STRUCTURE GEOTECHNICAL REPORT

Proposed Retaining Wall

Retaining Wall SN 049-W088

IDOT Project D-91-086-16,

PTB 178-001, Contract 62B65

City of Lake Forest

Lake County, Illinois

Prepared for:

Knight E/A
221 North LaSalle Street
Suite 300
Chicago, Illinois 60601

Prepared by:

Geo Services, Inc.
805 Amherst Court
Suite 204
Naperville, Illinois 60565
(630) 305-9186

JOB NO. 16017

Revised: 07/30/19

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm

Revised: July 30, 2019
July 23, 2019
April 24, 2019
Draft: October 24, 2018

Knight E/A
221 North LaSalle Street, Suite 300
Chicago, IL 60601

Attn: Mr. Robert F. Mack, P.E., C.F.M.

GSI Project No. 16017

Re: Structure Geotechnical Report
Proposed Retaining Wall
Retaining Wall SN 049-W088
IDOT Project No. D-91-086-16, PTB# 178-001, Contract 62B65
Lake Forest, IL.

Dear Mr. Mack:

The following report presents the geotechnical analysis and recommendations for the construction of the proposed retaining wall SN 049-W088 planned near at the proposed detention pond (north of the proposed IDOT Pump Station #38), located at the northwest quadrant of Deerpath Road and Skokie Valley Bike Path in Lake County, Illinois. A total of two (2) retaining wall borings (RW-01 and RW-02) were completed at the site by Geo Services, Inc. (GSI). Copies of these boring logs, along with its location plan are included in this report.

If there are any questions regarding the information submitted herein, please do not hesitate to contact us.

Very truly yours,

GEO SERVICES, Inc.

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enc.

TABLE OF CONTENTS

SECTION 01: INTRODUCTION

The following report presents the results of the geotechnical investigation performed for the proposed retaining wall SN 049-W088 located at the northwest quadrant of Deerpath Road and Skokie Valley Bike Path in Lake County, Illinois. This report is based upon the boring information obtained (RW-01 and RW-02), which were drilled in the month of September, 2017 at the proposed retaining wall site.

Boring locations were selected by Geo Services, Inc. and were reviewed and approved by Knight E/A. Boring locations were laid out in the field by GSI personnel at the proposed locations using a GPS handheld device. Offsets were made by the GSI field personnel, where borings were inaccessible to the drill rig at the pre-marked boring locations. Elevations of the as-drilled borings were taken from topographic information provided by Knight E/A and are shown on the boring logs.

The project is located in Lake Forest, Lake County, Illinois with the following range/township information: T44N R12E, Section 32. The project location is shown on the boring location map included in the Appendix.

This report includes a site location map, boring location diagrams and boring logs, as well as descriptions of soil and groundwater conditions, recommendations pertaining to the design and construction of the retaining wall and general construction considerations for the site.

SECTION 02: PROJECT DESCRIPTION

The proposed retaining wall will surround the south half of the proposed detention pond (north of the proposed IDOT Pump Station #38), located at the northwest quadrant of Deerpath Road and Skokie Valley Bike Path in Lake County, Illinois. Based on the plan and cross-section drawings provided by the designer (Knight E/A), the proposed retaining wall will be a cut wall, which will retain embankment heights ranging from 8 to 10 feet. In addition, the wall will have a retained embankment side slope of 1V:3H. It is proposed that the retaining wall is to be supported on shallow foundation per drawings provided.

For estimated loading of the proposed wall, we calculated the maximum factored bearing pressure to be 4.3 kips per square foot (ksf) based on the cross-section drawings (using maximum wall height of approximately 10 feet) provided by Knight E/A, and assumed gravity wall parameters.

SECTION 03: SUBSURFACE INVESTIGATION PROCEDURES

Borings RW-01 and RW-02 were performed during the month of September, 2017. The borings were drilled using a truck and/or ATV-mounted drilling rig equipped with a CME automatic hammer, advanced by hollow stem augers to depths of 30 feet, and then switching to rotary drilling to completion. Representative soil samples were obtained employing split spoon sampling procedures in accordance with AASHTO Method T-206. Samples obtained in the field were brought to our laboratory for further examination and testing.

Split spoon sampling involves driving a 2.0-inch outside diameter split-barrel sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. Blow counts are recorded at 6" intervals and the blow counts are shown on the boring logs. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N). The N-value is an indication of the relative density of the soil.

SECTION 04: LAB TESTING PROGRAM

The test procedures were performed in accordance with test procedures discussed in the IDOT Geotechnical Manual. All split-spoon samples obtained from the drilling operation were visually classified in the field. Cohesive samples were tested in the field for unconfined compressive strength using an IDOT modified RIMAC test device and/or calibrated penetrometer.

The soil testing program included performing water content, density and either unconfined compression and/or calibrated penetrometer tests on the cohesive samples recovered. Water content tests were performed on the non-cohesive samples recovered. These tests were performed upon representative portions of the samples obtained in the field. The results of the above testing, along with a visual classification of the material based upon both the Illinois textural classification and the AASHTO Soil Classification System, are indicated on the boring logs.

SECTION 05: SOIL AND GROUNDWATER CONDITIONS

5.1 Soil Conditions

Boring logs can be found in Appendix C. The stratification lines shown on the boring logs represent the approximate boundary between soil types, and the actual transition may be gradual.

Surface conditions at the boring locations indicated 12 to 18 inches of topsoil. The soil profile generally consists of thick layers of stiff to hard clay to clay loam to boring

termination at approximate elevation 616 feet. A 5-foot stratum of medium dense clayey sand was also encountered within the clay strata at boring RW-01 at approximate elevation 634 feet.

Moisture contents of the cohesive soils ranged from mid-teens to low twenties. Granular soils had moisture contents at mid-teens.

5.2 Groundwater Conditions

Groundwater was encountered at approximate elevation 634 feet at boring RW-01 upon drilling completion. Groundwater was dry at boring RW-02. Based on the coloration change of the soils from brown and gray to gray, we estimate the long-term water table to be from elevation 656 to 661 feet. Fluctuations in the amount of water accumulated and in the hydrostatic water table can be anticipated depending upon variations in precipitation, and surface runoff.

SECTION 06: ANALYSIS

6.1 Settlement

Based on the plans and cross-sections provided by Knight E/A, the drawings show that the retaining wall will be a cut wall to retain the existing embankment soils ranging from 8 to 10 feet. Based on the soil conditions for the wall alignment at borings RW-01 and RW-02 where shallow foundations are proposed, settlement is estimated to be less than 0.4 inch using a maximum embankment height of approximately 10 feet as worst-case scenario. The estimated settlements are within the permissible levels and not anticipated to be an issue.

6.2 Slope Stability

Slope stability of the proposed retaining walls were calculated using the cross-section drawings provided by Knight E/A, normal and high-water level conditions, and assuming undrained soil strengths. Based on the soil profile, the maximum retained fill height of 10 feet, and water level conditions, the Factors of Safety (FOS) were calculated to be greater than 1.7, which satisfies the FOS requirement for a cut embankment per IDOT requirements.

6.3 Bearing Capacity

The base of foundation footing elevations for the wall sections to be supported on shallow foundations have been estimated based on the plans and cross-sections provided by Knight E/A. A summary of the bearing analyses for wall is provided on the following tables.

Table 1 – Bearing Summary (for Shallow Foundations)

Borings	Bearing Material Description (Qu=tsf, wc=%)	Approx. Base of Foundation Elev. (feet)	Estimated Factored Bearing Resistance (psf) [1]	Allowable Bearing Pressure of Soil (psf) [2]
RW-01	Stiff Clay (Qu=1.8 tsf, wc=19%)	650.0	4,500	2,900
RW-02	Stiff Clay (Qu=1.6 tsf, wc=19%)	650.0	4,100	2,650

Notes: 1. Factored Bearing Resistance is computed for a resistance factor of 0.5 for (for clays) per AASTHO LRFD Bridge Manual, Tables 10.5.5.2.2-1, and 10.6.2.
2. Allowable Bearing Pressure of the soil is computed for a Factor of Safety of 3.0.

SECTION 07: FOUNDATION RECOMMENDATIONS

7.1 Shallow Foundation Recommendations

It is planned that the precast modular retaining wall is to be supported mainly on shallow foundations. Based on the soil conditions provided in the borings, the use of spread footing foundations for support is feasible for the proposed retaining wall.

Plans and cross-section drawings show that the bottom of the retaining wall footing foundation will be based at approximate elevation 650 feet. Based on the soil profile and the maximum bearing pressure of 4.3 ksf (see hand-calculations in Appendix E of this report), the upper subgrade soils at boring RW-01 has sufficient bearing resistance, and will not need undercutting. However, the low bearing, upper subgrade soils (stiff clays) at boring RW-02 are not suitable for support of the retaining wall due to insufficient bearing resistance (as shown in Table 1 – Bearing Summary (for Shallow Foundations); therefore, undercutting the low bearing material is anticipated to reach the required maximum factored bearing pressure of 4.3 ksf based on the maximum wall height of approximately 10 feet. Note that the maximum factored bearing pressure of 4.3 ksf is based on worst-case scenario, where the pond is dry, and the soils behind the retaining wall is in saturated condition.

A tabulation of the remedial treatment at boring RW-02 is shown in Table 2 next page.

Table 2 – Remedial Treatment Recommendations

Boring	Subgrade Description (water content %)	Unconfined Compressive Strength (tsf)	Remedial Treatment Depth (feet) [1]	Reason for Remedial Treatment	Approx. Elevation to Suitable Soil (feet)	Remedial Treatment
RW-02	Stiff Clay (wc=19%)	1.6	1.0	Low Bearing Clay soils; Undercut to meet bearing.	649.0	Remove low bearing soils from approx. bearing elevation 650 feet, and replace with Approved Structural (Granular) Fill

Notes: 1. Soil conditions should be verified in the field at time of construction.

Soils shall be verified in the field at the time of construction by an experienced Geotechnical Engineer or representative. Actual extents of any remedial treatments shall be determined at this time. If soils with less than adequate bearing strength are noted at the foundation level during footing construction, the weaker soils encountered at the base of the footings shall be undercut to reach suitable bearing soils, and the undercut area filled with lean concrete or an approved compacted structural (granular) fill material. Any undercutting and backfilling procedures shall be in accordance with Section 205 of the IDOT Standard Specifications for Road and Bridge Construction.

Any structural fill utilized to support footings shall be extended at least 12 inches beyond the proposed footing limits and then 1 foot horizontally for each 1 foot of fill placed below the base of the footing. Any new fill shall consist of inorganic material free of debris. Suitable fill materials include crushed granular materials corresponding to IDOT gradation CA-1, CA-6 or CA-7.

Structural fill shall be placed in loose lifts having a maximum 8 inches thickness. CA-6 shall be compacted to a minimum of 95% of the maximum dry density obtained in accordance with ASTM Standard D-1557, modified Proctor method. The moisture content of the fill shall be controlled within +2% of the optimum moisture content. CA-1 and CA-7 materials can be compacted by placing in lifts and rolling with a smooth drum vibratory compactor or thoroughly tamping with a backhoe bucket.

The following Table 3 next page may be used for design of the retaining wall and temporary earth retaining systems.

Table 3 – Soil Parameters for Lateral Resistance

Material (Approx. Elevation, feet)	Unit Weight (pcf)	Drained Friction Angle (°)	Undrained Cohesion (psf)	Lateral Modulus of Subgrade Reaction (pci)	Strain
Hard Clay (667 to 653)	125	32	4,500	2,000	0.004
Stiff Clay (653 to 634)	125	28	1,600	750	0.006
Medium Dense Clayey Sand (634 to 629)	125	28	n/a	120	--
Very Stiff Clay (629 to 616)	125	28	2,000	750	0.005

Note: 1. Values recommended for use in design from L-pile Software Manual.

7.2 General Wall Design

Fill behind the retaining wall shall be placed in compliance with Section 205 of the IDOT Standard Specifications for Road and Bridge Construction. Backfill behind the wall shall consist of a compacted, free-draining granular material.

For the design of flexible walls, it is recommended that a lateral active earth pressure of 40 psf per foot of depth be used above the water table assuming a free-draining granular backfill is utilized. For cohesive soils, a lateral active earth pressure of 55 psf per foot should be used. For non-flexible walls with granular backfill, a lateral at-rest pressure of 50 psf per foot should be used, assuming proper drainage. For cohesive soils, a lateral at-rest pressure of 65 psf per foot should be used.

Allowances should be made for any surcharge loads adjacent to the retaining structure. The bases of the retaining walls are to be founded in natural clay material. According to the NAVFAC Design Manual 7.2, a value of 0.34 may be used for the coefficient of friction between the concrete base and drained cohesive soils (this assumes a concrete base on the stiff cohesive soils). Assuming granular fill, a friction angle of 28 degrees may be used for the concrete on granular fill, leading to a coefficient friction value of 0.53. We recommend a resistance factor against sliding of 0.8 to be used based on LRFD Manual procedures Section 10.6.3.4.

To provide adequate frost protection, we recommend the bottom of the modular-block, gravity wall footing be at a minimum of 3.5 feet below final grade.

SECTION 08: GENERAL CONSTRUCTION CONSIDERATIONS

The temporary soil retention system shall be designed by the Contractor (or as directed by the Engineer) as specified in Section 522 of the IDOT Standard Specifications. All excavations should be performed in accordance with the latest Occupational Safety and Health Administration (OSHA) requirements. Allowances should be made for any surcharge loads adjacent to the excavation areas. The information provided below should not be interpreted to mean that Geo Services, Inc. is assuming responsibility for construction site safety or the contractor's activities. Construction site safety is the sole responsibility of the contractor, who should also be solely responsible for the means, methods, and sequencing of construction operations.

The OSHA Occupational Safety and Health Standards-Excavations classify soils into three basic types (e.g. Type A, B, and C). Depending upon the soil type, OSHA requirements for temporary excavation slopes range from 3/4H to 1V (horizontal to vertical) for Type A soils, 1H to 1V for Type B soils, and 1-1/2H to 1V for Type C soils. Per OSHA, any excavation extending to a depth of more than 20 feet shall be designed by a licensed professional engineer. Based upon the subsurface conditions encountered at most boring locations, the excavations will extend through predominately stiff to very stiff cohesive soil (embankment fill) and into native medium stiff to very stiff cohesive soils. The cohesive fill material sampled in the borings typically exhibited unconfined compressive strengths in excess of 0.5 tsf. Cohesive soils having unconfined compressive strengths greater than 0.5 tsf but less than 1.5 tsf classify as Type B soils according to OSHA regulations. OSHA recommends a maximum slope inclination of 1 horizontal to 1 vertical for temporary excavations in Type B cohesive soils. Considerations should be given to the allowable construction easement when developing the excavation plan. Particular caution should be exercised if excavations are performed near existing utility lines. Existing backfill for utility lines is often poorly compacted and the limits of the old excavation form a ready failure surface. The OSHA trench safety guidelines for adequate side slopes based on the soil types may not apply in these situations.

SECTION 09: GENERAL QUALIFICATIONS

The analysis and recommendations presented in this report are based upon the data obtained from the soil borings performed at the indicated locations and from any other information discussed in this report. This report does not reflect any variations that may occur between borings or across the site. In addition, the soil samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. The nature and extent of such variations may not become evident until construction. If variations appear evident, it will be necessary to reevaluate the recommendations of the report. In addition, it is recommended that Geo Services Inc. be retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No other warranties, either expressed or implied, are intended or made. In the event that any changes in the nature, design or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing by the geotechnical engineer. Also note that Geo Services Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of the report's subsurface data or engineering analyses without the express written authorization of Geo Services Inc.

APPENDIX A

GENERAL NOTES

GENERAL NOTES

CLASSIFICATION

American Association of State Highway & Transportation Officials (AASHTO) System used for soil classification.

Cohesionless Soils

Relative Density	No. of Blows per foot N
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	Over 50

Cohesive Soils

Consistency	Unconfined Compressive Strength - qu (tsf)
Very Soft	Less than 0.25
Soft	0.25 - 0.5
Medium Stiff	0.5 - 1.0
Stiff	1.0 - 2.0
Very Stiff	2.0 - 4.0
Hard	Over 4.0

TERMINOLOGY

Streaks are considered to be paper thick. **Lenses** are considered to be less than 2 inches thick. **Layers** are considered to be less than 6 inches thick. **Stratum** are considered to be greater than 6 inches thick.

DRILLING AND SAMPLING SYMBOLS

SS:	Split Spoon 1-3/8" I.D., 2" O.D.	HS:	Housel Sampler
ST:	Shelby Tube 2" O.D., except where noted	WS:	Wash Sample
AS:	Auger Sample	FT:	Fish Tail
DB:	Diamond Bit - NX: BX: AX	RB:	Rock Bit
CB:	Carboloy Bit - NX: BX: AX	WO:	Wash Out
OS:	Osterberg Sampler		

Standard "N" Penetration: Blows per foot of a 140 lb. hammer falling 30" on a 2" O.D. Split Spoon

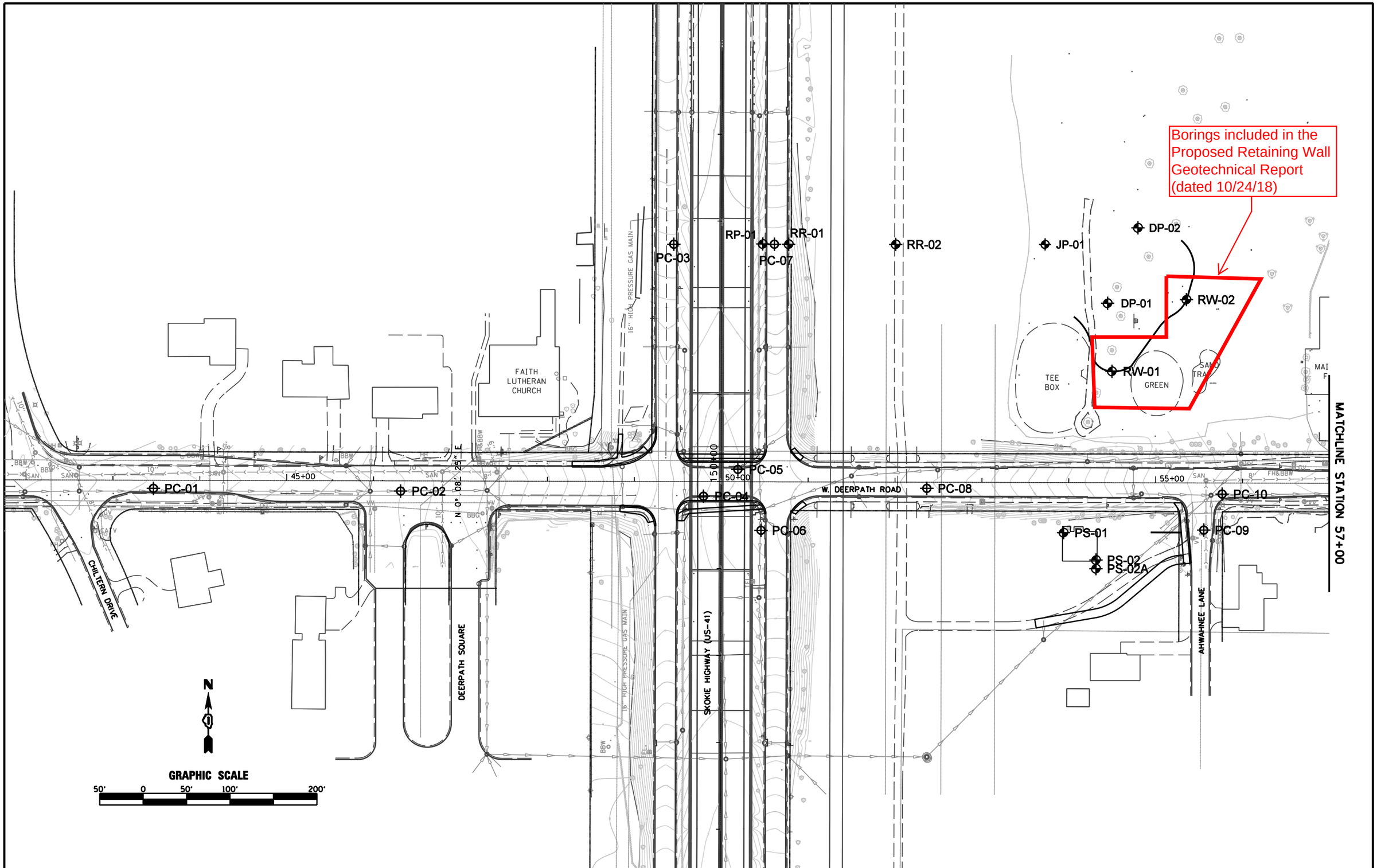
WATER LEVEL MEASUREMENT SYMBOLS

WL:	Water	WD:	While Drilling
WCI:	Wet Cave In	BCR:	Before Casing Removal
DCI:	Dry Cave In	ACR:	After Casing Removal
WS:	While sampling	AB:	After Boring

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In impervious soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence on ground water elevations must be sought.

APPENDIX B

SOIL BORING PLAN



Geo Services, Inc.
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USER NAME = #USER#	DESIGNED - RWC	REVISED -	
	DRAWN - RWC	REVISED -	
PLOT SCALE = #SCALE#	CHECKED - AJP	REVISED -	
PLOT DATE = #DATE#	DATE - 8/1/2018	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

FAP 346 (US ROUTE 41) @ DEERPATH ROAD
SOIL BORING LOCATION DIAGRAM

SCALE 1"=100' | SHEET 1 OF 2 SHEETS | STA. 42+00 TO STA. 57+00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	(130S)I; (21&21S)-I	LAKE	2	1
IDOT PROJECT No. D-91-086-16		CONTRACT NO. 62B65		
ILLINOIS	FED. AID PROJECT			

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APPENDIX C

SOIL BORING LOGS

Geo Services, Inc.
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Naperville, Illinois 60565
(630) 355-2838

SOIL BORING LOG

GSI Job No. 16017

Date 9/14/17

ROUTE FAP 346 **DESCRIPTION** Retaining Wall **LOGGED BY** NM

SECTION _____ **LOCATION** NW 1/4, **SEC.** 32, **TWP.** T44N, **RNG.** R12E, 3rd **PM**

COUNTY Lake **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Diedrich Automatic

STRUCT. NO. _____
Station _____

BORING NO. RW-01
Station 54+49
Offset 128.20ft Left
Ground Surface Elev. 666.10 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 631.6 ft ▼
Upon Completion 634.1 ft ▽
After _____ **Hrs.** _____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
12.0" TOPSOIL-black			
665.10			47
CLAY-gray-stiff to hard	2		
	2	1.5	20
	3	P	
	2		
	3	2.7	21
-5	4	B	
	5		
	6	5.7	16
	10	B	
	4		
	7	5.7	17
-10	11	B	
	3		
	6	3.8	16
	9	B	
	2		
	4	1.2	16
-15	5	B	
	3		
	4	1.9	20
	6	B	
	3		
	4	2.0	20
-20	6	B	
CLAY-gray-stiff to hard *(continued)*			
	3		
	4	1.6	14
	7	B	
	3		
	5	1.9	21
-25	7	B	
	3		
	5	1.9	22
	5	B	
	4		
	6	2.2	21
-30	7	B	
634.10 ▽			
CLAYEY SAND-gray-medium dense			
	4		
▼	6		17
-35	7		
629.10			
CLAY-gray-very stiff			
	5		
	7	2.3	18
-40	10	B	

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

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SOIL BORING LOG

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STRUCT. NO. _____
Station _____

BORING NO. RW-01
Station 54+49
Offset 128.20ft Left
Ground Surface Elev. 666.10 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter 631.6 ft ▼
Upon Completion 634.1 ft ▽
After _____ **Hrs.** _____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
CLAY-gray-very stiff *(continued)*				
	6			
	9	2.5	22	
-45	11	B		
	5			
End Of Boring @ -50.0'. Boring backfilled with cuttings.	9	1.3	23	
616.10 -50	10	B		
-55				
-60				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

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SECTION _____ **LOCATION** NW 1/4, **SEC.** 32, **TWP.** T44N, **RNG.** R12E, 3rd **PM**

COUNTY Lake **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Diedrich Automatic

STRUCT. NO. _____
Station _____

BORING NO. RW-02
Station 55+35
Offset 211.00ft Left
Ground Surface Elev. 666.50 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After _____ **Hrs.** _____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				18.0" TOPSOIL-black
			49	
665.00	2			
	2		46	CLAY to CLAY LOAM-brown & gray-stiff to hard
	2			
	3			
-5	4	2.1	21	
	5	B		
				becoming gray @ -5.5'
	3			
	5	4.6	17	
	8	B		
	6			
	8	6.1	18	
-10	12	B		
	4			
	5	3.1	19	
	8	B		
	3			
	3	1.9	15	
-15	6	B		
	3			
	4	1.6	14	
	6	B		
	3			
	4	1.5	18	
-20	6	B		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				CLAY to CLAY LOAM-brown & gray-stiff to hard *(continued)*
	3			
	4	1.3	20	
	5	B		
	3			
-25	3	1.5	18	
	6	B		
	3			
	4	1.8	21	
	6	B		
	3			
	5	1.9	22	
-30	6	B		
	4			
	8	4.4	17	
-35	10	B		
	4			
	6	1.8	19	
-40	8	P		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

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SOIL BORING LOG

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SECTION _____ **LOCATION** NW 1/4, **SEC.** 32, **TWP.** T44N, **RNG.** R12E, 3rd **PM**

COUNTY Lake **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Diedrich Automatic

STRUCT. NO. _____
Station _____

BORING NO. RW-02
Station 55+35
Offset 211.00ft Left
Ground Surface Elev. 666.50 **ft**

Surface Water Elev. n/a **ft**
Stream Bed Elev. n/a **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion Dry **ft**
After _____ **Hrs.** _____ **ft**

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY to CLAY LOAM-brown & gray-stiff to hard *(continued)*				
		5		
		7	2.2	20
	-45	9	B	
		4		
End Of Boring @ -50.0'. Boring backfilled with cuttings.		5	1.6	24
616.50	-50	7	B	
	-55			
	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Z:\PROJECTS\2016\16017 KNIGHT EA, IDOT PUMP STATION 38 FAP 346 (PTB 178, ITEM 1)\16017 BORING LOGS\16017_LOG.GPJ 10/24/17

APPENDIX D

GENERAL PLAN AND ELEVATION DRAWINGS FOR RETAINING WALL SN 049-W088

Bench Mark: Benchmark "C" Sta. 74+42.06, 23.4' Lt
Brass Disk on NE Corner of Bridge, Deerpath Road over Skokie River Elev. 666.74 (NAVD 88)

Existing Structure: None

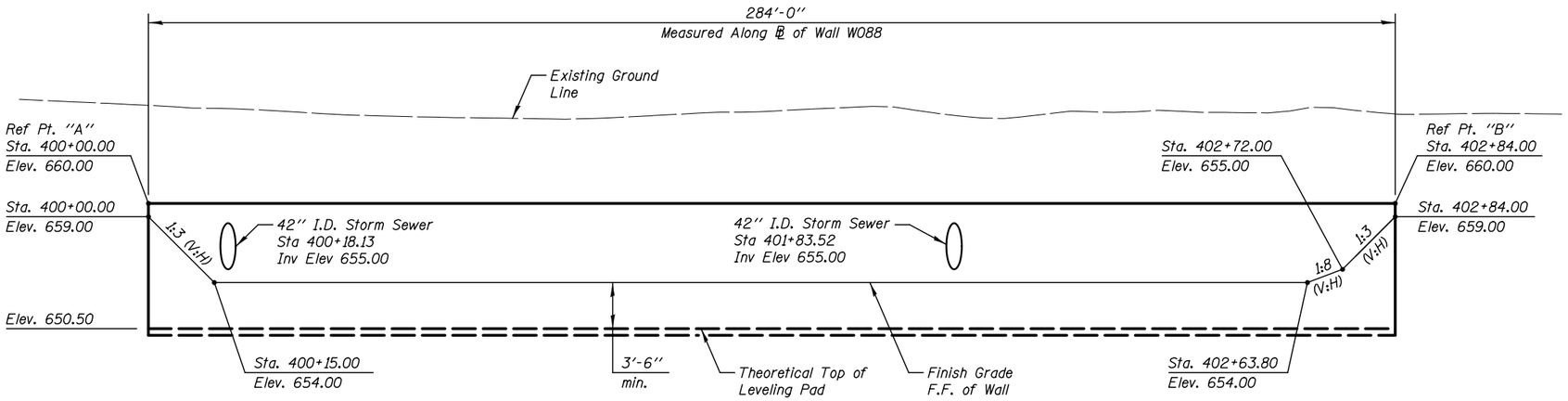
DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications,
Customary U.S. Units, 8th Edition

DESIGN STRESSES

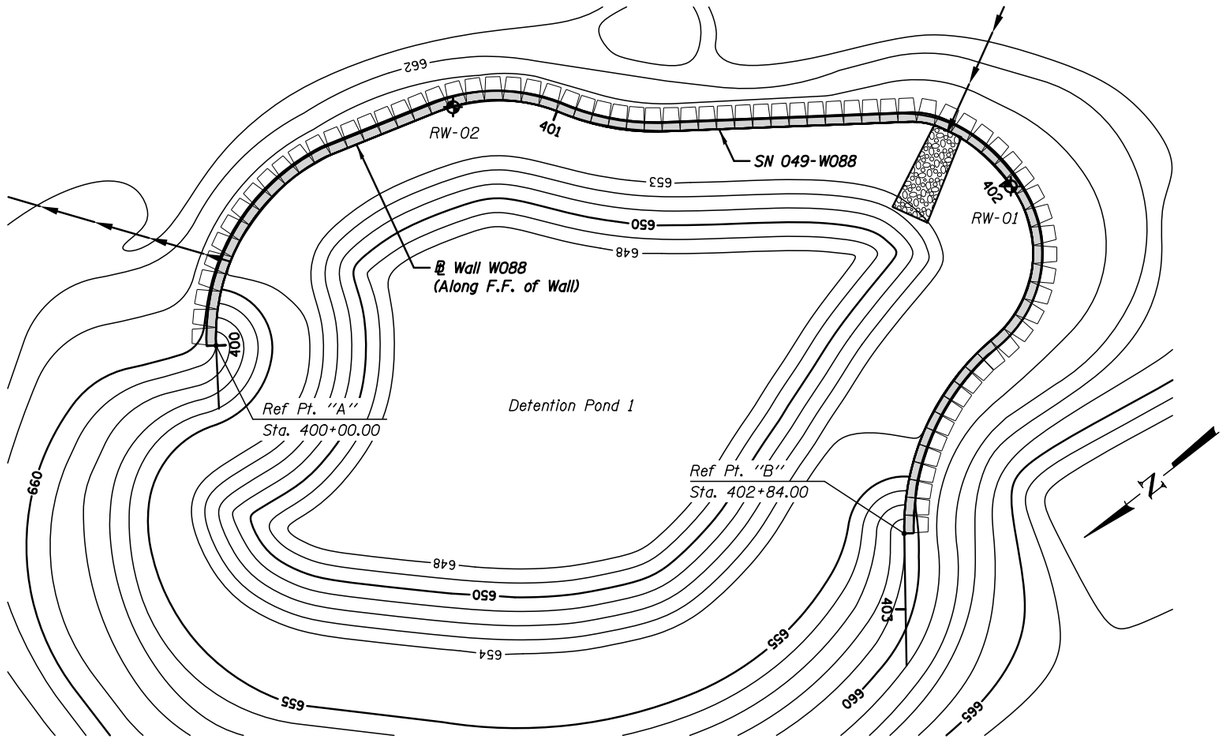
PRECAST UNITS

f'_c = 4,500 psi



UNFOLDED ELEVATION

(Looking at F.F. of Wall)



PLAN

CURVE DATA

℄ Wall W088
Curve W088_3
Δ = 65° 37' 32" (RT)
D = 134° 37' 33"
R = 42.56'
T = 27.44'
L = 48.75'
E = 8.08'
PC STA. 400+00.00
PT STA. 400+48.75
PI STA. 400+27.44

℄ Wall W088
Curve W088_6
Δ = 44° 34' 44" (RT)
D = 165° 27' 51"
R = 34.63'
T = 14.19'
L = 26.94'
E = 2.80'
PC STA. 400+73.97
PT STA. 401+00.91
PI STA. 400+88.16

℄ Wall W088
Curve W088_7
Δ = 24° 50' 08" (LT)
D = 110° 15' 21"
R = 51.97'
T = 11.44'
L = 22.53'
E = 1.24'
PC STA. 401+00.91
PT STA. 401+23.43
PI STA. 401+12.35

℄ Wall W088
Curve W088_10
Δ = 24° 24' 16" (RT)
D = 381° 58' 19"
R = 15.00'
T = 3.24'
L = 6.39'
E = 0.35'
PC STA. 401+75.02
PT STA. 401+81.41
PI STA. 401+78.26

℄ Wall W088
Curve W088_11
Δ = 39° 57' 08" (RT)
D = 168° 31' 01"
R = 34.00'
T = 12.36'
L = 23.71'
E = 2.18'
PC STA. 401+81.41
PT STA. 402+05.12
PI STA. 401+93.77

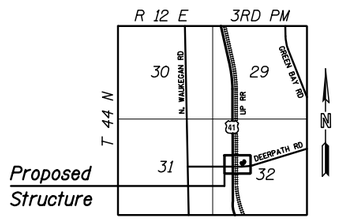
℄ Wall W088
Curve W088_12
Δ = 78° 04' 18" (RT)
D = 243° 48' 43"
R = 23.50'
T = 19.05'
L = 32.02'
E = 6.75'
PC STA. 402+05.12
PT STA. 402+37.14
PI STA. 402+24.17

℄ Wall W088
Curve W088_13
Δ = 51° 14' 35" (LT)
D = 109° 28' 20"
R = 52.34'
T = 25.10'
L = 46.81'
E = 5.71'
PC STA. 402+37.14
PT STA. 402+83.95
PI STA. 402+62.24

℄ Wall W088
(Offsets from ℄ Deerpath Rd. to F.F. of Wall)
Ref Pt. "A"
Sta. 400+00 - ℄ Wall W088 =
Sta. 55+25.78, 281.38' Lt. - ℄ Deerpath Rd.
Ref Pt. "B"
Sta. 402+84.00 - ℄ Wall W088 =
Sta. 54+05.29, 190.95' Lt. ℄ Deerpath Rd.

Legend

- Soil Borings
- F.F. Front Face
- B.F. Back Face



LOCATION SKETCH

GENERAL PLAN & ELEVATION

DEERPATH ROAD

F.A.P. RTE. 346 SEC. (21&21S)-I

LAKE COUNTY

STA. 54+05 TO 55+25

STRUCTURE NO. 049-W088

PLOT DATE = 7/22/2019

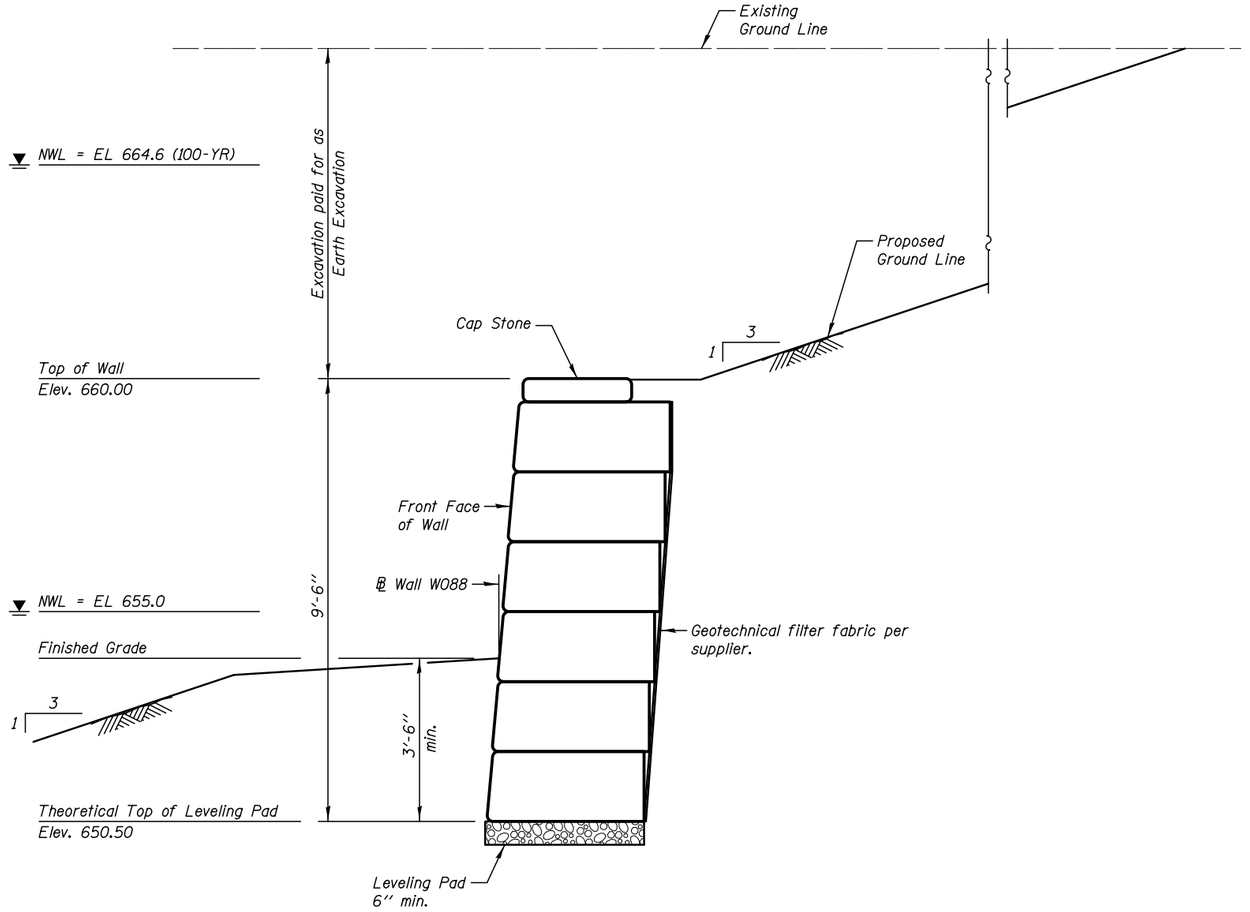
KNIGHT
Engineers & Architects

		DESIGNED - RS	REVISED
		CHECKED - PRD	REVISED
SCALE - NONE		DRAWN - RS	REVISED
DATE - 7/22/2019		CHECKED - PRD	REVISED

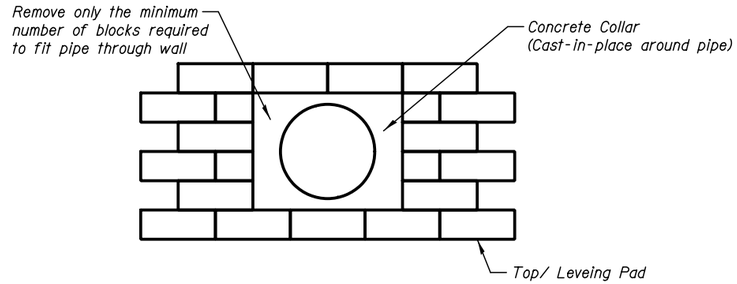
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
STRUCTURE NUMBER 049-W088
SHEET NO. SC-1 OF 2 SHEETS

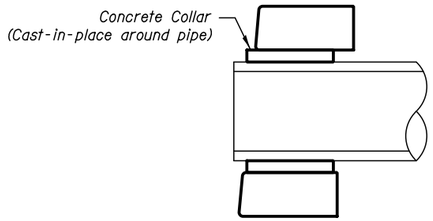
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	(21&21S)-I	LAKE		
		CONTRACT NO. 62B65		
	ILLINOIS	FED. AID PROJECT		



TYPICAL WALL SECTION



ELEVATION VIEW



SECTION VIEW

PIPES INSTALLED PERPENDICULAR THROUGH WALL

PLOT DATE = 7/22/2019

KNIGHT
Engineers & Architects

		DESIGNED - RS	REVISED
		CHECKED - PRD	REVISED
SCALE - NONE		DRAWN - RS	REVISED
DATE - 7/22/2019		CHECKED - PRD	REVISED

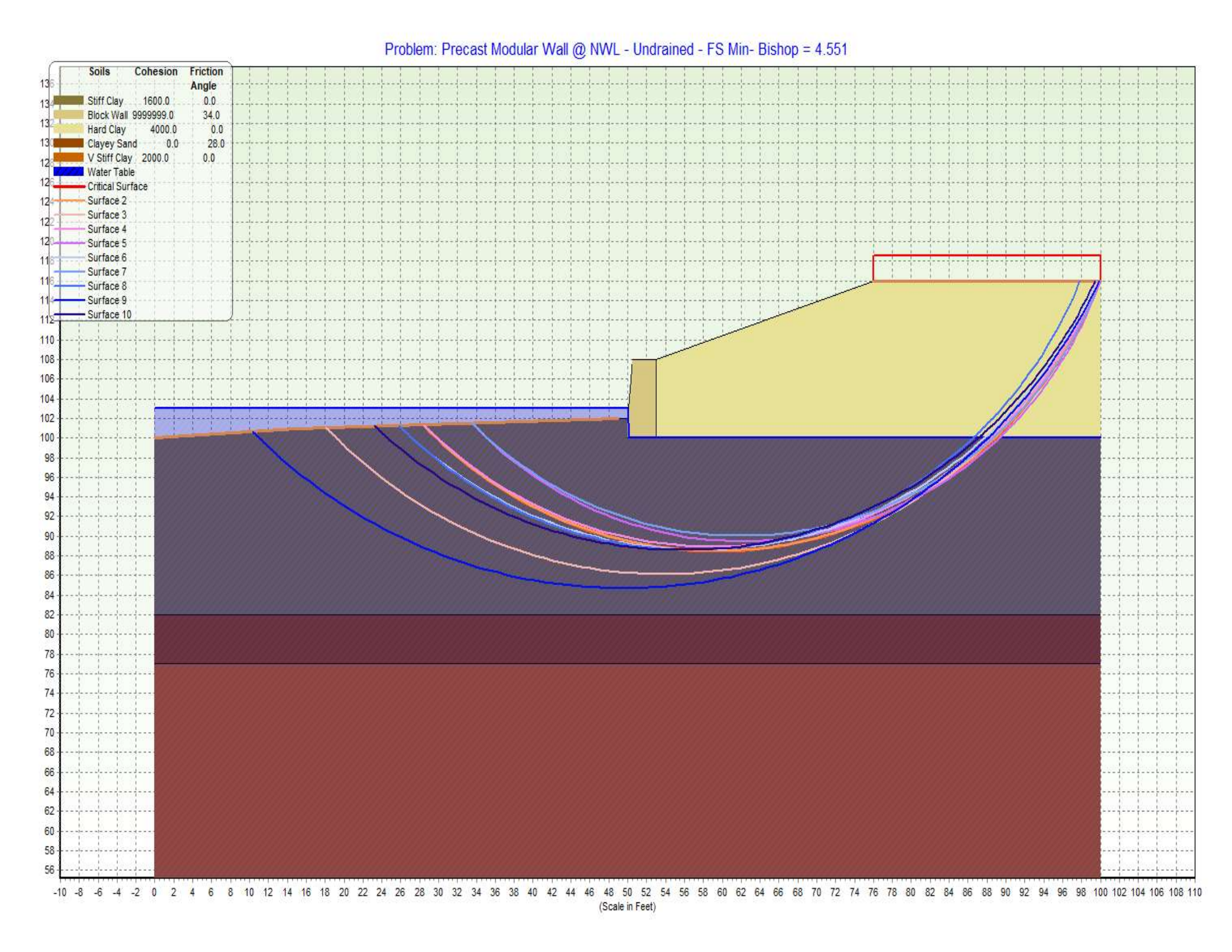
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

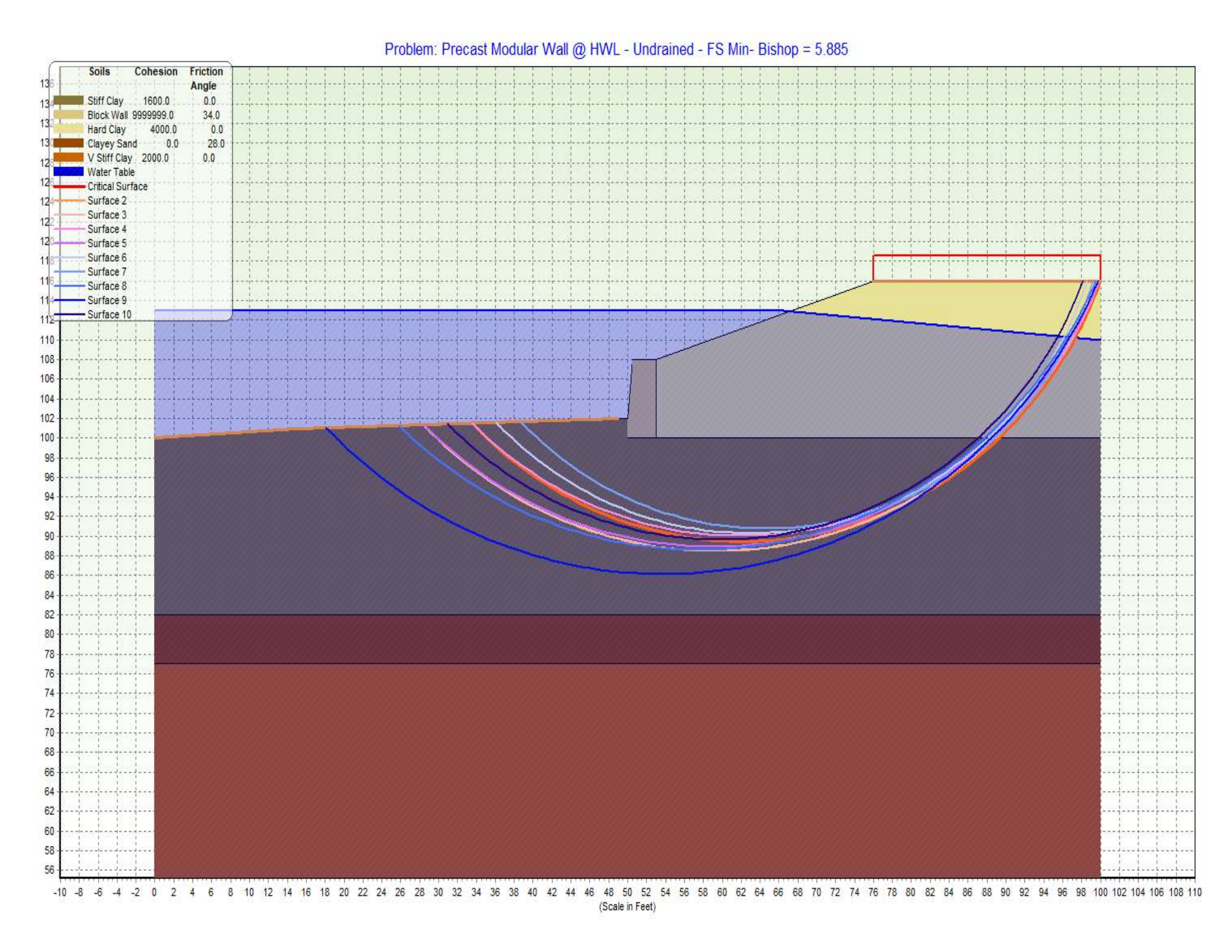
TYPICAL CROSS SECTION
STRUCTURE NUMBER 049-W088
SHEET NO. SC-2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	(21&21S)-I	LAKE		
		CONTRACT NO. 62B65		
	ILLINOIS	FED. AID PROJECT		

APPENDIX E

GLOBAL STABILITY CALCULATION


Problem: Precast Modular Wall @ NWL - Undrained - FS Min- Bishop = 4.551
Soils
Cohesion
Friction Angle
Stiff Clay 1600.0 0.0
Block Wall 9999999.0 34.0
Hard Clay 4000.0 0.0
Clayey Sand 0.0 28.0
V Stiff Clay 2000.0 0.0
Water Table
Critical Surface
Surface 2
Surface 3
Surface 4
Surface 5
Surface 6
Surface 7
Surface 8
Surface 9
Surface 10
(Scale in Feet)

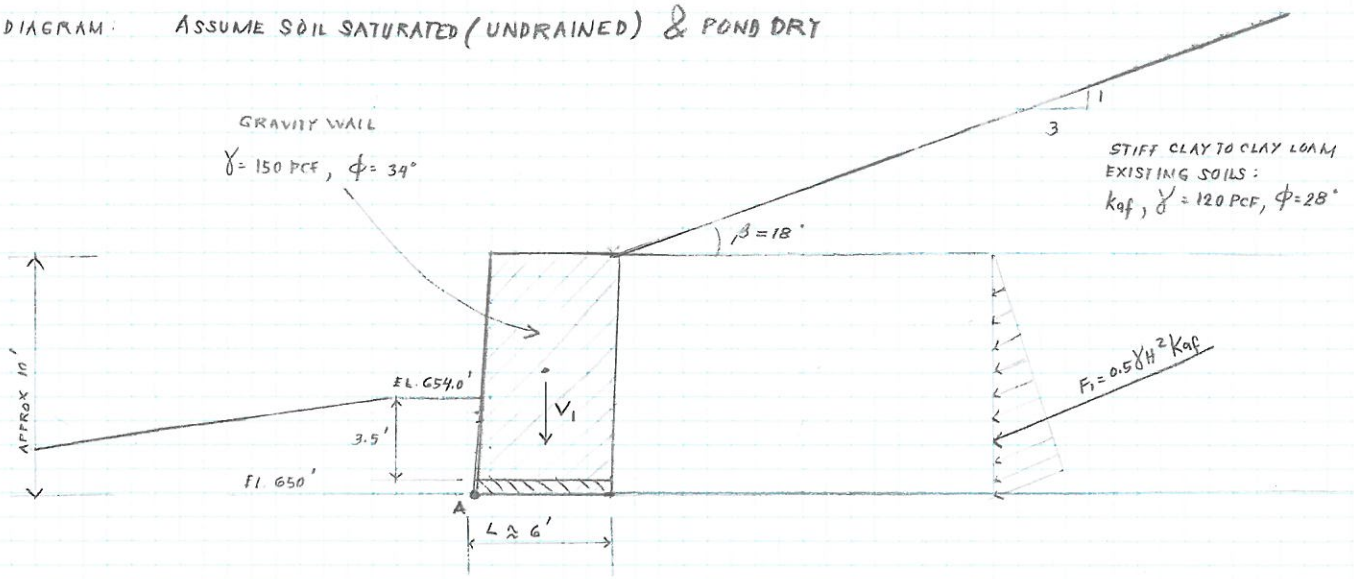

Problem: Precast Modular Wall @ HWL - Undrained - FS Min- Bishop = 5.885
Soils
Cohesion
Friction Angle
Stiff Clay 1600.0 0.0
Block Wall 9999999.0 34.0
Hard Clay 4000.0 0.0
Clayey Sand 0.0 28.0
V Stiff Clay 2000.0 0.0
Water Table
Critical Surface
Surface 2
Surface 3
Surface 4
Surface 5
Surface 6
Surface 7
Surface 8
Surface 9
Surface 10
(Scale in Feet)

PROJECT: IDOT PS 38 RET. WALL W088 CALCULATED BY: RR DATE: 4/19/19 REVISED: 7/30/19

PROJECT NUMBER: 16017 CHECKED BY: ASP DATE: 4/22/19

PROBLEM : CALCULATE BEARING PRESSURE OF WALL SN 049-W088 & BEARING RESISTANCE BASED ON "WORST-CASE" BORING RW-02.

DIAGRAM: ASSUME SOIL SATURATED (UNDRAINED) & POND DRY



GIVEN / ASSUMPTIONS :

γ OF GRAVITY MASS = 150 PCF

ϕ OF REINFORCED ZONE = 34°

WALL HEIGHT = 10' (NEGLECT COVER)

BASE WIDTH ≈ 6'

β ≈ 18°

γ OF EXISTING SOIL = 125 PCF

ϕ OF EXISTING SOIL = 28°

AVERAGE Q_u OF STIFF CLAYS = 1.6 TSF ⟶ C = 1.6 KSF
(BASED ON "WORST-CASE" BORING RW-02)

ψ LOAD FACTORS (PER TABLE 3.10.1.1-1 & 3.10.1.1-2) :

LL STRENGTH LIMIT STATE = 1.75

VERTICAL EARTH PRESSURE (RET. WALL) = 1.35
HORIZONTAL EARTH PRESSURE (ACTIVE) = 1.50
HORIZONTAL EARTH PRESSURE (AT REST) = 1.35

N_c = 5.1 (FIG. 18.2 FOUNDATION ENG., PECK)

ϕ = 0.5 FOR CLAY (TABLE 10.5.5.2.2-1 AASHTO LRFD BRIDGE MANUAL)

PROJECT: IDOT PS 38 RET. WALL W088 CALCULATED BY: RR DATE: REVISED: 7/22/19 4/8/19

PROJECT NUMBER: 16017 CHECKED BY: ABP DATE: 4/22/19

SOLUTION:

FOR EARTH PRESSURE COEFFICIENTS:

$$K_{af} = \cos\beta\left(\frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}}\right)$$

$$= \cos 18^\circ\left(\frac{\cos 18^\circ - \sqrt{\cos^2 18^\circ - \cos^2 28}}{\cos 18 + \sqrt{\cos^2 18 - \cos^2 28}}\right)$$

$$= 0.951\left(\frac{0.951 - \sqrt{0.125}}{0.951 + \sqrt{0.125}}\right)$$

$$= 0.951\left(\frac{0.597}{1.305}\right)$$

$K_{af} = 0.435 \longrightarrow$ SAY 0.44

K_a (GRAVITY WALL) $= \tan^2(45^\circ - \phi/2)$

$= \tan^2(45^\circ - 34^\circ/2)$

$K_a = 0.283$

$P_a = 0.44(125\ PCF - 62.4\ PCF) + 62.4\ PCF$

$P_a = 89.9\ PCF$

VERTICAL WEIGHTS:

① WT OF GRAVITY WALL : $V_1 = \gamma HB = (150\ PCF)(10')(6') = 9\ KLF$

Σ OF VERTICAL WEIGHTS $= V_1 = 9.0\ KLF$

HORIZONTAL FORCES:

① EXISTING SOILS ACTING ON WALL : $F_1 = 0.5\ P_a H^2 = (0.5)(89.9\ PCF)(10')^2 = 4.5\ KLF$

$F_{1H} = F_1 \cos\beta = (4.5\ KLF)(\cos 18^\circ) = 4.3\ KLF$

$F_{1V} = F_1 \sin\beta = (4.5\ KLF)(\sin 18^\circ) = 1.4\ KLF$

PROJECT: IDOT PS 38 RET. WALL W088 CALCULATED BY: RR DATE: 4/19/A

PROJECT NUMBER: 16017 CHECKED BY: KDP DATE: 4/22/A

Σ OF DRIVING FORCES =

$\Sigma F_H = F_{1H} = 4.3$ KLF

Σ OF FACTORED $F_H = (F_{1H} \times 1.50) = (4.3 \text{ KLF} \times 1.50)$

Σ OF FACTORED $F_H = 6.45$ KLH

Σ OF RESISTING FORCES -

$\Sigma F_V = V_1 + F_{1V} = 9 \text{ KLF} + 1.4 \text{ KLF} = 10.4$ KLF

Σ OF FACTORED $F_V = [(V_1 \times 1.35) + (F_{1V} \times 1.50)]$

$= [(9 \text{ KLF} \times 1.35) + (1.4 \text{ KLF} \times 1.50)]$

$= 12.15 \text{ KLF} + 2.1 \text{ KLF}$

Σ OF FACTORED $F_V = 14.24$ KLF

DUE TO SHEAR CAUSED BY GRAVITY WALL, Σ OF FACTORED $F_V = (\tan 34^\circ) \times \Sigma F_V$

$= (\tan 34^\circ) \times 14.25 \text{ KLF}$

$= 9.61$ KLF

FOS SLIDING : $\frac{\Sigma F_V}{\Sigma F_H} = \frac{9.61 \text{ KLF}}{6.45 \text{ KLF}} \approx 1.5$

PROJECT: IDOT PS 38 RET WALL W088 CALCULATED BY: RR DATE: REVISED: 7/22/19 4/9/A

PROJECT NUMBER: 16017 CHECKED BY: ASV DATE: 4/22/A

Σ OF MOMENTS @ POINT A :

VERTICAL FORCE	×	ARM LENGTH	RESISTING MOMENT, M_R
V_1 = 9 KLF		$L/2 = 6'/2 = 3'$	27.0 KIPS – FT

ΣM_R = 27.0 KIPS – FT

FACTORED $M_R = \Sigma M_R \times \psi = (27.0 \text{ KIPS-FT})(1.35)$
$= 36.45$ KIPS – FT

HORIZONTAL FORCE	×	ARM LENGTH	OVERTURNING MOMENT, M_o
F_{1H} = 4.3 KLF		$H/3 = 10'/3 = 3.3'$	14.33 KIPS – FT

ΣM_o = 14.33 KIPS-FT

FACTORED $M_o = \Sigma M_o \times \psi = (14.33 \text{ K-FT} \times 1.35)$

FACTORED M_o = 19.35 KIPS-FT

FOS OVERTURNING : $\dfrac{\Sigma M_R \text{ (FACTORED)}}{\Sigma M_o \text{ (FACTORED)}} = \dfrac{36.45 \text{ KIPS-FT}}{19.35 \text{ KIPS-FT}} \approx 1.9$

ECCENTRICITY : $e = \dfrac{B}{2} - (M_R - M_o) / R$

$= \dfrac{6'}{2} - \dfrac{(36.45 \text{ KIPS-FT} - 19.35 \text{ KIPS-FT})}{12.15 \text{ KLF}}$

$e = 3' - 1.41'$

$e = 1.59'$

$R = \Sigma$ VERTICAL FORCE $\times \psi$
$= (9.0 \text{ KLF})(1.35)$
$R = 12.15$ KLF
↑ FACTORED R

PROJECT: IDOT PS 32 RET. WALL W088 CALCULATED BY: KR DATE: REVISED: 7/22/19 9/19/19

PROJECT NUMBER: 16017 CHECKED BY: AGP DATE: 9/22/19

MAX BEARING PRESSURE :

$$\sigma_V = \frac{R}{(B-2e)} = \frac{12.15\ KLF}{(6'-2(1.59'))} = 4.3\ KSF$$

CALCULATE MAX FACTORED BEARING RESISTANCE @ RW-02 :

$q_U = c\,N_c$ (EQ. 18.2 PER FOUNDATION ENGINEERING, PECK) $N_c = 5.1$

$= (1.6\ KSF)(5.1)$

$q_U = 8.2\ KSF$

$q_R = \phi\, q_U = 0.5 \times 8.2\ KSF = 4.1\ KSF < \sigma_V$ → WILL NEED U/C TO MEET THE REQUIRED BEARING.

DETERMINE UNDERCUT DEPTH (PER IDOT S-33 MANUAL) :

RF = 1.0 @ D = 0'
RF = 0.83 @ D = 1'
RF = 0.72 @ D = 2'
} FOR B = 6' $Q_{MAX} = \sigma_V$

$q_* = RF \times Q_{MAX}$

DEPTH	q_*	REMARKS
0'	4.3 KSF	NEEDS UNDERCUT
1'	3.6 KSF	$q_R > q_*$; OK TO UNDERCUT & REPLACE 1' W/ STRUCTURAL FILL

∴ UNDERCUT 1' TO MEET THE REQUIRED FACTORED BEARING OF 4.3 KSF

Geo Services, Inc.
Geotechnical | Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2828

GSI Job No. 16017

SOIL BORING LOG

Page 1 of 2

Date 9/14/17

ROUTE FAP 346 DESCRIPTION Retaining Wall LOGGED BY NM

SECTION _____ LOCATION NW 1/4, SEC. 32, TWP. T44N, RNG. R12E, 3rd PM

COUNTY Lake DRILLING METHOD Hollow Stem Auger HAMMER TYPE Diedrich Automatic

STRUCT. NO. _____
Station _____

BORING NO. RW-02
Station 55+35
Offset 211.00ft Left
Ground Surface Elev. 666.50 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
				18.0" TOPSOIL-black
			49	
665.00	2			
	2		46	CLAY to CLAY LOAM-brown & gray-stiff to hard
	2			
	3			
-5	4	2.1	21	
	5	B		
				becoming gray @ -5.5'
	3			
	5	4.6	17	
	8	B		
	6			
-10	8	6.1	18	
	12	B		
	4			
	5	3.1	19	
	8	B		
	3			
-15	3	1.9	15	
	6	B		
	3			BEARING @ 650.0'
	4	1.6	14	
	6	B		
				AVERAGE Qu = 1.6 TSF
				C = 1.6 KSF
	3			
-20	4	1.5	18	
	6	B		
				CLAY to CLAY LOAM-brown & gray-stiff to hard *(continued)*
	3			
	4	1.3	20	
	5	B		
	3			
-25	3	1.5	18	
	6	B		
	3			
	4	1.8	21	
	6	B		
	3			
-30	5	1.9	22	
	6	B		
	4			
	8	4.4	17	
-35	10	B		
	4			
	6	1.8	19	
-40	8	P		

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The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2818

GSI Job No. 16017

SOIL BORING LOG

Page 2 of 2

Date 9/14/17

ROUTE FAP 346 DESCRIPTION Retaining Wall LOGGED BY NM

SECTION _____ LOCATION NW 1/4, SEC. 32, TWP. T44N, RNG. R12E, 3rd PM

COUNTY Lake DRILLING METHOD Hollow Stem Auger HAMMER TYPE Diedrich Automatic

STRUCT. NO. _____
Station _____

BORING NO. RW-02
Station 55+35
Offset 211.00ft Left
Ground Surface Elev. 666.50 ft

Surface Water Elev. n/a ft
Stream Bed Elev. n/a ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY to CLAY LOAM-brown & gray-stiff to hard *(continued)*			
	5		
	7 9	2.2 B	20
-45			
	4		
End Of Boring @ -50.0'. Boring backfilled with cuttings. 616.50 -50	5 7	1.6 B	24
-55			
-60			

Z:\PROJECTS\2016\16017 KNIGHT EA, IDOT PUMP STATION 38 FAP 346 (PTB 178, ITEM 1)\16017 BORING LOGS\16017_LOG.GPJ 10/24/17

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Bench Mark: Benchmark "C" Sta. 74+42.06, 23.4' Lt
Brass Disk on NE Corner of Bridge, Deerpath Road over Skokie River Elev. 666.74 (NAVD 88)

Existing Structure: None

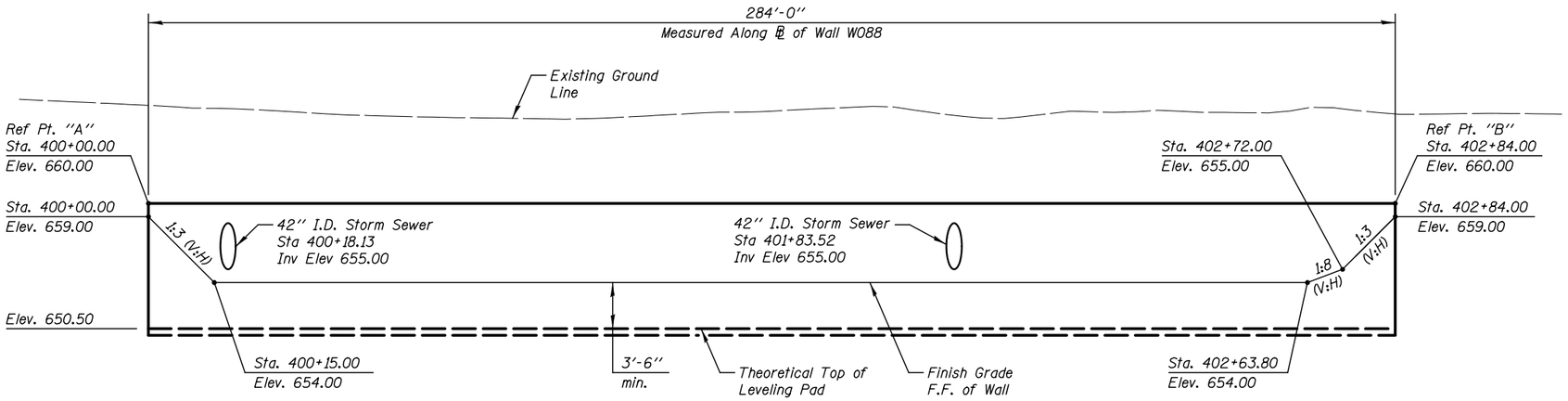
DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications,
Customary U.S. Units, 8th Edition

DESIGN STRESSES

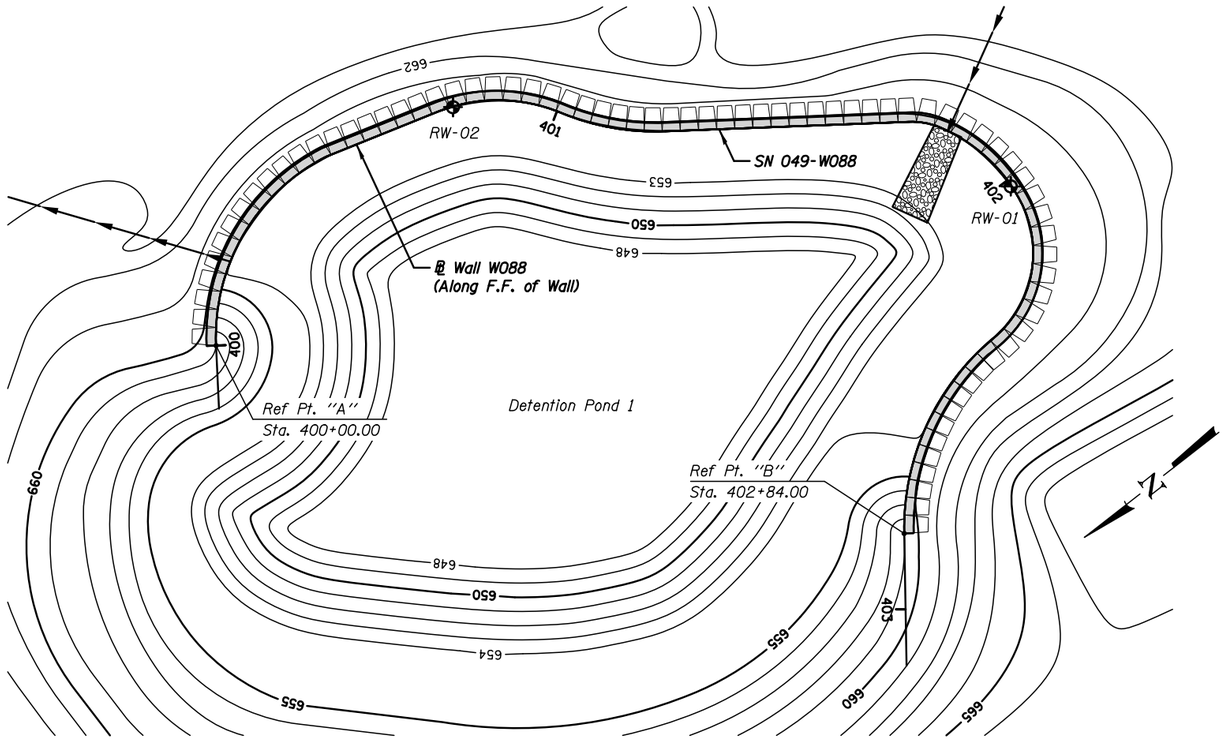
PRECAST UNITS

f'_c = 4,500 psi



UNFOLDED ELEVATION

(Looking at F.F. of Wall)



PLAN

CURVE DATA

℄ Wall W088
Curve W088_3
Δ = 65° 37' 32" (RT)
D = 134° 37' 33"
R = 42.56'
T = 27.44'
L = 48.75'
E = 8.08'
PC STA. 400+00.00
PT STA. 400+48.75
PI STA. 400+27.44

℄ Wall W088
Curve W088_6
Δ = 44° 34' 44" (RT)
D = 165° 27' 51"
R = 34.63'
T = 14.19'
L = 26.94'
E = 2.80'
PC STA. 400+73.97
PT STA. 401+00.91
PI STA. 400+88.16

℄ Wall W088
Curve W088_7
Δ = 24° 50' 08" (LT)
D = 110° 15' 21"
R = 51.97'
T = 11.44'
L = 22.53'
E = 1.24'
PC STA. 401+00.91
PT STA. 401+23.43
PI STA. 401+12.35

℄ Wall W088
Curve W088_10
Δ = 24° 24' 16" (RT)
D = 381° 58' 19"
R = 15.00'
T = 3.24'
L = 6.39'
E = 0.35'
PC STA. 401+75.02
PT STA. 401+81.41
PI STA. 401+78.26

℄ Wall W088
Curve W088_11
Δ = 39° 57' 08" (RT)
D = 168° 31' 01"
R = 34.00'
T = 12.36'
L = 23.71'
E = 2.18'
PC STA. 401+81.41
PT STA. 402+05.12
PI STA. 401+93.77

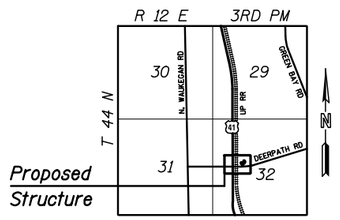
℄ Wall W088
Curve W088_12
Δ = 78° 04' 18" (RT)
D = 243° 48' 43"
R = 23.50'
T = 19.05'
L = 32.02'
E = 6.75'
PC STA. 402+05.12
PT STA. 402+37.14
PI STA. 402+24.17

℄ Wall W088
Curve W088_13
Δ = 51° 14' 35" (LT)
D = 109° 28' 20"
R = 52.34'
T = 25.10'
L = 46.81'
E = 5.71'
PC STA. 402+37.14
PT STA. 402+83.95
PI STA. 402+62.24

℄ Wall W088
(Offsets from ℄ Deerpath Rd. to F.F. of Wall)
Ref Pt. "A"
Sta. 400+00 - ℄ Wall W088 =
Sta. 55+25.78, 281.38' Lt. - ℄ Deerpath Rd.
Ref Pt. "B"
Sta. 402+84.00 - ℄ Wall W088 =
Sta. 54+05.29, 190.95' Lt. ℄ Deerpath Rd.

Legend

- Soil Borings
- F.F. Front Face
- B.F. Back Face



LOCATION SKETCH

GENERAL PLAN & ELEVATION

DEERPATH ROAD

F.A.P. RTE. 346 SEC. (21&21S)-I

LAKE COUNTY

STA. 54+05 TO 55+25

STRUCTURE NO. 049-W088

PLOT DATE = 7/22/2019

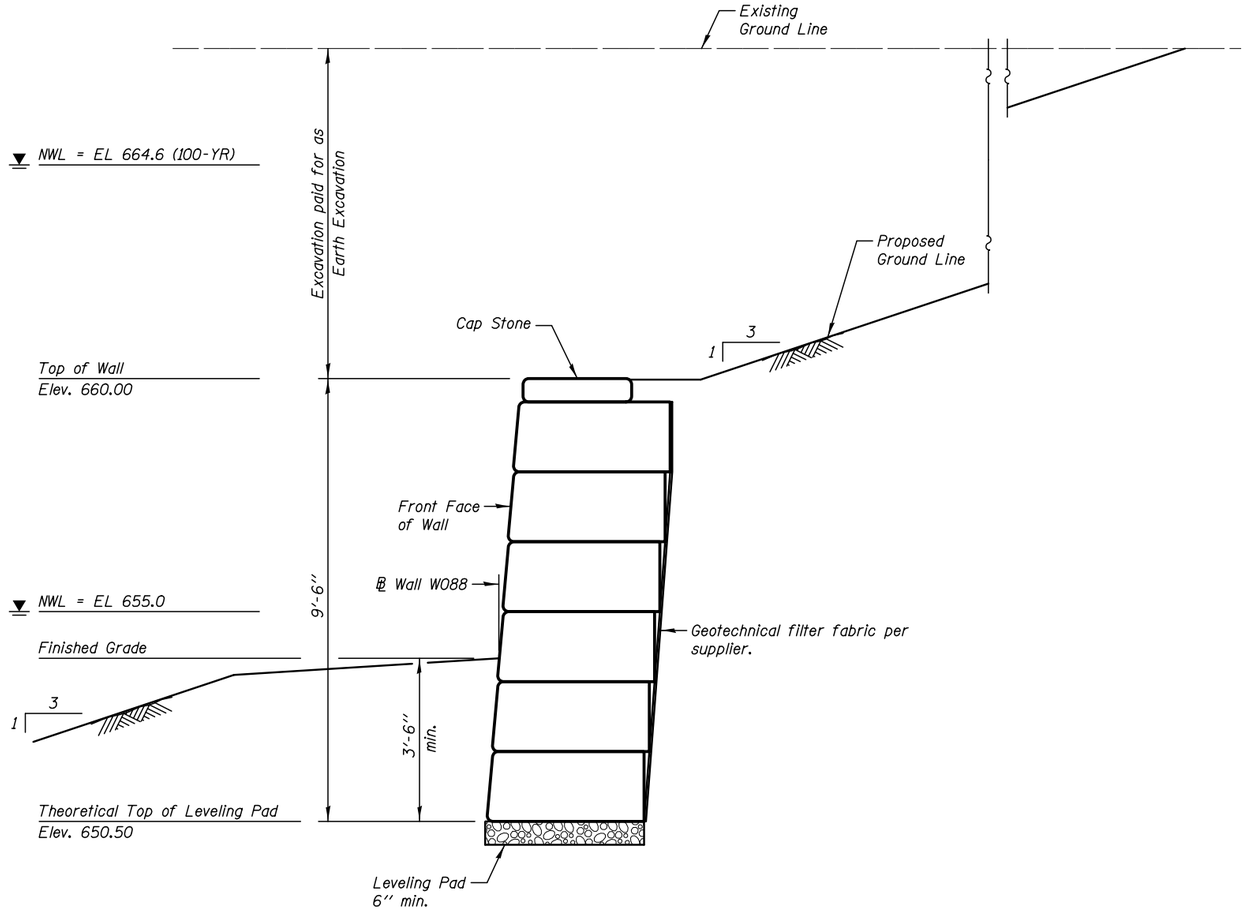
KNIGHT
Engineers & Architects

		DESIGNED - RS	REVISED
		CHECKED - PRD	REVISED
SCALE - NONE		DRAWN - RS	REVISED
DATE - 7/22/2019		CHECKED - PRD	REVISED

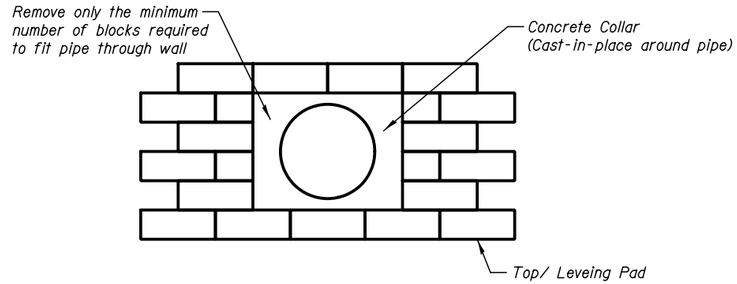
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
STRUCTURE NUMBER 049-W088
SHEET NO. SC-1 OF 2 SHEETS

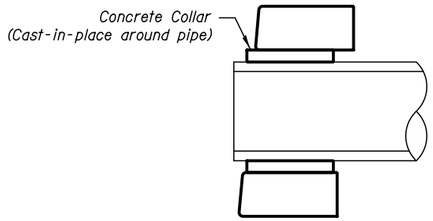
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	(21&21S)-I	LAKE		
		CONTRACT NO. 62B65		
	ILLINOIS	FED. AID PROJECT		



TYPICAL WALL SECTION



ELEVATION VIEW



SECTION VIEW

PIPES INSTALLED PERPENDICULAR THROUGH WALL

PLOT DATE = 7/22/2019

KNIGHT
Engineers & Architects

		DESIGNED - RS	REVISED
		CHECKED - PRD	REVISED
SCALE - NONE		DRAWN - RS	REVISED
DATE - 7/22/2019		CHECKED - PRD	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

TYPICAL CROSS SECTION
STRUCTURE NUMBER 049-W088
SHEET NO. SC-2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
346	(21&21S)-I	LAKE		
		CONTRACT NO. 62B65		
	ILLINOIS	FED. AID PROJECT		