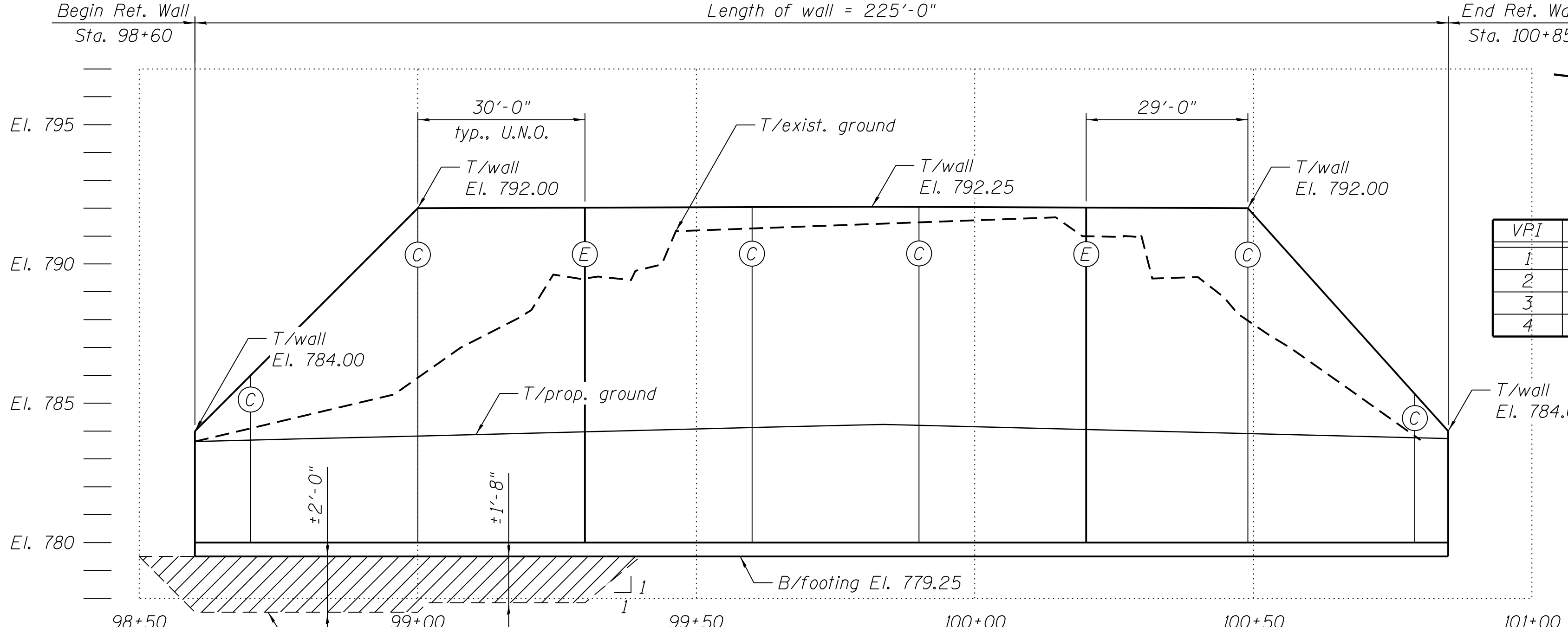


0 0.25 0.5 0.75 1.0 Mile

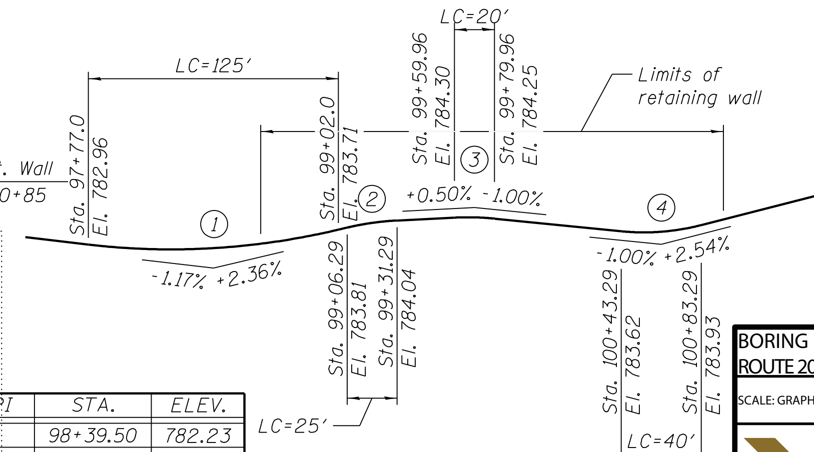
SITE LOCATION MAP: RETAINING WALL, ILLINOIS ROUTE 59 AND US ROUTE 20 INTERCHANGE, IDOT D-91-012-12, COOK COUNTY, ILLINOIS		
SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: H. Bista CHECKED BY: M. Seyhun
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR BOWMAN, BARRETT & ASSOCIATES, INC.		314-16-01

Benchmark: Cut "□" on the southwest corner of the west pier crashwall of the US 20/IL 59 bridge. Elev. 786.22.

Existing Structure: S.N. 016-0254 carrying US 20 over IL 59 was built in 1990 as part of Project No. IX-21(52). The structure is a three-span bridge with an overall bk. to bk. abutment length of ±182'-9" and out to out deck width of 103'-2". The superstructure consists of a 7½" thick reinforced concrete deck supported by 54" deep PPC I-beams. The substructure consists of multi-column piers with crashwall founded on spread footings, and integral abutments founded on 14" ϕ metal shell piles. The existing slopewall will be removed and replaced to accommodate the proposed retaining wall. No retaining wall currently exists. Traffic will be maintained on IL 59 during construction.



REFLECTED ELEVATION



VPI	STA.	ELEV.
1	98+39.50	782.23
2	99+18.79	784.10
3	99+69.96	784.35
4	100+63.29	783.42

PATH PROFILE GRADE LINE

(Along left edge of path)

HIGHWAY CLASSIFICATION

F.A.P. Rte. 338 (IL Rte 59) Sutton Rd.
Functional Class: Other Principal Arterial
ADT: 45,200 (2010); 50,000 (2040)
ADTT: 4,972 (2010); 5,500 (2040)
DHV: 2,500 (2040)
Design Speed: 50 m.p.h.
Posted Speed: 45 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Specifications, 7th Edition

BORING LOCATION PLAN: RETAINING WALL, ILLINOIS ROUTE 59 AND US ROUTE 20 INTERCHANGE, IDOT D-91-012-12, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: H. Bista CHECKED BY: M. Seyhun

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FOR BOWMAN, BARRETT & ASSOCIATES, INC. | 314-16-01

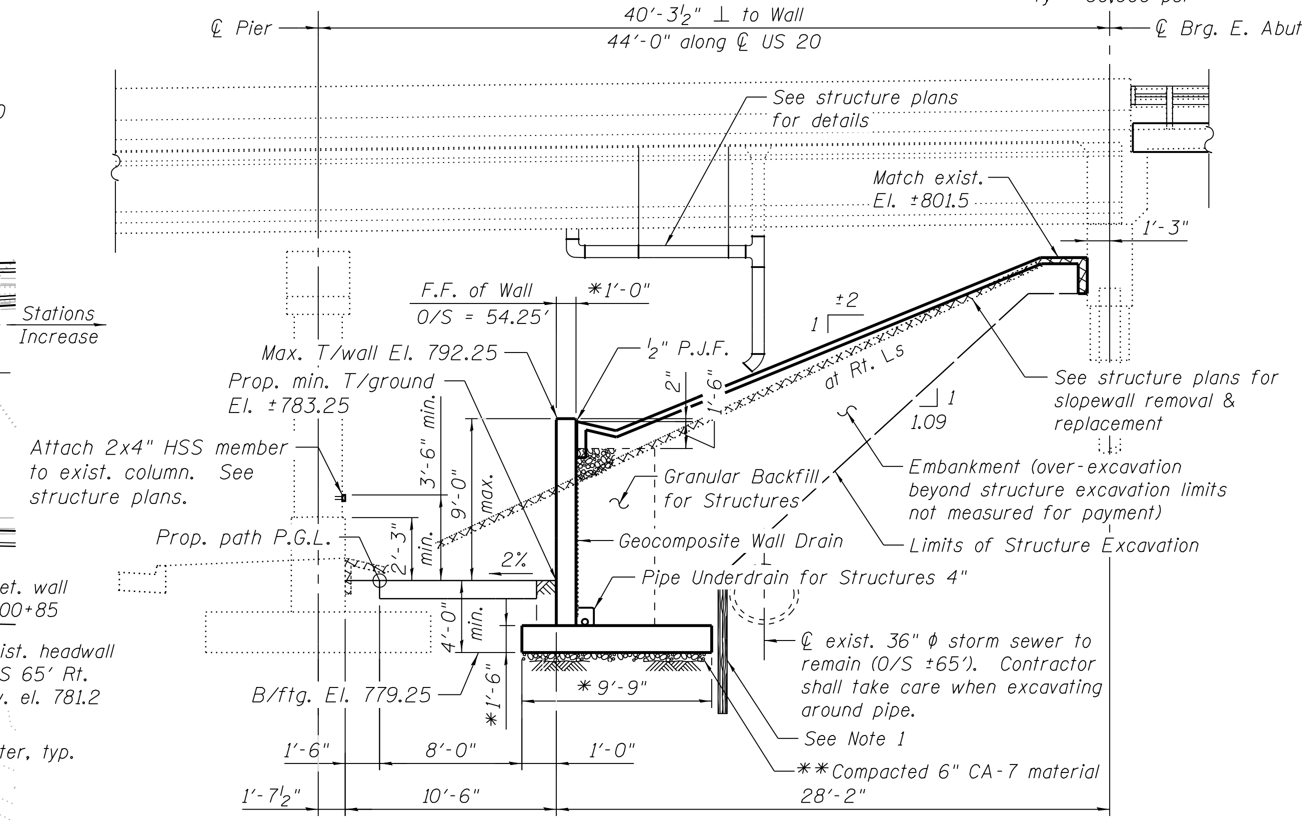
NOTES

1. Contractor shall provide soil retention/pipe bracing to prevent movement of existing storm sewer. Cost included with Structure Excavation.

* Subject to refinement in final design.
** Depth as req'd for areas containing unsuitable material.

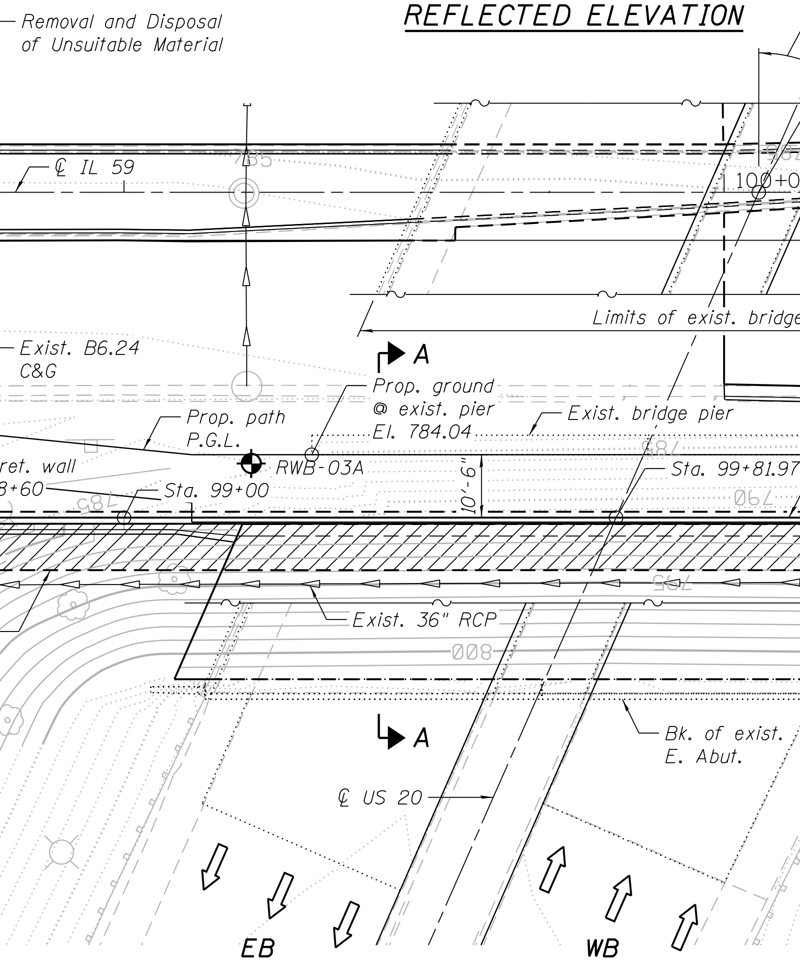
DESIGN STRESSES

FIELD UNITS
f'c = 3,500 psi
fy = 60,000 psi

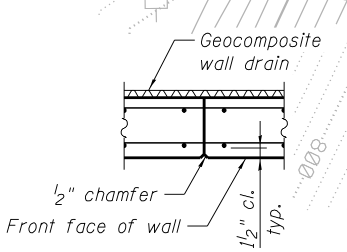


SECTION A-A

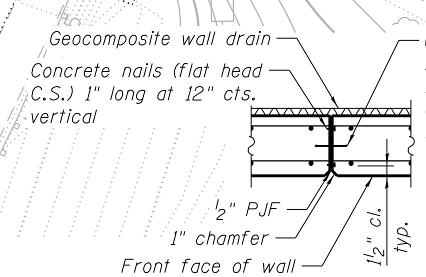
(Dimensions at Rt. ∟ to wall U.N.O.)
(Offset shown from ℄ IL 59)



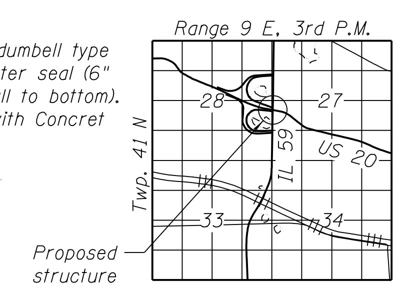
PLAN



CONSTRUCTION JOINT



EXPANSION JOINT



LOCATION SKETCH

LEGEND

- Soil Boring
- Exist. Storm Sewer
- Ⓔ Ⓒ = Exp. Jt., Const. Jt.

GENERAL PLAN & ELEVATION
U.S. ROUTE 20 OVER IL ROUTE 59
F.A.P. RTE. 338 & 345 - SEC. 7K-1(12)
COOK COUNTY
STA. 98+60 TO 100+85
STRUCTURE NO. (IDOT to provide)

USER NAME =	DESIGNED - DF	REVISED
	CHECKED - -	REVISED
PLOT SCALE =	DRAWN - LAM	REVISED
PLOT DATE =	CHECKED - DF	REVISED

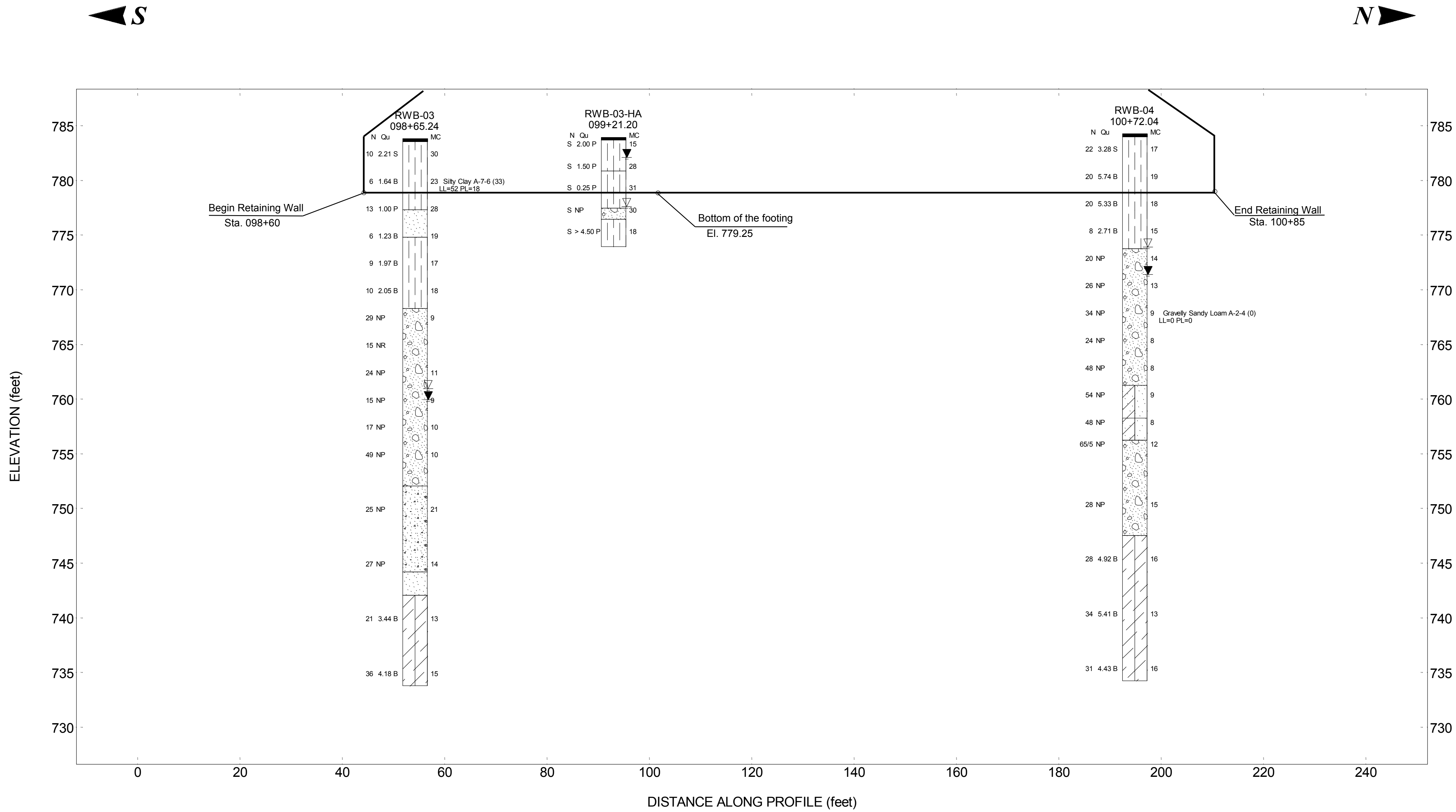
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

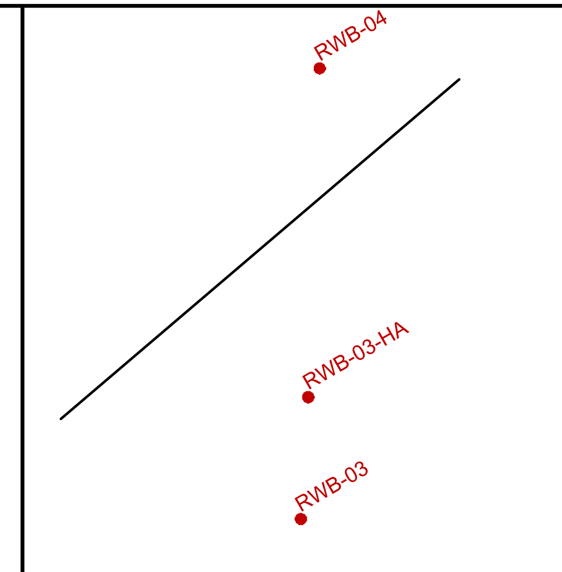
SHEET NO. RW OF 8 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
345(8)	7K-1(12)	COOK	$TOT	$RW01

CONTRACT NO. 60V57
ILLINOIS FED. AID PROJECT

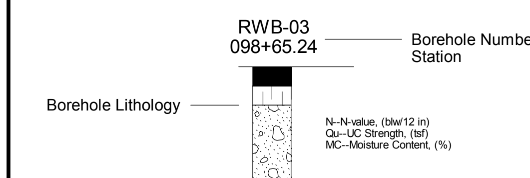
$FILEL$





Site Map Scale 1 inch equals 90 feet

Explanation:



Water Level Reading at time of drilling.

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

0 — 24

Horizontal Scale (feet)

Vertical Exaggeration: 2x

Lithology Graphics

- Topsoil
- IDH Silty Clay, Silty Clay Loam
- IDH Sand, Sandy Loam
- Gravelly sand, sandy gravel
- Coarse sand
- IDH Clay Loam
- IDH Loam

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1145 N Main Street
Lombard, IL 60148

Retaining Wall Soil Profile

WEI SINCE 1982

IL Route 59/US Route 20 (FAP 345) Interchange
Cook County, IL

JOB NUMBER	PLATE NUMBER
314-16-01	EXHIBIT 3

WEI 11X17 3141601.GPJ WANGENG.GDT 1/30/15

APPENDIX A

BORING LOG RWB-03

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

WEI Job No.: 314-16-01

Client: **Bowman, Barrett, and Associates**
Project: **IL Route 59/US Route 20 (FAP 345) Interchange**
Location: **Cook County, IL**

Datum: NAVD 88
Elevation: 783.83 ft
North: 1945475.64 ft
East: 1019646.85 ft
Station: 098+65.24
Offset: 42.5 RT

SOIL AND ROCK DESCRIPTION

Elevation (ft)	Soil and Rock Description	Depth (ft)
783.6	3-inch thick, black SILTY LOAM --TOPSOIL--	
	Stiff to very stiff, black and brown SILTY CLAY, trace organic matter --L_L(%)=52, P_L(%)=18-- --%Gravel=0.3-- --%Sand=7.9-- --%Silt=60.0-- --%Clay=31.8-- --A-7-6 (33)--	5
777.3	Brown SANDY LOAM --Moist--	
774.8	Stiff to very stiff, brown and gray SILTY CLAY, trace gravel	10, 15
768.3	Medium dense to dense, brown and gray GRAVELLY SANDY LOAM --Moist-- --Wet--	20, 25
	--Saturated--	30
752.1	Medium dense, gray medium to coarse SAND, little gravel --Saturated--	35
744.2	Brown and gray, fine to medium SAND with SILT	40
742.1	Very stiff to hard, gray CLAY LOAM, trace gravel --Moist--	45
733.8	Boring terminated at 50.00 ft	50

Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
1	3, 4, 6	2.21 S	30
2	4, 3, 3	1.64 B	23
3	3, 6, 7	1.00 P	28
4	6, 3, 3	1.23 B	19
5	3, 3, 6	1.97 B	17
6	3, 4, 6	2.05 B	18
7	21, 20, 9	NP	9
8	18, 7, 8	NR	
9	7, 9, 15	NP	11
10	5, 6, 9	NP	9
11	7, 8, 9	NP	10
12	11, 31, 18	NP	10
13	11, 13, 12	NP	21
14	11, 12, 15	NP	14
15	7, 8, 13	3.44 B	13
16	9, 16, 20	4.18 B	15

GENERAL NOTES

Begin Drilling **12-22-2014** Complete Drilling **12-22-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 ATV**
Driller **K&K** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.5' interval to 30', 5' interval thereafeter; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **23.00 ft**
At Completion of Drilling ▼ **24.00 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 RWB-03-HA

WEI Job No.: 314-16-01

Client: **Bowman, Barrett, and Associates**
Project: **IL Route 59/US Route 20 (FAP 345) Interchange**
Location: **Cook County, IL**

Datum: NAVD 88
Elevation: 783.96 ft
North: 1945531.52 ft
East: 1019650.20 ft
Station: 099+21.20
Offset: 45.2 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
783.7	3-inch thick, black SILTY LOAM --TOPSOIL--					
	Stiff to very stiff, brown and gray SILTY CLAY LOAM, trace gravel --FILL--		0	PUSH	2.00 P	15
780.9			1	PUSH	1.50 P	28
	Soft to stiff, brown and gray SILTY CLAY	5	2	PUSH	0.25 P	31
777.5	Brown GRAVELLY SANDY LOAM --Saturated--		3	PUSH	NP	30
776.5	Stiff to hard, brown and gray SILTY CLAY to SILTY CLAY LOAM, trace gravel		4	PUSH	> 4.50 P	18
774.0	Boring terminated at 10.00 ft	10				

GENERAL NOTES

Begin Drilling **01-29-2015** Complete Drilling **01-29-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **Geoprobe**
Driller **F&A** Logger **A. Tomaras** Checked by **C. Marin**
Drilling Method **Continuous Sampling**

WATER LEVEL DATA

While Drilling ∇ **6.50 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.

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BORING LOG RWB-04

WEI Job No.: 314-16-01

Client: **Bowman, Barrett, and Associates**
Project: **IL Route 59/US Route 20 (FAP 345) Interchange**
Location: **Cook County, IL**

Datum: NAVD 88
Elevation: 784.28 ft
North: 1945682.36 ft
East: 1019655.45 ft
Station: 100+72.04
Offset: 48.7 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
784.0	3-inch thick, black SILTY LOAM --TOPSOIL--					
	Very stiff to hard, brown SILTY CLAY LOAM, trace gravel --FILL--		1	7, 11, 11	3.28 S	17
		5	2	6, 8, 12	5.74 B	19
			3	6, 9, 11	5.33 B	18
		10	4	2, 3, 5	2.71 B	15
773.8	Medium dense to dense, brown GRAVELLY SANDY LOAM to SANDY GRAVEL --Wet--		5	6, 8, 12	NP	14
		15	6	10, 10, 16	NP	13
	--Wet-- --%Gravel=33.0-- --%Sand=37.6-- --%Silt=26.4-- --%Clay=3.0-- --A-2-4 (0)--		7	6, 18, 16	NP	9
		20	8	8, 12, 12	NP	8
			9	14, 20, 28	NP	8
761.3	Dense to very dense, gray LOAM --Moist--	25	10	20, 30, 24	NP	9
	--trace gravel--		11	18, 18, 30	NP	8
756.3	Medium dense to very dense, gray GRAVELLY SAND --Wet--	30	12	65/5	NP	12
		35	13	12, 15, 13	NP	15
747.5	Hard, gray CLAY LOAM to SILTY CLAY LOAM, trace gravel	40	14	8, 11, 17	4.92 B	16
		45	15	8, 10, 24	5.41 B	13
734.3		50	16	6, 11, 20	4.43 B	16
	Boring terminated at 50.00 ft					

GENERAL NOTES

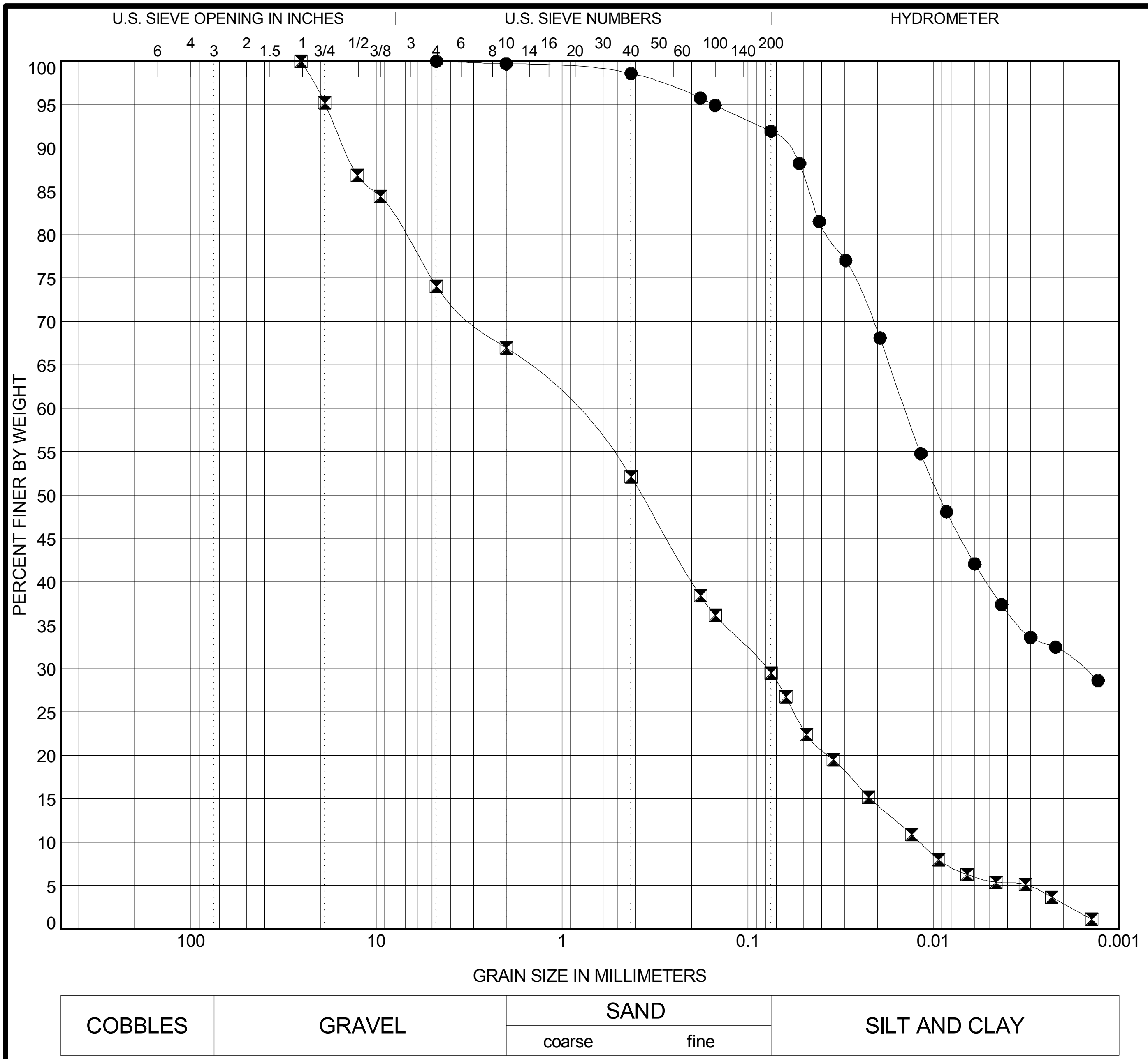
Begin Drilling **12-22-2014** Complete Drilling **12-23-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 ATV**
Driller **K&K** Logger **A. Happel** Checked by **C. Marin**
Drilling Method **2.5' interval to 30', 5' interval thereafeter; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **10.50 ft**
At Completion of Drilling ▼ **13.00 ft**
Time After Drilling **NA**
Depth to Water **NA**

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

APPENDIX B



	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	**RWB-03#2**	**3.5 ft**	**Silty Clay**	**52**	**18**	**34**		
⧗	**RWB-04#7**	**16.0 ft**	**Gravelly Sandy Loam**	**NP**	**NP**	**NP**	**0.54**	**81.86**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RWB-03#2**	**3.5 ft**	**4.75**	**0.014**	**0.002**		**0.3**	**7.9**	**60.0**	**31.8**
⧗	**RWB-04#7**	**16.0 ft**	**25.4**	**0.966**	**0.079**	**0.012**	**33.0**	**37.6**	**26.4**	**3.0**

WEI
SINCE 1982

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GRAIN SIZE DISTRIBUTION

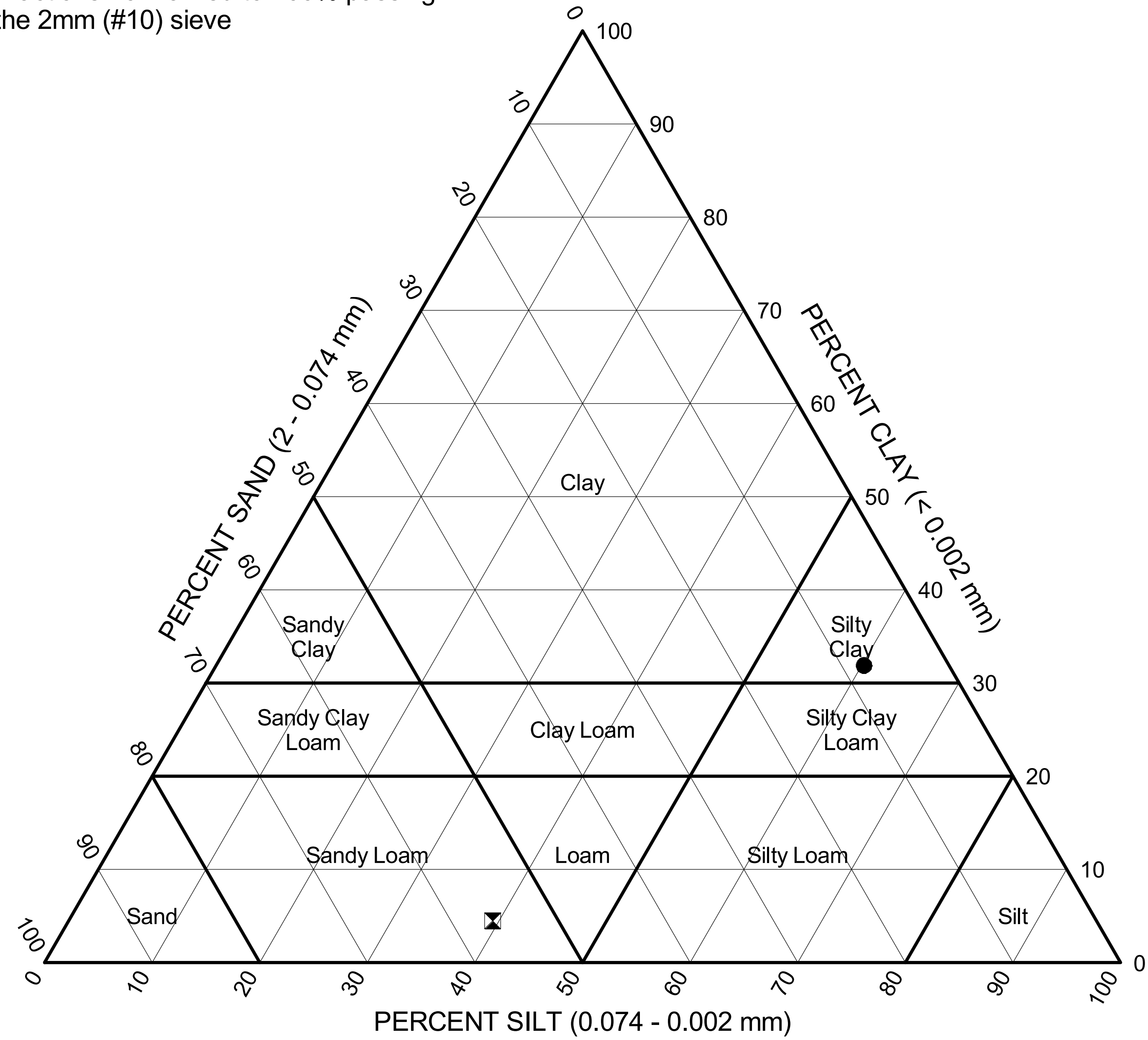
Project: IL Route 59/US Route 20 (FAP 345) Interchange

Location: Cook County, IL

Number: 314-16-01

WEI GRAIN SIZE IDH 3141601.GPJ US LAB.GDT 1/19/15

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



	Sample	Depth (ft)	Sand (%)	Silt (%)	Clay (%)	Classification		
						IL DOT	AASHTO	ASTM
●	**RWB-03#2**	**3.5**	**7.9**	**60.2**	**31.9**	**Silty Clay**	**A-7-6 (33)**	**CH**
⧗	**RWB-04#7**	**16.0**	**56.1**	**39.4**	**4.5**	**Gravelly Sandy Loam**	**A-2-4 (0)**	**SM**

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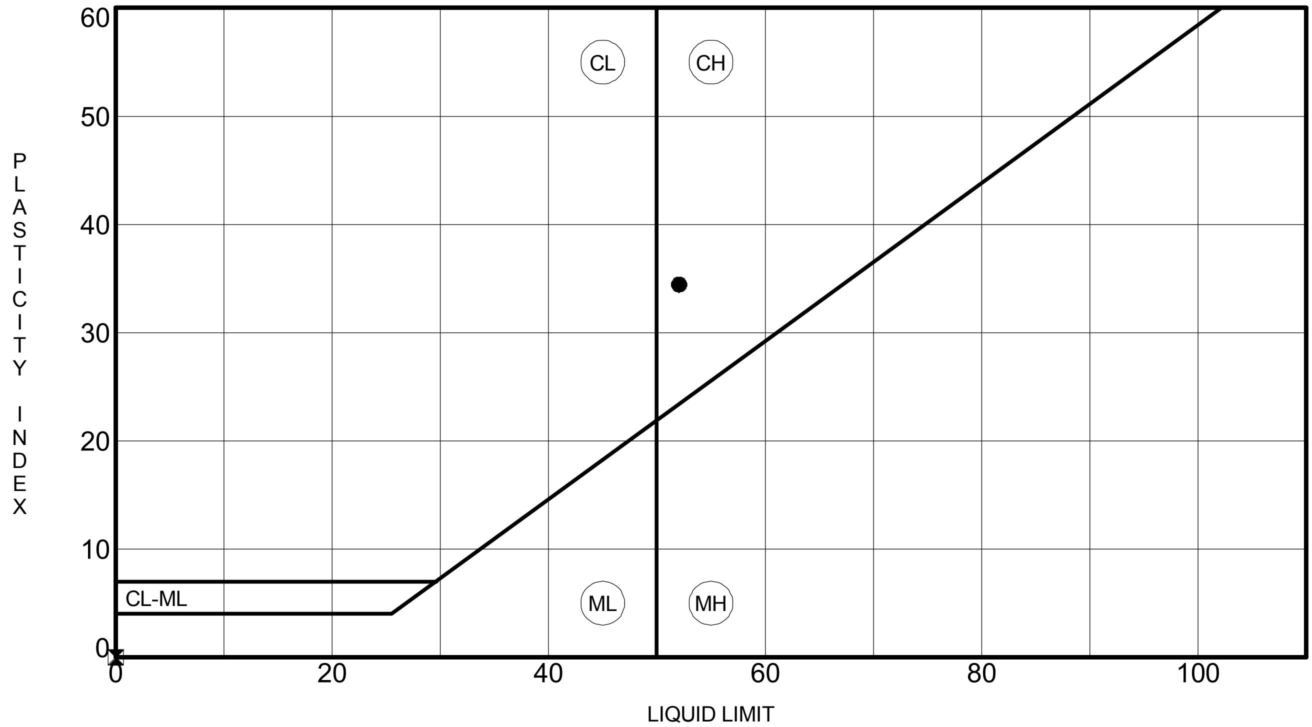
Fax: 630 953-9928

IDH Textural Classification Chart

Project: IL Route 59/US Route 20 (FAP 345) Interchange

Location: Cook County, IL

Number: 314-16-01



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	**RWB-03#2**	**3.5 ft**	**52**	**18**	**34**	**92**	**Silty Clay**
⧗	**RWB-04#7**	**16.0 ft**	**NP**	**NP**	**NP**	**30**	**Gravelly Sandy Loam**

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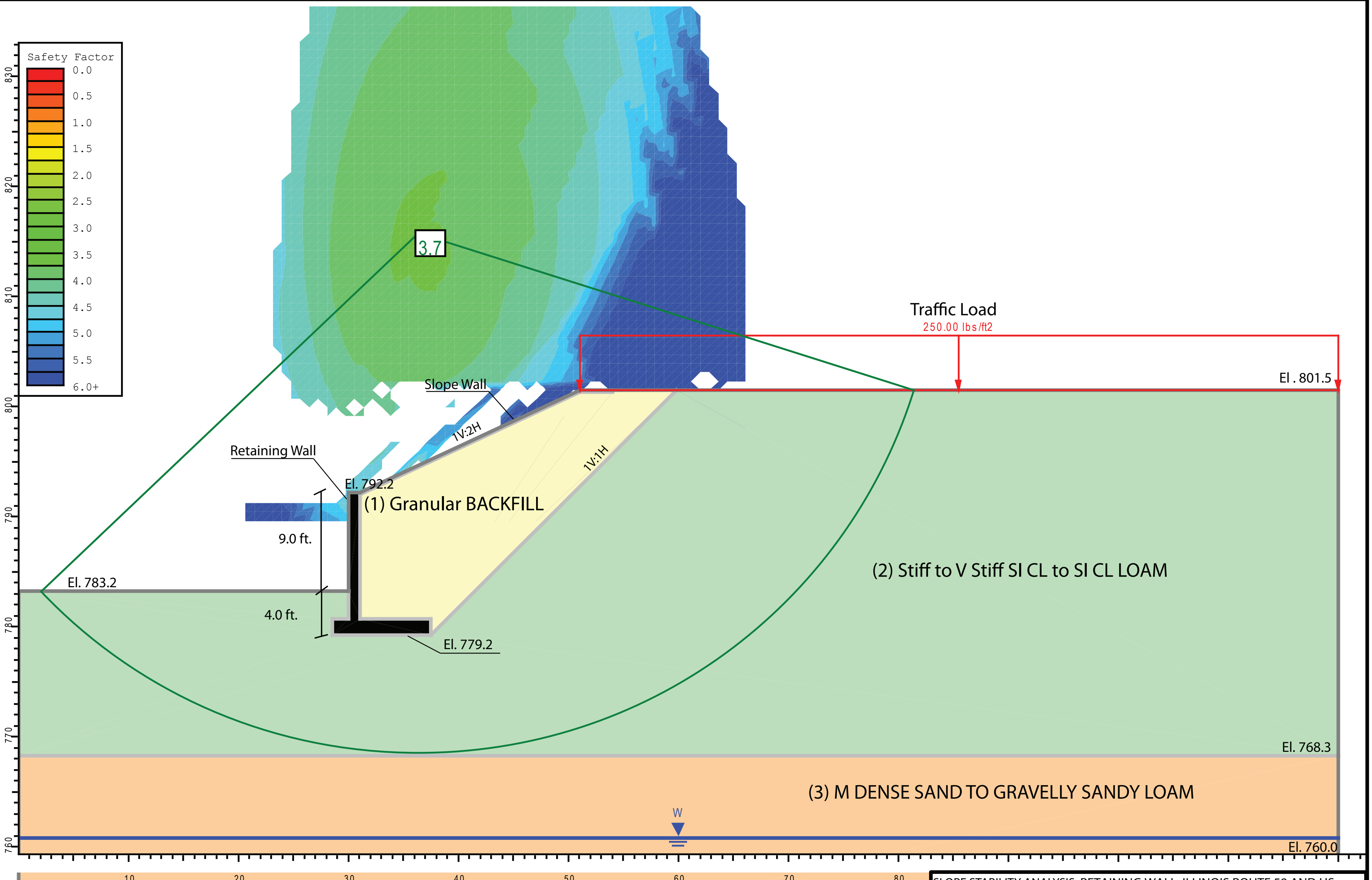
ATTERBERG LIMITS' RESULTS

Project: IL Route 59/US Route 20 (FAP 345) Interchange

Location: Cook County, IL

Number: 314-16-01

APPENDIX C



Slope Stability Analysis-Short Term, Retaining Wall, Ref Boring RWB-03

Layer ID	Soil Type	Unit Weight (pcf)	Undrained Parameters C (psf)	Undrained Parameters ϕ (deg.)
1	Granular BACKFILL	125	0	32
2	Stiff to Very Stiff SILTY CLAY to SILTY CLAY LOAM	120	1600	0
3	Medium Dense SAND to GRAVELLY SANDY LOAM	120	0	33

SLOPE STABILITY ANALYSIS: RETAINING WALL, ILLINOIS ROUTE 59 AND US ROUTE 20 INTERCHANGE , IDOT D-91-012-12, COOK COUNTY, ILLINOIS

SCALE: GRAPHIC | APPENDIX C-1 | DRAWN BY: H. Bista | CHECKED BY: M. Seyhun

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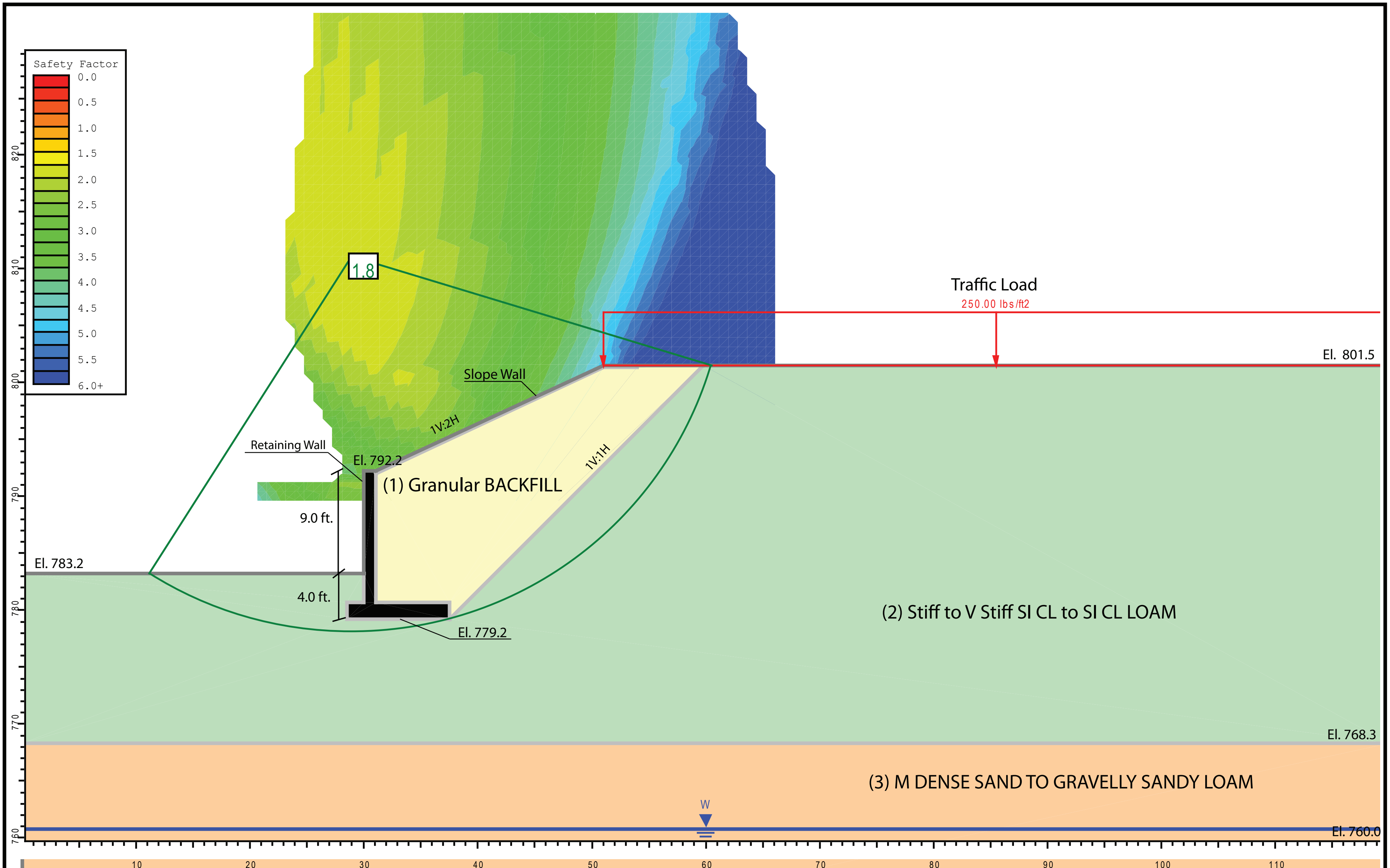
FOR BOWMAN, BARRETT & ASSOCIATES, INC. | 314-16-01



Slope Stability Analysis-Long Term, Retaining Wall, Ref Boring RWB-03

Layer ID	Soil Type	Unit Weight (pcf)	Drained Parameters C' (psf)	Drained Parameters ϕ (deg.)
1	Granular BACKFILL	125	0	32
2	Stiff to Very Stiff SILTY CLAY to SILTY CLAY LOAM	120	100	29
3	Medium Dense SAND to GRAVELLY SANDY LOAM	120	0	33

SLOPE STABILITY ANALYSIS: RETAINING WALL, ILLINOIS ROUTE 59 AND US ROUTE 20 INTERCHANGE , IDOT D-91-012-12, COOK COUNTY, ILLINOIS

SCALE: GRAPHIC

APPENDIX C-2

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

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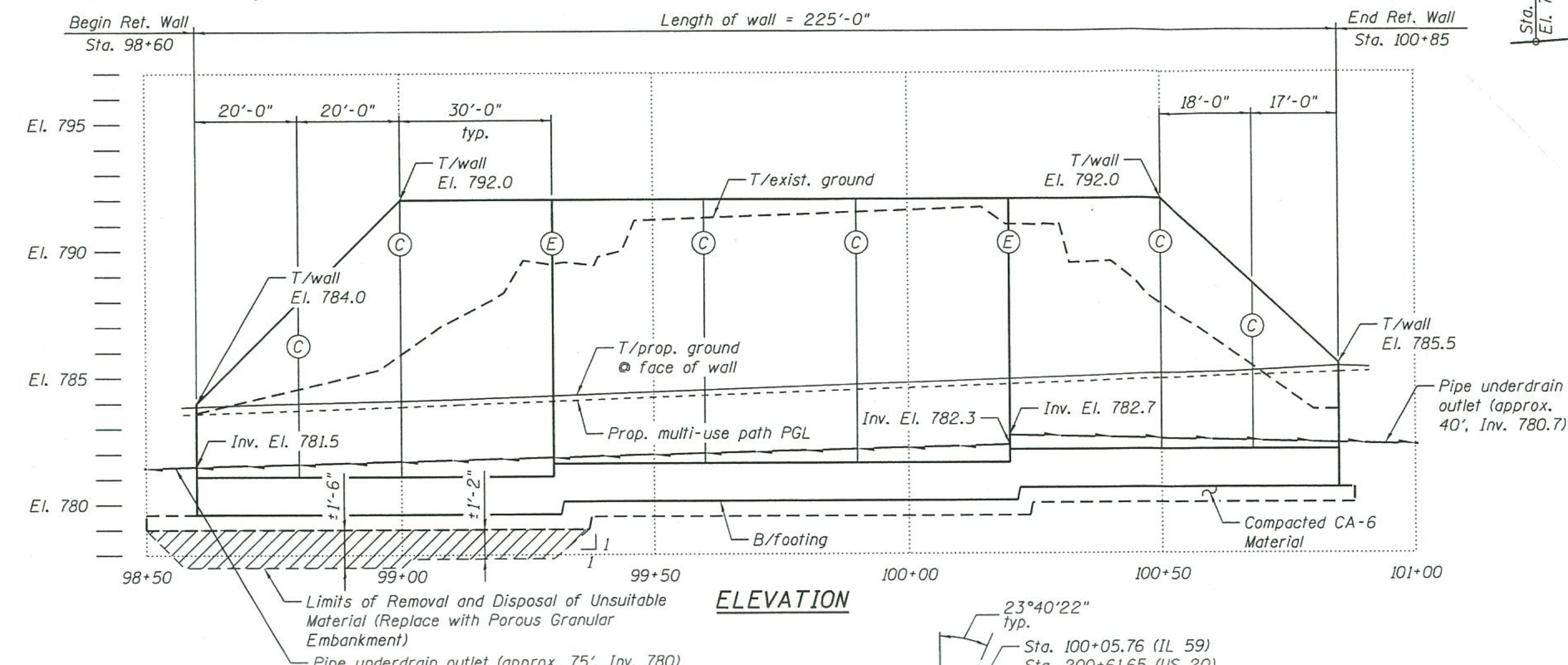
FOR BOWMAN, BARRETT & ASSOCIATES, INC.

314-16-01

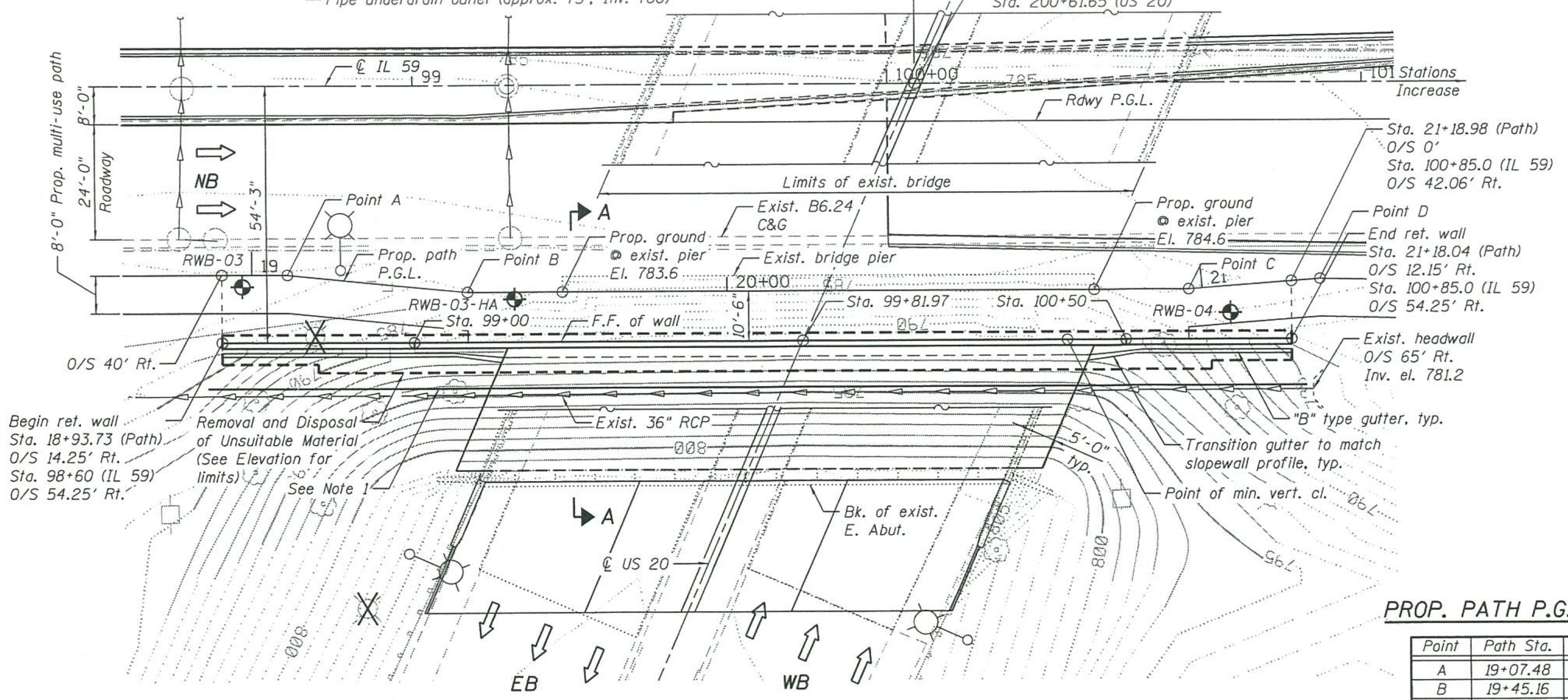
APPENDIX D

Benchmark: Cut "□" on the southwest corner of the west pier crashwall of the US 20/IL 59 bridge. Elev. 786.22.

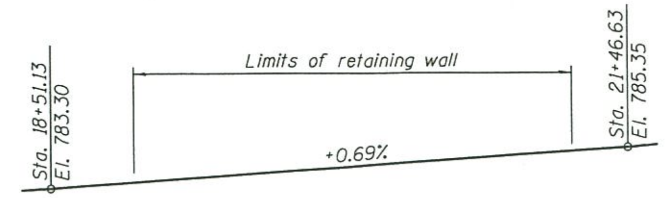
Existing Structure: S.N. 016-0254 carrying US 20 over IL 59 was built in 1990 as part of Project No. IX-21(52). The structure is a three-span bridge with an overall bk. to bk. abutment length of ±182'-9" and out to out deck width of 103'-2". The superstructure consists of a 7½" thick reinforced concrete deck supported by 54" deep PPC I-beams. The substructure consists of multi-column piers with crashwall founded on spread footings, and integral abutments founded on 14" ϕ metal shell piles. The existing slopewall will be removed and replaced to accommodate the proposed retaining wall. No retaining wall currently exists. Traffic will be maintained on IL 59 & US 20 during construction.



ELEVATION



PLAN



PATH PROFILE GRADE LINE

(Along left edge of path)

NOTES

1. Contractor shall provide soil retention/pipe bracing to retain embankment and prevent movement of existing storm sewer. Cost included with Structure Excavation.
2. The factored bearing resistance required shall be a minimum of 3,000 p.s.f. Contractor shall verify soil properties and notify the Engineer if bearing values are not encountered at bottom of footing elevations.
3. See sheet 2 for Section A-A.

APPROVED

AUG 13 2015

AS A BASIS FOR PREPARATION OF DETAILED PLANS

PROP. PATH P.G.L. REFERENCE POINTS

Point	Path Sta.	O/S	IL 59 Sta.	O/S
A	19+07.48	0'	98+73.75	40' Rt.
B	19+45.16	0'	99+11.25	43.75' Rt.
C	20+97.21	0'	100+63.29	43.75' Rt.
D	21+24.75	0'	100+90.96	41.6' Rt.

HIGHWAY CLASSIFICATION

F.A.P. Rte. 338 (IL Rte 59) Sutton Rd.
Functional Class: Other Principal Arterial
ADT: 45,200 (2010); 50,000 (2040)
ADTT: 4,972 (2010); 5,500 (2040)
DHV: 2,500 (2040)
Design Speed: 50 m.p.h.
Posted Speed: 45 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

F.A.P. Rte. 345 (US 20) Lake St.
Functional Class: Other Principal Arterial
ADT: 31,600 (2013); 37,389 (2032)
ADTT: 2,243 (2013); 5,235 (2032)
DHV: 2,243 (2032)
Design Speed: 50 m.p.h.
Posted Speed: 45 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Specifications, 7th Edition with 2015 AASHTO Interim Revisions

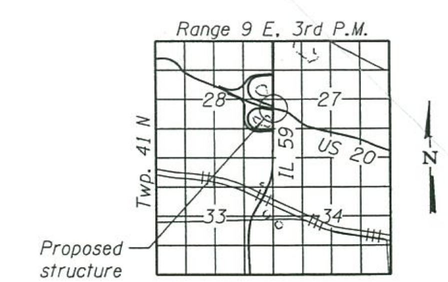
DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi

LEGEND

Ⓔ Ⓒ = Exp. Jt., Const. Jt.
= Soil Boring
= Prop. Light Pole
= Prop. Pipe Underdrain
= Exist. Storm Sewer
= Exist. Light Pole Removal



LOCATION SKETCH

GENERAL PLAN
U.S. ROUTE 20 OVER IL ROUTE 59
F.A.P. RTE. 338 & 345 - SEC. 7K-1(12)
COOK COUNTY
STA. 98+60 TO 100+85
SN 016-Z032

BOWMAN, BARRETT & ASSOCIATES INC.
CONSULTING ENGINEERS
Chicago, Illinois
312.228.0100
www.bbandainc.com

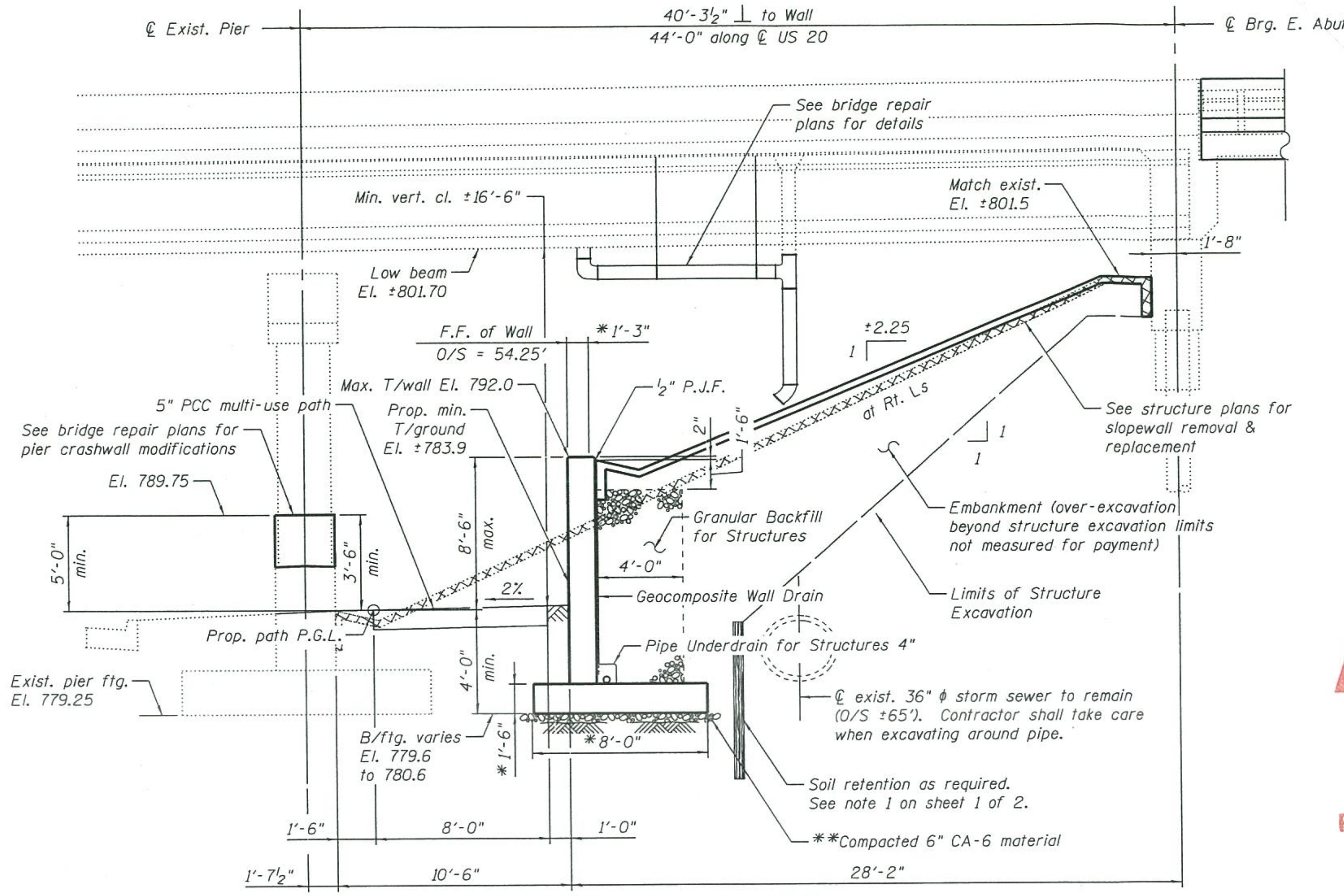
USER NAME =	DESIGNED - DF	REVISED	
	CHECKED - -	REVISED	
PLOT SCALE = N.T.S.	DRAWN - LAM	REVISED	
PLOT DATE = 7/29/2015	CHECKED - DF	REVISED	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
345	7K-1(12)	COOK		
		CONTRACT NO. 60V57		
	ILLINOIS FED. AID PROJECT			

016Z032-60V57-TSL-001.dgn

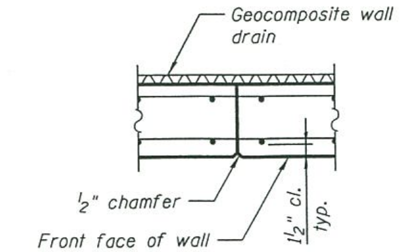


SECTION A-A

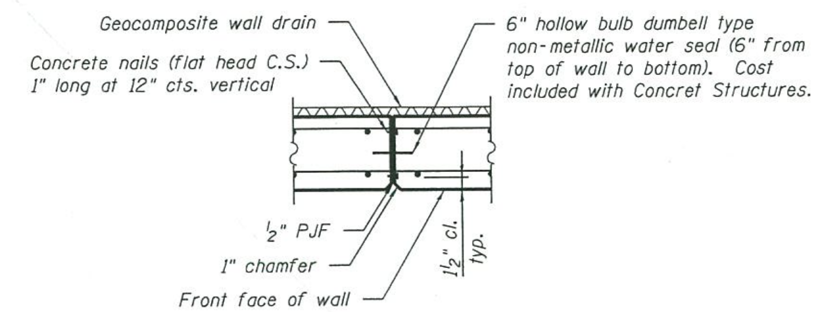
(Dimensions at Rt. L to wall U.N.O.)
(Offset shown from ℄ IL 59)

* Subject to refinement in final design.

** For areas with Removal of Unsuitable Material, cap Porous Granular Emabankment with 6" compacted CA-6 material.

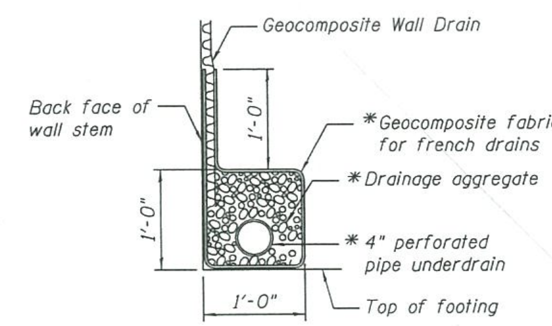


CONSTRUCTION JOINT



EXPANSION JOINT

APPROVED
AUG 13 2015
AS A BASIS FOR PREPARATION OF DETAILED PLANS



PIPE UNDERDRAIN DETAIL

*Cost included with Pipe Underdrains for Structures 4"

DETAILS
U.S. ROUTE 20 OVER IL ROUTE 59
F.A.P. RTE. 338 & 345 - SEC. 7K-1(12)
COOK COUNTY
STA. 98+60 TO 100+85
SN 016-Z032

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		CHECKED - -	REVISED
	PLOT SCALE = N.T.S.	DRAWN - LAM	REVISED
	PLOT DATE = 7/29/2015	CHECKED - DF	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
345	7K-1(12)	COOK		
		CONTRACT NO. 60V57		
		ILLINOIS FED. AID PROJECT		

016Z032-60V57-TSL-002.dgn