Structural Geotechnical Report

Retaining Wall #4
SN: 099-1002
I-55 at IL 59 Diverging Diamond Interchange Station 319+50 to 327+60
IDOT PTB 189-011
Will County, Illinois

Prepared for

Illinois Department of Transportation
Contract Number: D-91-368-18

Project Design Engineer Team
Alfred Benesch & Company

Geotechnical Consultant:
GSG Consultants, Inc.

June 4, 2021

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June 4, 2021

Mr. Kurt Naus, P.E., S.E.
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Structural Geotechnical Report
Retaining Wall #4 – 099-1002
I-55 Northbound STA 319+50 to 327+60
PTB 189-011

Dear Mr. Naus:

Attached is a copy of the Structural Geotechnical Report for the above referenced project. This report provides a brief description of the site investigation, site conditions, foundation, and construction recommendations. The site investigation included advancing sixteen (16) soil borings to depths between 20 and 41 feet.

Should you have any questions or require additional information, please call us at 630-994-2600.

Sincerely,

Suhaib Ibrahim
Project Engineer

Ala E Sassila, Ph.D., P.E.
Principal

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Will County, Illinois
IDOT PTB 189-011

1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the Phase II design of Retaining Wall #4 between Station 319+50 and 327+60, along the east side of I-55 northbound and west side of Frontage Road in the Village of Shorewood, Will County, Illinois. The purpose of this Phase II site investigation was to explore the subsurface conditions along the entire proposed structure location, to determine engineering properties of the subsurface soil, and to develop final design and construction recommendations for Retaining Wall #4 (SN: 099-1002).

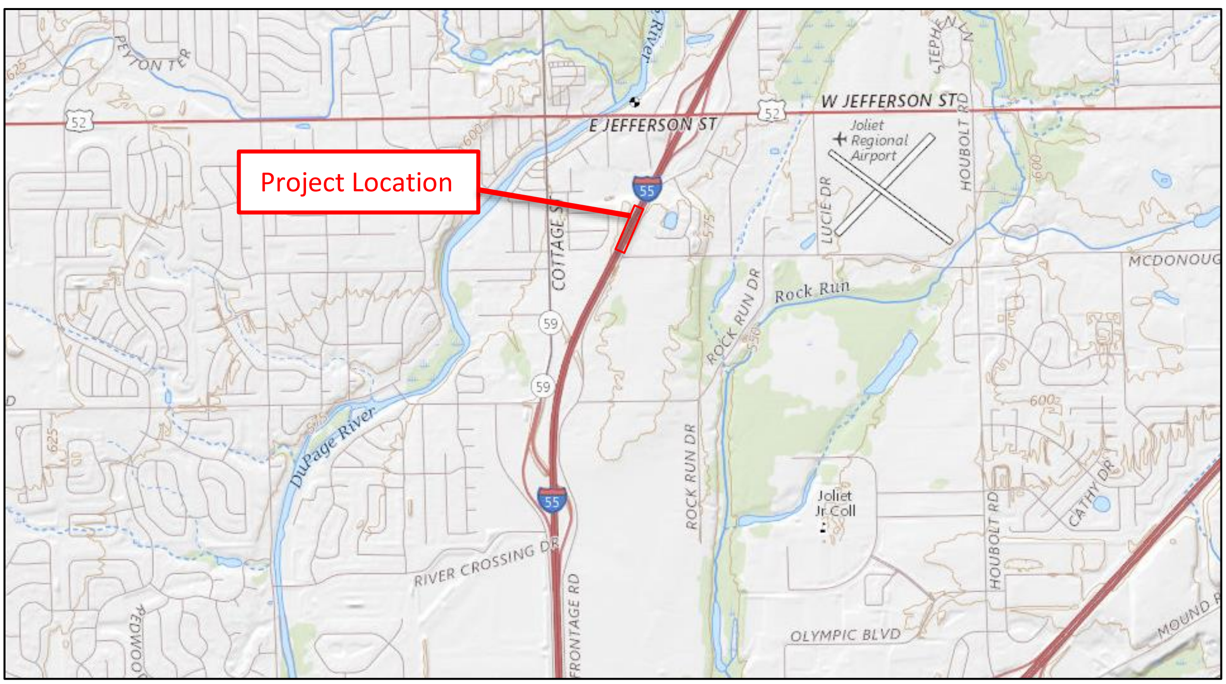


Exhibit 1 – Project Location Map
(Source: USGS Topographic Maps, usgs.gov)

The general scope of the overall project is the conversion of a partial access interchange to a full access interchange at I-55 and IL 59, including the construction Diverging Diamond Interchange (DDI) and associated auxiliary lanes at the intersection of I-55 IL 59. Two new ramps are proposed to provide access and include a southbound exit and northbound entrance from/to I-55. An auxiliary lane between IL 59 and US 52 along I-55 is also proposed in each direction along the mainline. In proximity to the DDI, the existing I-55 East Frontage Road will be realigned further east. This report pertains to Retaining Wall #4 (W099-1002), which will be located along the auxiliary lane in northbound direction on I-55 south of US 52.

1.1 Existing Site Conditions

The proposed Retaining Wall # 4 will be located on the east side of the I-55 northbound lanes and the west side of SE Frontage Road. The area where the proposed improvements are to be built will be on existing IDOT property right-of-way (ROW) and consists of the unoccupied ditch and utility corridor between I-55 and Frontage Road. **Exhibit 2** generally shows the existing conditions where the proposed retaining wall will be constructed.

Exhibit 2 – Existing Site Conditions at Proposed Wall Location, Looking northeast along SE Frontage Rd

1.2 Proposed Retaining Wall Information

Based on the design information and drawings provided by Benesch (dated February 8, 2021), the proposed improvements will include construction of an auxiliary lane in the northbound direction of I-55 between SE Frontage Road and I-55 northbound. According to the cross sections provided, the proposed retaining wall will mainly have "cut" sections between the existing I-55 and Frontage Road. A soldier pile wall is proposed for this location. A ground mounted noise abatement wall (NAW#2) is proposed along the frontage road behind the proposed retaining wall. The west face of the noise wall is 7 feet east of the front face of the solider pile wall. The noise wall will be supported on drilled shafts, which will be spaced to miss the solider piles. A 12-inch storm sewer is proposed along Frontage Road east of the noise wall. **Table 1** presents a summary of the proposed retaining wall.

Table 1 –Retaining Wall Summary

Wall Name	Wall Stations	Proposed Wall Type	Approximate Length (ft)	Maximum Anticipated Retained Wall Height (ft)
SN: W099-1002	Sta. 319+50 to Sta. 327+60	Soldier Pile	810	14.0

2.0 SITE SUBSURFACE EXPLORATION PROGRAM

This section describes the subsurface exploration program and laboratory testing program completed as part of this project. The proposed locations and depths of the soil borings were selected in accordance with IDOT requirements and review with Benesch for available design information at the time of the field activities. The borings were completed in the field based on field conditions and accessibility.

2.1 Subsurface Exploration Program

Soil borings were completed between November 25 and, 2019 and November 3, 2020. The exploration program included advancing sixteen (16) standard penetration test (SPT) borings at locations along the length of the proposed wall. The as-drilled locations of the soil borings are shown on the Soil Boring Location Plan and Subsurface Profile (**Appendix B**). **Table 2** presents a list of the borings used for the proposed retaining wall analysis.

Table 2 – Summary of Subsurface Exploration Borings

Boring ID	Station *	Offset (ft)/ Direction	Depth (ft)	Surface Elevation (ft)
RWB-29	319+50.5	91.92 RT	20.0	601.0
RWB-18	320+26.5	87.5 RT	20.0	600.0
RWB-19	321+06.7	88.3 RT	20.0	600.3
RWB-20	321+78.0	86.9 RT	25.0	600.0
RWB-21	322+55.6	87.4 RT	30.0	599.5
RWB-22	323+30.2	87.3 RT	30.0	598.8
RWB-23	324+05.4	86.4 RT	30.0	595.3
RWB-24	324+72.5	87.3 RT	35.0	597.0
RWB-25	325+47.1	89.5 RT	30.0	594.5
RWB-26	326+32.2	90.2 RT	25.0	591.8
RWB-27	326+95.2	89.5 RT	20.0	589.9
RWB-28	327+60.0	90.98 RT	20.0	588.3
NAW2-10	320+00.0	95.0 RT	41.0	601.2
NAW2-11	322+00.0	95.0 RT	30.0	601.1
NAW2-12	326+50.0	95.0 RT	38.0	592.5

Boring ID	Station *	Offset (ft)/ Direction	Depth (ft)	Surface Elevation (ft)
NAW2-13	328+50.0	95.0 RT	23.0	585.2

* Based on existing I-55 Stationing

The soil borings were drilled using truck-mounted Diedrich D-50 and CME-75 drill rig using 3¼-inch I.D. hollow stem augers and an automatic hammer. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained at 2.5-foot intervals to the termination depth. Water level measurements were made in each boring when evidence of free groundwater was detected on the drill rods or in the samples. The boreholes were also checked for free water immediately after auger removal, and before filling the open boreholes with soil cuttings.

GSG's field representative inspected, visually classified and logged the soil samples during the subsurface exploration activities and performed unconfined compressive strength tests on cohesive soil samples using a calibrated Rimac compression tester and a calibrated hand penetrometer in accordance with IDOT procedures and requirements. Representative soil samples collected from each sample interval, were placed in jars and were returned to the laboratory for further testing and evaluation.

2.2 Laboratory Testing Program

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area of the proposed retaining wall. The following laboratory tests were performed on representative soil samples:

- Moisture content ASTM D2216 / AASHTO T-265
- Atterberg Limits ASTM D4318 / AASHTO T-89 / AASHTO T-90
- Dry Unit Weight ASTM D7263
- Organic Content ASTM D7348 / AASHTO T-267

The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (2015), and per ASTM and AASHTO requirements. Based on the laboratory test results, the soils encountered were classified according to the AASHTO and the Illinois

Division of Highways (IDH) classification systems. The results of the laboratory testing program are included in the **Appendix D Laboratory Test Results** and are also shown along with the field test results in **Appendix C Soil Boring Logs**.

2.3 Subsurface Soil Conditions

This section provides a brief description of the soils encountered in the borings performed in the vicinity of the proposed retaining wall. Variations in the general subsurface soil profile were noted during the drilling activities. Detailed descriptions of the subsurface soils are provided in the Soil Boring Logs (**Appendix C**). The soil boring logs provide specific conditions encountered at each boring location, including soil descriptions, stratifications, penetration resistance, elevations, location of the samples, water levels (when encountered), and laboratory test data. Variations in the general subsurface soil profile were noted during the drilling activities. The stratifications shown on the boring logs represent the conditions only at the actual boring locations and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

STA 319+50 to 323+68 (RWB-18 through RWB-22, RWB-29, NAW2-010 and NAW2-011)

The surface elevations of these borings ranged between 598.8 and 601.2 feet. The borings noted 4 to 6 inches of topsoil followed by brown and gray silty clay fill to a depth of about 6.0 feet. Under the fill, the borings encountered brown and gray stiff to hard silty clay to depths of 10.0 to 16.0 feet, gray stiff to hard silty clay to depths of 19.0 to 20.0 feet, gray loose to very dense silty loam to depths of 27 to 41 feet. Borings RWB-18 and RWB-29 were terminated in gray silty clay at a depth of 20 feet, borings RWB-19 and RWB-20 in gray silty loam at depths of 20 to 25 feet and borings RWB-21 and RWB-22 in gray silty clay at a depth of 30 feet. Boring NAW2-010 was terminated in gray silty loam upon encountering auger refusal on apparent bedrock. NAW2-010 was terminated in gray silty loam at a depth of 30 feet. A layer of high plasticity gray clay was encountered in borings RWB-18 and 20, that was approximately 2 feet thick, between depths of 8 to 13 feet below grade. This layer had liquid limits of 54 to 60 percent and plastic limits of 23 to 26 percent.

The unconfined compressive strength of the upper brown and gray clay ranged between 2.5 and 6.0 tsf with most values between 3.0 and 5.0 tsf, and the strength of the gray silty clay ranged between 1.0 and 5.4 tsf. The SPT blow counts 'N' values of the silt ranged between 10 and 16 blows per foot (bpf). The SPT blow counts 'N' values for the loose to very dense silty loam are between 10 and 60 bpf.

STA 323+68 to 327+60 (RWB-23 through RWB-28, NAW2-012 and NAW2-013)
The surface elevations of these borings ranged between 585.2 and 597.0 feet. The borings noted 4 to 6 inches of topsoil followed by brown and gray silty clay fill to depths between 6.0 and 13.5 feet. Below the fill, boring RWB-23 encountered brown and gray silty clay to a depth of 11 feet followed by very stiff to hard gray silty clay to a depth of 17 feet. Boring RWB-24 encountered very stiff gray silty clay loam to a depth of 16.0 feet. Borings RWB-26 and RWB-27 encountered medium dense to dense brown sandy loam to a depth of 11 to 14 feet. Below the gray silty clay or the brown sandy loam, the borings encountered medium dense to dense gray silty loam to depths of 16 to 28 feet and stiff to very stiff gray silty clay to a depth of 33 feet at boring RWB-24, 22.5 feet at boring NAW2-012 or the termination depths of the remaining borings. Boring RWB-24 was terminated upon auger refusal in weathered limestone and boring RWB-28 was terminated in a layer of soft silty clay. Boring NAW2-012 encountered medium dense gray silt and stiff to very stiff gray silty clay before termination upon encountering auger refusal in weathered limestone.

The unconfined compressive strength of the brown and gray silty clay ranged between 2.92 and 4.79 tsf, and the strength of the gray silty clay ranged between 1.0 and 4.17 tsf. The SPT blow counts 'N' values of the silty loam ranged between 11 and 47 bpf.

2.4 Groundwater Conditions

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed. While drilling, groundwater was encountered at depths of 15 to 27 feet (elevation 564.2 to 580.0 feet) in borings RWB-25, RWB-28, NAW2-012 and NAW2-013. No groundwater was observed after drilling at this location or within the remaining borings at these times. No delayed groundwater readings were obtained as the borings were backfilled immediately upon completion.

Based on the color change from brown and gray to gray, it is anticipated that the long-term groundwater level could range between elevations 572.0 to 590.0 feet. Water level readings were made in the boreholes at times and under conditions shown on the boring logs and stated in the text of this report. However, it should be noted that fluctuations in groundwater level may occur due to variations in rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported herein.

3.0 GEOTECHNICAL ANALYSES

This section provides GSG's geotechnical analysis and recommendations for the design of the proposed retaining wall based on the results of the field exploration, laboratory testing, and geotechnical analysis. Subsurface conditions between borings may vary from those encountered at the boring locations. If structure locations, loadings, or elevations are changed, we request that GSG be contacted so that we may re-evaluate our recommendations.

3.1 Derivation of Soil Parameters for Design

GSG determined the geotechnical parameters to be used for the project design based on the results of field and laboratory test data on individual boring logs as well as our experience. Unit weights, friction angles and shear strength parameters were estimated using corrected standard penetration test (SPT) using published correlations for N values results for the fill and cohesionless soils and in-situ and laboratory test results for cohesive soils. The SPT N values were corrected for hammer efficiency. The hammer efficiency correction factor considers the use of a safety hammer/rope/cat-head system, generally estimated to be 60% efficient. Thus, correlations should be based upon what is currently termed as N_{60} data. The efficiencies of the automatic hammers used for this exploration were estimated to be approximately 88% for the Diedrich D-50 and based on previous efficiency testing of the drill rigs. The correction for hammer efficiency is a direct ratio of relative efficiencies as follows:

$$N_{60} = N_{Field} * (88/60)\text{: Diedrich D-50}$$

* Where the N_{Field} value is the blow counts recorded during the subsurface investigation.

Based on the field investigation data collected, generalized soil parameters for the soils in the project area for use in design are presented in **Tables 3a** and **3b**.

Table 3a –Soil Parameters Table- STA 319+50 to 323+68
(RWB-18 through RWB-22, RWB-29, NAW2-010 and NAW2-011)

Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
	New Engineered Clay Fill	120	1,000	0	50	25
	New Engineered Granular Fill	125	0	30	0	30
601-594	Brown and Gray Silty Clay FILL	141	4,800	0	480	25
594-586	Brown and Gray Very Stiff to Hard Silty Clay	122	3,700	0	370	28
586-580	Gray Stiff to Hard Silty Clay	135	3,000	0	300	28
580-560	Gray Medium Dense to Very Dense Silty Loam	131	0	35	0	35
571-565 RWB-021&022	Gray Stiff Silty Clay	134	1,400	0	140	28

Table 3b – Soil Parameters Table- STA 323+68 to 327+60
(RWB-23 through RWB-28, NAW2-012 and NAW2-013)

Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
	New Engineered Clay Fill	120	1,000	0	50	25
	New Engineered Granular Fill	125	0	30	0	30
597-583	Brown and Gray Silty Clay FILL	139	4,200	0	420	25
583-578 RWB-23 & 24	Gray Very Stiff to Hard Silty Clay	122	3,500	0	350	28
582-578 RWB-26 & 27	Brown Medium Dense Sandy Loam	134	0	37	0	37

Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
578-570	Gray Medium Dense to Dense Silty Loam	133	0	38	0	38
570-555	Gray Stiff to Very Stiff Silty Clay	136	1,500	0	150	28

4.0 GEOTECHNICAL RECOMMENDATIONS

This section provides GSG's geotechnical recommendations for the design of the proposed retaining wall based on the results of the field exploration, laboratory testing, and geotechnical analyses, and information provided by the designer. If there are any significant changes to the project characteristics or if significantly different subsurface conditions are encountered during construction, GSG should be consulted so that the recommendations of this report can be reviewed.

4.1 Retaining Wall Type Recommendations

There are several types of retaining walls that could be utilized for retaining earth embankments in fill areas or excavation slopes in cut areas. Based on the proposed grading, it appears that the proposed wall is located within a cut area, adjacent to the roadway possible wall types may include cast-in-place concrete cantilever, Mechanically Stabilized Earth (MSE), prefabricated modular gravity, steel sheet piles, soil nail wall, and soldier-pile and lagging.

The wall type should be selected based on soil conditions, construction schedule, and cost. The following provides a brief description of each type of wall that could be considered at this location.

A. CIP Concrete Cantilever Walls

CIP concrete cantilever retaining walls are typically used in fill areas. They are constructed with a footing that extends laterally both in front of and behind the wall. They can be designed to resist horizontal loading with or without tie-backs by changing the geometry of the foundation. This type of wall typically requires that the area behind the wall be excavated to facilitate construction or are constructed where new fill embankments are necessary.

The advantages of a CIP wall include that it is a conventional system with well-established design procedures and performance characteristics; it is durable; and it has the ability to easily be formed, textured, or colored to meet aesthetic requirements. Disadvantages include a relatively long construction period due to undercutting, excavation, form work, steel placement, and curing of the concrete. This wall system is also sensitive to total and differential settlements.

B. Mechanically Stabilized Earth Walls

An MSE wall is typically associated with fill wall construction and consists of facing such as segmental precast units, dry block concrete or CIP concrete facing units connected to horizontal steel strips, bars or geosynthetic to create a reinforced soil mass. The reinforcement is typically placed in horizontal layers between successive layers of granular backfill. A free draining backfill is required to provide adequate performance of the wall. MSE walls can be used in cut situations as well. The additional cost of the excavations for an MSE wall is usually offset by the savings in construction costs and schedule as compared to a CIP wall on spread footings.

Advantages of the MSE wall include a relatively rapid construction schedule that does not require specialized labor or equipment, provided excavation for the reinforcement is not extensive. This type of retaining wall can accommodate relatively large total and differential settlements without distress, and the reinforcement materials are light and easy to handle. Facing panels can be designed for various architectural finishes.

The design of MSE walls for internal stability is normally the Contractor’s responsibility and will need to be designed by a licensed Structural Engineer in the State of Illinois. The length of the reinforced soil mass from the outside face should be a minimum of 8 feet, but not less than 70% of the wall height. The length should be determined to satisfy eccentricity and sliding criteria and provide adequate length to prevent structural failure with respect to pullout and rupture of reinforcement. The MSE wall could be designed using a unit weight of 120 pcf and a friction angle of 34 degrees for the reinforced backfill soil.

C. Prefabricated Modular Gravity Walls

This type of wall typically consists of interlocking soil or rock-filled concrete, steel, or wire modules or bins (such as gabions). The combined weight of the wall materials resists the lateral loads from the soil embankment being retained. This type of wall may be used where conventional reinforced concrete walls are also being considered but are typically selected when the overall wall height will be less than 25 feet.

The advantage of this type of wall is that less select fill is required for the backfill behind the wall and the construction is relatively more economical compared to other wall types; however, this type of wall may require additional soil excavation for placement of the modules. The additional cost of the excavations could be offset by the savings in construction costs and schedule as compared to other walls.

D. Sheet Pile Walls

Sheet pile walls are typically used in cut areas when continuous support must be provided to maintain existing structures or other adjacent facilities. Sheet piles are also used in wide trench excavations when the use of trench boxes becomes impractical. This type of wall can also be covered with precast panels for aesthetics. The installation of sheet pile walls requires the use of specialty equipment to drive the piles into the ground. To provide lateral resistance against the retained soil, the walls can be designed to act as a cantilever or can use tie backs behind the wall. The walls maintain the existing site conditions with minimal disturbance to existing structures and can be installed relatively quickly in most situations.

E. Soil Nail Walls

Soil nail retaining walls are typically used in cut areas when continuous support must be provided to maintain existing structures or other adjacent facilities. Soil nails are reinforcing, passive elements that are drilled and grouted sub-horizontally in the ground to support excavations in soil that contribute to the stability of earth-resisting systems mainly through tension as a result of the deformation of the retained soil. The soil nail walls must experience some lateral soil movement (0.3% of the wall height for fine-grained soils) in order to generate the resistance to lateral movement, therefore the soil nail walls will be subject to the active lateral earth pressure. Soil nail walls are constructed using a “top-down” construction sequence, where the ground is excavated in lifts of limited height. The soil nail wall is normally constructed by drilling an inclined hole, installing a steel bar, and grouting the hole. Soil nails and an initial shotcrete facing are installed at each excavation lift to provide support. Nails are most often installed at a vertical spacing of 3 to 6 feet depending on soil type. The horizontal spacing of nails is often also in the range of 4 to 6 feet. The final (permanent) facing thickness will be based on structural and architectural finish considerations.

F. Soldier Pile and Lagging Walls

Soldier pile and lagging walls are typically used in cut areas where the existing ground surface needs to be maintained during construction or when a near vertical excavation is needed. The wall may be constructed with driven steel piles or steel piles placed in drilled holes and backfilled with concrete. The depth of the soldier pile is normally estimated to be two times the wall exposed height. Soldier piles are typically spaced at 8 to 10 foot on center and are faced with cast-in-place or precast concrete. Tie backs may be used to provide additional lateral resistance, if required. The installation of soldier pile walls requires the use of specialty equipment to drive the piles into the ground. To provide lateral resistance against the retained soil, the walls can be designed to act as a cantilever or can use tie backs behind the wall. The walls maintain the existing site conditions with minimal disturbance to existing structures and can be installed relatively quickly in most situations.

G. Recommended Wall Type

Based on the proposed grading plan and location of the wall within a cut area, adjacent to the proposed roadway improvements, GSG concurs with the Benesch's design selection of a soldier pile and lagging wall for this section of the project. GSG evaluated the global and external stability and movement to determine the suitability of the retaining wall for this section of the project. The wall section should be analyzed to determine that adequate factors of safety relative to overturning failure.

4.2 Retaining Wall Design Recommendations

The engineering analyses performed for evaluation of the retaining wall options followed the current AASHTO Load and Resistance Factor Design (LRFD) Methodology as required by IDOT. LRFD methodology incorporates the use of load factors and resistance factors to account for uncertainty in applied loads and load resistance of structure elements separately. The AASHTO LRFD Bridge Design Specifications outline load factors and combinations for various strength, extreme event, service, and fatigue limit states. Section 11, which outlines geotechnical criteria for retaining walls, of the AASHTO specifications requires the evaluation of bearing resistance failure, lateral sliding, and overturning at the strength limit state and excessive vertical displacement, excessive lateral displacement, and overall stability at the service limit state. The selected wall should be also evaluated with respect to the collision load. **Table 4** outlines the load factors used in evaluation of the retaining wall in accordance with AASHTO Specification Tables 3.4.1-1 and 3.4.1-2.

Table 4 - LRFD Load Factors for Retaining Wall Analyses

	Type of Load	Sliding and Eccentricity Strength	Bearing Resistance Strength I	Sliding and Eccentricity Extreme II	Bearing Resistance Extreme II	Settlement Service I
Load Factors for Vertical Loads	Dead Load of Structural Components (DC)	0.90	1.25	1.00	1.00	1.00
	Vertical Earth Pressure Load (EV)	1.00	1.35	1.00	1.00	1.00
	Earth Surcharge Load (ES)		1.50			
	Live Load Surcharge (LS)		1.75		0.50	1.00
Load Factors for Horizontal Loads	Horizontal Earth Pressure Load (EH) Active At-Rest AEP for anchored walls	1.50	 1.50 1.35 1.35	1.00	1.00	1.00
	Earth Surcharge (ES)	1.50	1.50			
	Live Load Surcharge (LS)	1.75	1.75	0.50	0.50	1.00
Load Factor for Vehicular Collision				1.00	1.00	

4.2.1 Lateral Earth Pressures and Loading

The wall should be designed to withstand earth and live lateral earth pressures. The lateral earth pressures on retaining walls depend on the type of wall (i.e. restrained or unrestrained), the type of backfill and the method of placement against the wall, and the magnitude of surcharge weight on the ground surface adjacent to the wall. Soldier pile walls are considered to be flexible and as such the earth loads may be calculated using active earth pressure for loads above the design grade, and both active and passive earth pressures below the design grade. The active earth pressure coefficient (Ka), and the passive earth pressure coefficient (Kp) were determined in accordance with AASHTO Section 3.11.5.3 and 3.11.5.4, respectively using the drained friction angles provided in **Tables 3a and 3b**. The passive earth pressure coefficients summarized in **Tables 5a and 5b** should be used together with the drained cohesion provided in **Tables 3a and 3b** to calculate the passive pressure according to AASHTO equation 3.11.5.4-1. **Tables 5a and 5b also** provide recommended lateral soil modulus and soil strain parameters that can be used for laterally loaded pile analysis via the p-y curve method based on the encountered subsurface conditions.

Table 5a – Lateral Soil Parameters - STA 319+50 to 323+68 (RWB-18 through RWB-22, RWB-29, NAW2-010 and NAW2-011)

Elevation Range (feet)	Soil Description	Long-term/Drained			Soil Parameters used in L-Pile		
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)	Coefficient of Lateral Modulus of Subgrade Reaction (k_{py}, pci)	Soil Strain (ε_{50})	Soil Type
	New Engineered Clay Fill	0.41	2.46	0.58	500	0.01	Stiff Clay w/o free water (Reese)
	New Engineered Granular Fill	0.33	3.00	0.50	90	N/A	Sand (Reese)
600-594	Brown and Gray Silty Clay FILL	0.41	2.46	0.58	2,400	0.004	Stiff Clay w/o free water (Reese)
594-586	Brown and Gray Very Stiff to Hard Silty Clay	0.36	2.77	0.53	2,000	0.004	Stiff Clay w/o free water (Reese)
586-580	Gray Stiff to Hard Silty Clay	0.36	2.77	0.53	1,500	0.005	Stiff Clay w/o free water (Reese)
580-560	Gray Medium Dense to Very Dense Silty Loam	0.27	3.69	0.43	60	N/A	Sand (Reese)
571-565 RWB-021&022	Gray Stiff Silty Clay	0.36	2.77	0.53	700	0.007	Stiff Clay w/o free water (Reese)

*The initial p-y modulus, E_{py} , varies linearly with depth. To obtain E_{py} use the equation $E_{py} = k_{py} * z$, where k_{py} is the coefficient of lateral modulus of subgrade reaction given in the table and z is the distance from the surface to the center point of the layer in inches.

Table 5b – Lateral Soil Parameters - STA 323+68 to 327+60 (RWB-23 through RWB-28, NAW2-012 and NAW2-013)

Elevation Range (feet)	Soil Description	Long-term/Drained			Soil Parameters used in L-Pile		
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)	Coefficient of Lateral Modulus of Subgrade Reaction (k_{py}, pci)	Soil Strain (ε_{50})	Soil Type
	New Engineered Clay Fill	0.41	2.46	0.58	500	0.01	Stiff Clay w/o free water (Reese)
	New Engineered Granular Fill	0.33	3.00	0.50	90	N/A	Sand (Reese)
597-583	Brown and Gray Silty Clay FILL	0.41	2.46	0.58	2,300	0.004	Stiff Clay w/o free water (Reese)
583-578 RWB-23 & 24	Gray Very Stiff to Hard Silty Clay	0.36	2.77	0.53	1,650	0.005	Stiff Clay w/o free water (Reese)
581-578 RWB-26 & 27	Brown Medium Dense Sandy Loam	0.24	4.2	0.38	90	N/A	Sand (Reese)
578-570	Gray Medium Dense to Dense Silty Loam	0.25	4.02	0.4	60	N/A	Sand (Reese)
570-555	Gray Stiff to Very Stiff Silty Clay	0.36	2.77	0.53	790	0.007	Stiff Clay w/o free water (Reese)

*The initial p-y modulus, E_{py} , varies linearly with depth. To obtain E_{py} use the equation $E_{py} = k_{py} * z$, where k_{py} is the coefficient of lateral modulus of subgrade reaction given in the table and z is the distance from the surface to the center point of the layer in inches.

Traffic and other surcharge loads should be included in the retaining wall design as applicable. A live load surcharge shall be applied where vehicular load is expected to act on the surface of the backfill within a distance equal to one-half the wall height behind the back face of the wall in accordance with AASHTO 3.11.6.4. An equivalent height (Heq) of two (2) feet of soil should be used for vehicular loadings on retaining walls.

Based on the drawings provided (dated 2/8/2021), a ground mounted noise wall supported on drilled shafts is proposed to be constructed 6 feet behind retaining wall 099-1002. The drilled shafts for the noise wall may impose additional lateral pressure on the lagging or the solider piles when the noise wall is subjected to lateral loading. The additional lateral pressure, the magnitude and the distribution are highly dependent on the distance between the drilled shaft and the soldier pile wall and the level of the lateral loading. According to FHWA Drilled Shafts construction Procedures and LRFD Design Methods section 12.3.4.1, Broms method can be used for simple analysis of relatively short, stiff drilled shafts subject to lateral shear and overturning moments. The detailed calculation based on Broms method and strain wedge theory for the additional loading from the drilled shafts to the solider pile wall is presented in **Appendix F**. The calculation is based on a noise wall height of 16 feet, a drilled shaft length of 12 feet and wind load of 35psf as provided by the design team (Benesch). **Exhibit 3** shows the equivalent additional pressure on the lagging between solider piles assuming that the arrangement of the solider piles is offset from the drilled shafts for the noise wall.

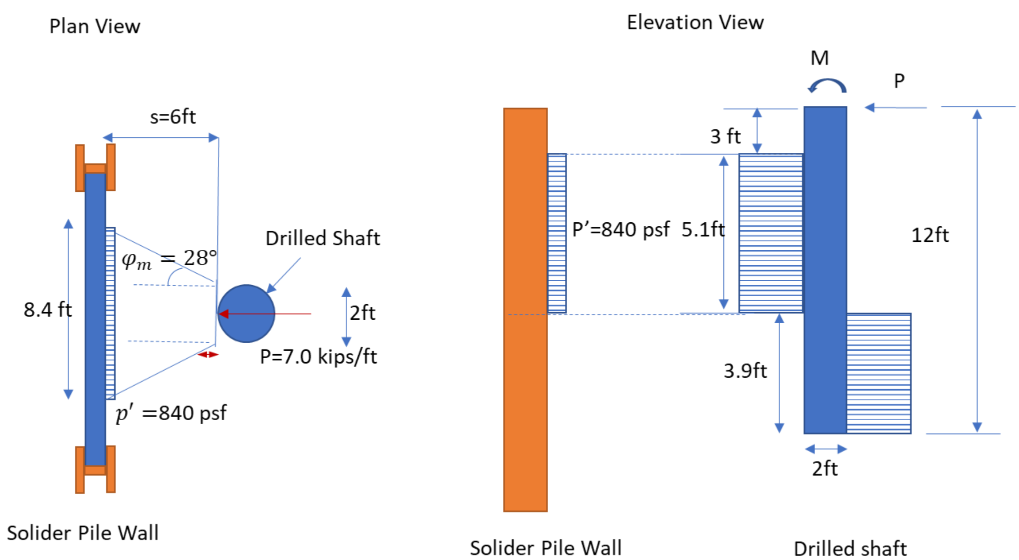


Exhibit 3: Additional Pressure from Drilled Shafts onto the Solider Pile Wall

The potential for development of hydrostatic pressures behind walls with discreet vertical elements and lagging is limited due to the presence of openings in the lagging. Water pressures may be considered reduced in design only if positive drainage, e.g., drainage blanket, geocomposite drainage panels, gravel drains with outlet pipes is provided to prevent buildup of hydrostatic pressure behind the wall. If the retaining wall is not allowed to drain, the effect of hydrostatic water pressure should be added to that of the earth pressure, the effects of which are shown in AASHTO Figure C3.11.3-1. Seepage shall be controlled by installation of a drainage medium behind the wall facing with outlets at or near the base of the wall. Drainage panels should maintain their drainage characteristics under the design earth pressures and surcharge loadings and shall extend from the base of the wall to a level of 1.0 feet below the top of the wall. Where thin drainage panels are used behind walls, and saturated or moist soil behind the panels may be subjected to freezing and expansion, either insulation shall be provided on the walls to prevent freezing of the soil, or the wall shall be designed for the pressures exerted on the wall by frozen soil. The passive lateral earth pressure coefficient (Kp) from the upper 3.5 feet of level backfill from the proposed grade in front of the wall should be neglected, unless the soil is confined or protected by a concrete slab or well drained pavement. The passive lateral earth pressure coefficient from the upper 3.5 feet of soil for a descending slope at the proposed grade of the wall should also be neglected, regardless of any surface protection.

4.2.2 Soldier Pile and Lagging

Soldier pile walls are generally constructed at 8 to 10-foot centers along the retaining wall alignment into the bearing stratum. The soldier piles could either be driven or drilled. Driving piles is normally less expensive but the designs are limited to H-pile and small W-sections. Drilled soldier piles can utilize larger W-sections, built up plate sections or multiple W-sections. For drilled piles, the pile will be placed into the hole and centered, and the annular space around each pile section will be filled with flowable grout. As the excavation progresses from the top down, the grout will be removed from the flanges and lagging will be constructed between the flanges of the pile sections. The lagging and piles should be designed based on structural analysis.

Resistance to lateral movement or overturning of the soldier pile is furnished by passive resistance of the soil below the depth of excavation. The passive pressure between the piles should act over an effective width equal to three times the width of the soldier piles for the stiff to hard brown and gray silty clay at the site. The total width of the solider pile should be taken as either the diameter of the borings pre-drilled and backfilled with concrete or the diameter of the driven steel pile.

In order to limit wall deflections and provide additional resistance, the soldier pile and lagging retention system could be restrained with tie-back anchors. The soldier pile and lagging retention system restrained with tie-backs will be subjected to “trapezoidal” lateral soil pressures. For tall retaining walls, the “trapezoidal” pressure will result in greater lateral forces and moments compared to the cantilever design.

4.2.3 Wall and Embankment Settlement

Based on information provided by Benesch, the proposed soldier pile and lagging retaining wall will be installed in a cut area. According to the cross-section profile of the proposed wall, less than 5 feet of new fill is anticipated behind the wall; therefore, settlement due to the improvements is considered to be negligible for the proposed retaining wall.

4.2.4 Global Slope Stability

Based on the preliminary information provided by Benesch, the retaining wall should be designed for external stability of the wall system. The parameters in **Table 6** were used to evaluate the proposed wall.

Table 6 – Wall Description: Sta. 319+50 to Sta. 327+60

*Based on drawings provided by Benesch dated February 8, 2021

Maximum total retained height of the retaining wall (H)*	14 feet
Minimum embedment length of pile to reach F.S. = 1.7	14 feet
Minimum pile tip elevation(s)	586.2 to 568.0

The actual wall width, and total height of the wall should be based on structural analysis performed by a Licensed Structural Engineer in the State of Illinois.

Slide 2018 is a comprehensive slope stability analysis software used to evaluate the proposed wall for the project based on the limit equilibrium method. The proposed wall was analyzed based on the preliminary grading and the soils encountered while drilling. A circular failure analyses were evaluated using the simplified Bishops analyses methods for the proposed wall geometry. The analyses were performed using the soil parameters in **Tables 3a** and **3b**. Based on the proposed geometry and the soil borings, global stability analyses were performed.

4.2.5 Global Slope Stability Results

A circular failure analyses was evaluated for both a short term (undrained) and long term (drained) condition based on the proposed geometry (**Table 6**) for the proposed retaining wall. The analyses were performed at Stations 323+00 and 325+00, at the anticipated maximum height of the proposed retaining wall, utilizing the soil parameters presented in **Tables 3a** and **3b,** respectively. The results of the analyses are shown in **Table 7**.

Table 7– Retaining Wall Global Slope Stability Analyses Results

Analysis Exhibit	Location	Analysis Type	Factor of Safety	Minimum Factor of Safety
Exhibit 3a	Station 323+00	Circular – Short Term	8.4	1.7
Exhibit 3b		Circular – Long Term	2.8	1.7
Exhibit 4a	Station 325+00	Circular – Short Term	5.2	1.7
Exhibit 4b		Circular – Long Term	3.0	1.7

Based on the analyses performed, the proposed retaining wall meets the minimum factor of safety of 1.7 for cut area. Copies of the slope stability analyses are included in the Slope Stability Analyses Exhibits (**Appendix E**).

4.3 Drainage Recommendations

The wall design should include drainage system to prevent the buildup of hydrostatic forces behind the wall. This could be accomplished with the installation of drainage blankets, geocomposite drainage panels, or gravel drains behind the facing of the wall with outlet pipes below the facing to collect and remove surface water away from the face of the soldier pile wall. Weep holes can also be used. If weep holes are to be used, it is recommended that a geocomposite wall drain to be placed over the interlocks and area of the weep holes.

5.0 CONSTRUCTION CONSIDERATIONS

All work performed for the proposed project should conform to the requirements in the IDOT Standard Specifications for Road and Bridge Construction (2016). Any deviation from the requirements in the manuals above should be approved by the design engineer.

5.1 Site Preparation

All of the borings were completed in the grass field along the outside shoulders of I-55 northbound. Based on the existing site conditions at the proposed wall location west of the existing roadway, it is anticipated that the surface will require stripping of vegetation and surface topsoil from the vicinity of the proposed wall. It is anticipated that topsoil stripping depths will be on the order of 4 to 6 inches. After stripping, areas intended to support new wall elements or new engineered fill should be carefully evaluated by a geotechnical engineer.

5.2 Existing Utilities

Based on the existing site conditions, significant utilities may exist along the project corridor that may interfere with construction of the proposed widening of the roadway and the retaining wall construction.

Before proceeding with construction, any existing utility lines that are to be abandoned and will interfere with construction should be completely relocated from beneath the proposed construction areas. Where possible, existing utility lines that are to be abandoned in place should be removed and/or plugged with a minimum of 2 feet of cement grout. All excavations resulting from underground utility removal activities should be cleaned of loose and disturbed materials, including all previously placed backfill, and backfilled with suitable fill materials in accordance with the requirements of this section. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water.

5.3 Site Excavation

Site excavations are expected to encounter various types of soils as described in the Subsurface Exploration section of this report. The contractor will be responsible to provide a safe excavation during the construction activities of the project. All excavations should be conducted in accordance with applicable federal, state, and local safety regulations, including, but not limited to the Occupational Safety and Health Administration (OSHA) excavation safety standards.

Excavation stability and soil pressures on temporary shoring are dependent on soil conditions, depth of excavations, installation procedures, and the magnitude of any surcharge loads on the ground surface adjacent to the excavation. Excavation near existing structures and underground utilities should be performed with extreme care to avoid undermining existing structures. Excavations should not extend below the level of adjacent existing foundations or utilities unless underpinning or other support is installed. It is the responsibility of the contractor for field determinations of applicable conditions and providing adequate shoring (if needed) for all excavation activities.

5.4 Groundwater Management

It is anticipated that the long-term water table is between elevations 572.0 and 590.0 feet. GSG does not anticipate groundwater related issues during construction activity based on the predominantly cohesive nature of the site and proposed design; however, water may become perched in the fill material encountered near the surface. If rainwater run-off or perched water is accumulated at the base of excavation, the contractor should remove accumulated water using conventional sump pit and pump procedures and maintain a dry and stable excavation. The location of the sump should be determined by the contractor based on field conditions. During earthmoving activities at the site, grading should be performed to ensure that drainage is maintained throughout the construction period. Water should not be allowed to accumulate in the foundation area either during or after construction. Undercut and excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

If water seepage occurs during excavations or where wet conditions are encountered such that the water cannot be removed with conventional sumping, we recommend placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation below the water table. The CA-7 stone should be placed to 12 inches above the water table, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable.

6.0 LIMITATIONS

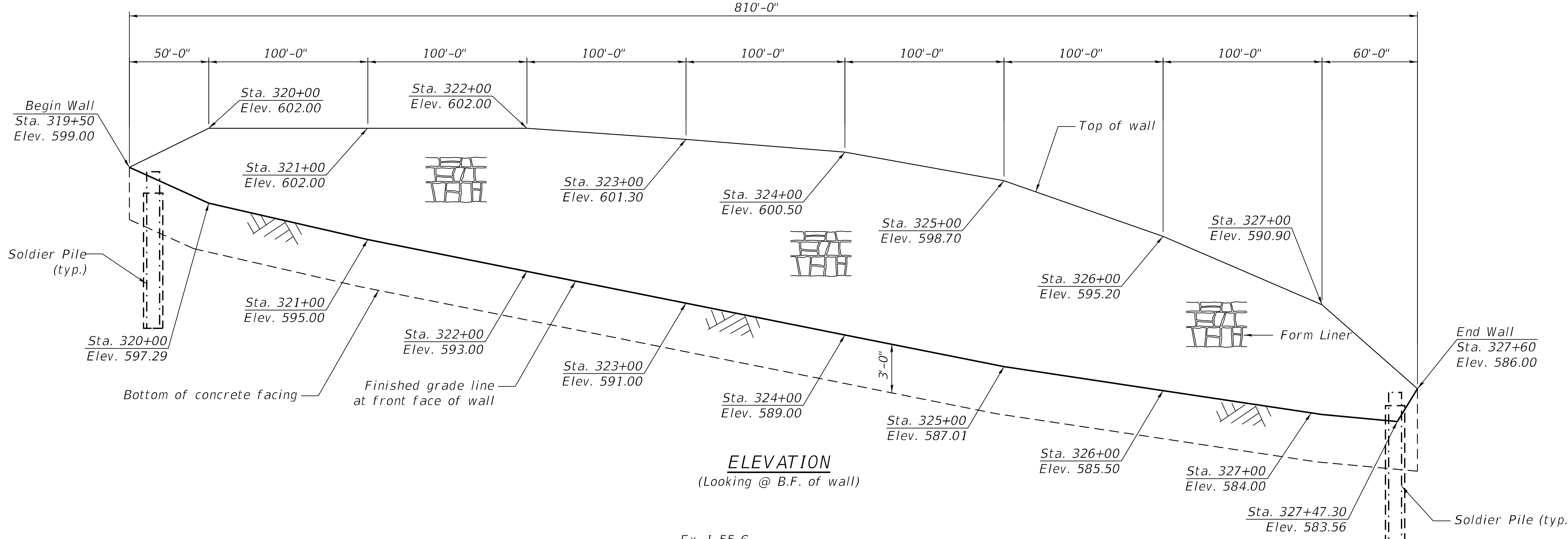
This report has been prepared for the exclusive use of the Illinois Department of Transportation (IDOT) and its Design Section Engineer consultant. The recommendations provided in the report are specific to the project described herein and are based on the information obtained at the soil boring locations within the proposed retaining wall area. The analyses have been performed, and the recommendations provided in this report, are based on subsurface conditions determined at the location of the borings. This report may not reflect all variations that may occur between boring locations or at some other time, the nature and extent of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations presented herein.

APPENDIX A

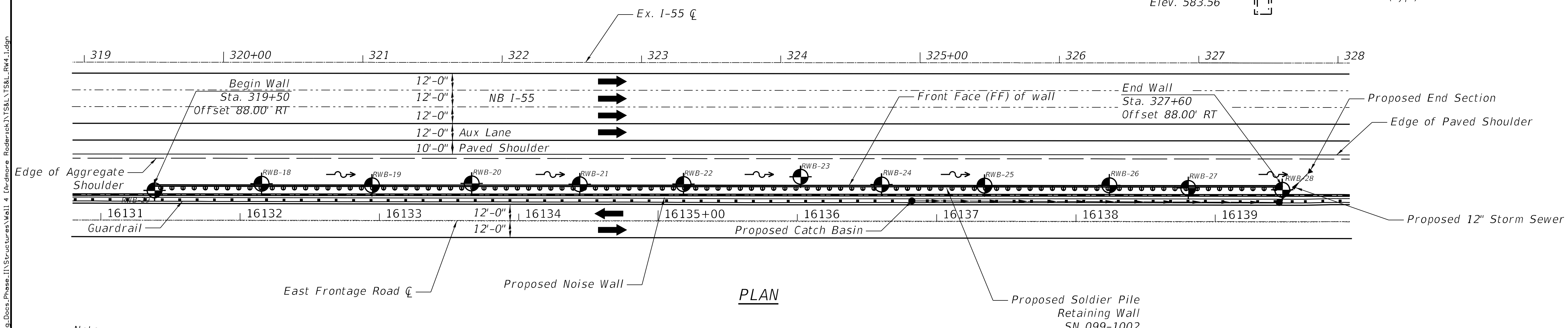
General Plans, Elevations, and Details

Bench Mark: BM-302 Set 2" diameter Aluminum Disc in bridge wall at northwest corner of existing NB IL-59 Ramp Bridge over I-55, El. 625.23.

Existing Structure: None



ELEVATION
(Looking @ B.F. of wall)



PLAN

Note:
Wall offsets are measured from the ℄ I-55 to the front face of panels.

HIGHWAY CLASSIFICATION

Interstate 55
Functional Class: Highway
ADT: 73,600 (2019) 90,300 (2040)
ADTT: 23% (including single and multiple unit trucks)
DHV: Future 3,005
Design Speed: 70 m.p.h.
Posted Speed: 65 m.p.h.

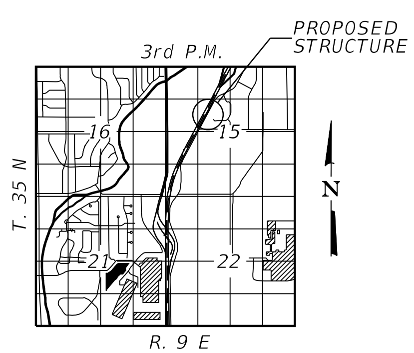
DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

DESIGN STRESSES

FIELD UNITS

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



LOCATION SKETCH

GENERAL PLAN & ELEVATION
I-55 RETAINING WALL
F.A.I. 55 INTERSTATE 55 (I-55)
SECTION 2018-075-R
WILL COUNTY
STATION 319+50 TO 327+60
STRUCTURE NO. 099-1002

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Ardmore Roderick
1500 West Carroll Avenue, Suite 300
Chicago, Illinois 60607
312-795-1400

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		CHECKED - JCE	REVISED -
PLOT SCALE =		DRAWN - VGR	REVISED -
PLOT DATE = 2/08/2021		CHECKED - JCE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.I/P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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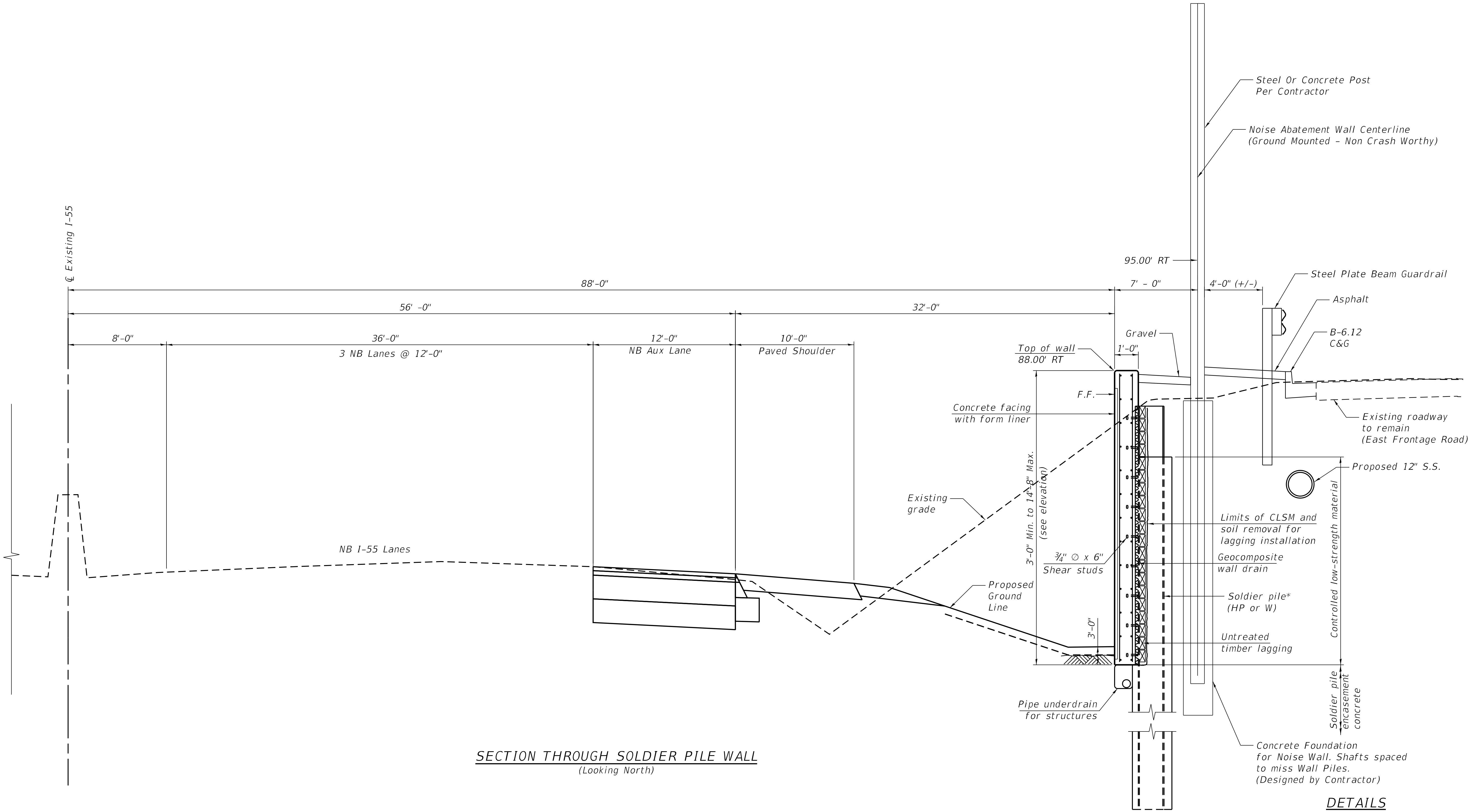
		CONTRACT NO. 62H15		
* FAI 55, FAP 338	ILLINOIS	FED. AID PROJECT		



SECTION THROUGH SOLDIER PILE WALL
(Looking North)

* Pile section, spacing, shaft diameter and tip elevation to be determined during final design.

DETAILS
I-55 RETAINING WALL
F.A.I 55 INTERSTATE 55 (I-55)
SECTION 2018-075-R
WILL COUNTY
STATION 319+50 TO 327+60
STRUCTURE NO. 099-1002

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Ardmore Roderick
Ardmore Roderick
1500 West Carroll Avenue, Suite 300
Chicago, Illinois 60607
312-795-1400

USER NAME = jeffreyehrhart	DESIGNED - VGR	REVISED -	
	CHECKED - JCE	REVISED -	
PLOT SCALE =	DRAWN - VGR	REVISED -	
PLOT DATE = 2/08/2021	CHECKED - JCE	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

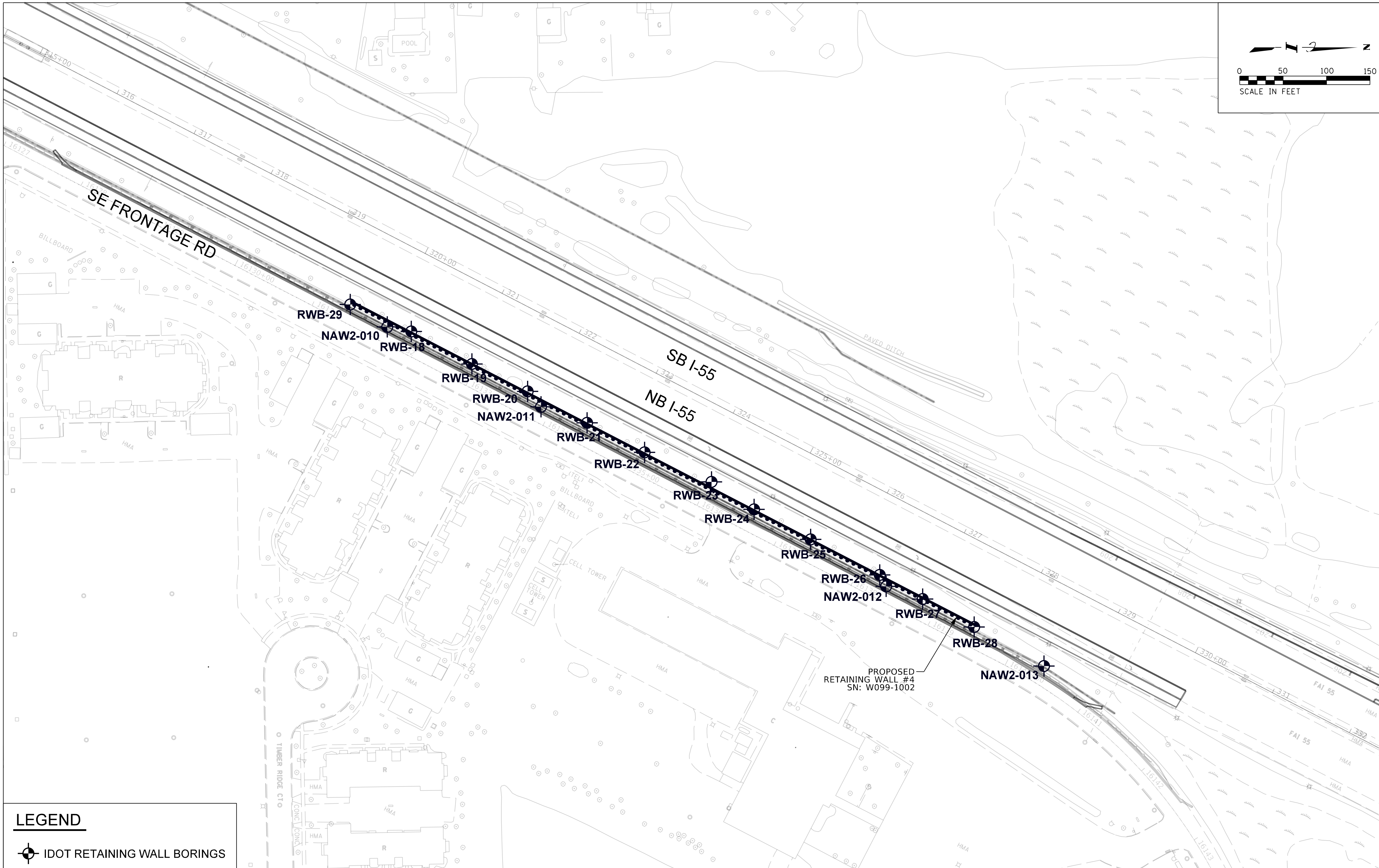
SHEET 2 OF 2 SHEETS

F.A.I/P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
*	2018-075-R	WILL		
		CONTRACT NO. 62H15		

* FAI 55, FAP 338 | ILLINOIS | FED. AID PROJECT

APPENDIX B

SOIL BORING LOCATION PLAN AND SUBSURFACE PROFILE



GSG CONSULTANTS, INC.

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PLOT DATE = 2/15/2021		DATE - 02/12/2021	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011

I-55/ROUTE 59 WILL COUNTY
RETAINING WALL NO. 4 BORING LOCATION PLAN

SCALE: AS NOTED | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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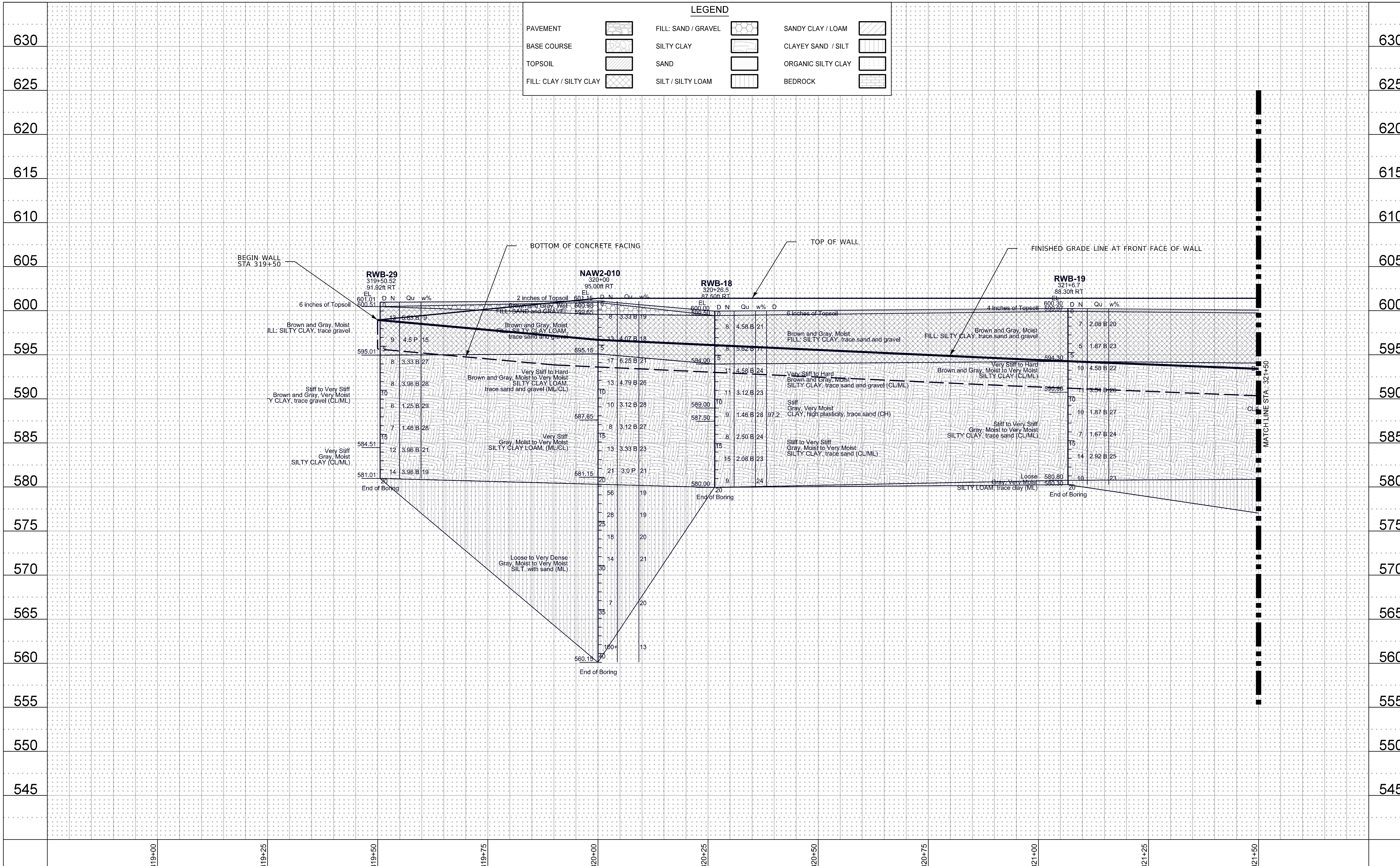
		CONTRACT NO. 189-011		
		ILLINOIS FED. AID PROJECT		



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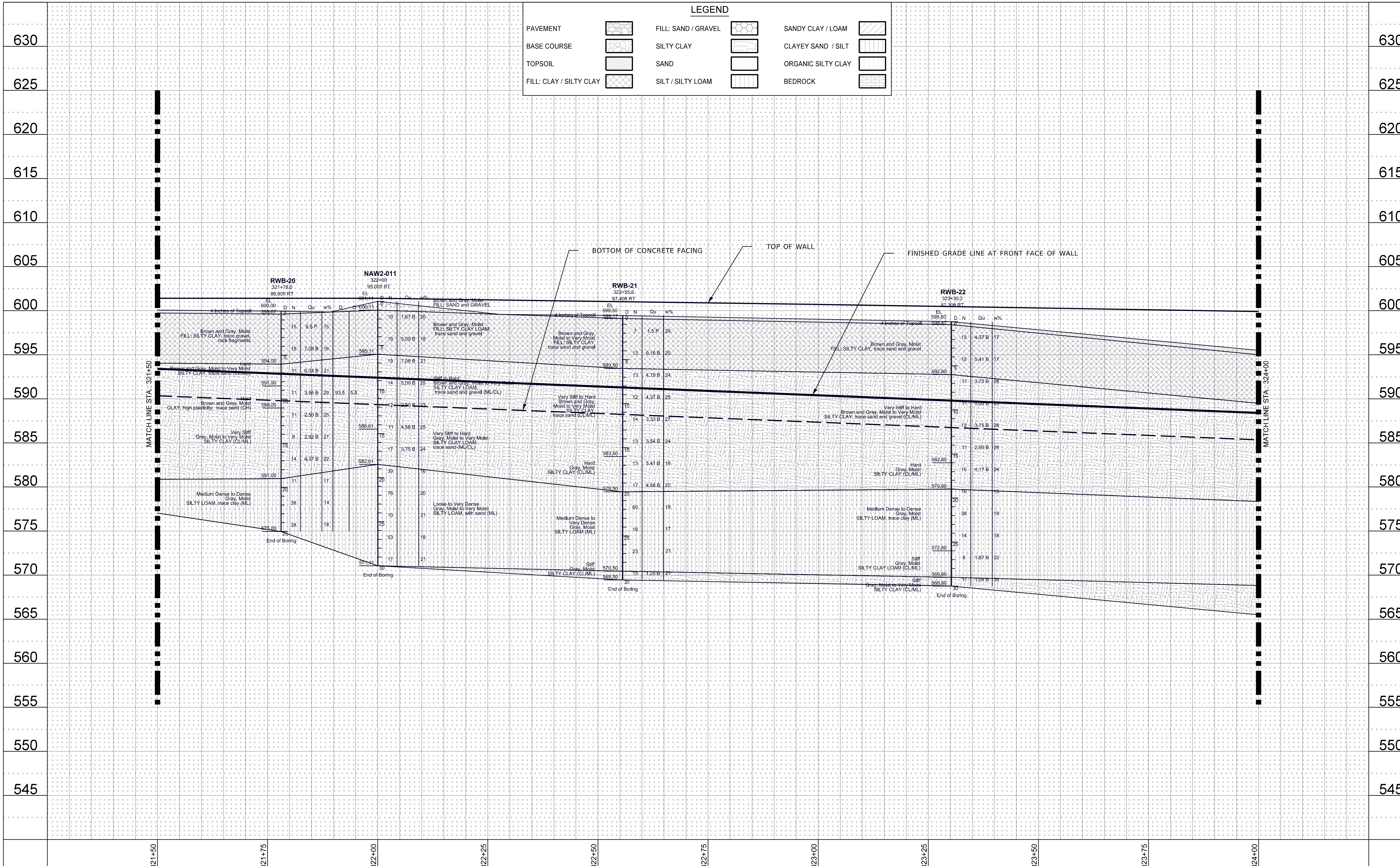
		ILLINOIS	FED. AID PROJECT	



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GSG CONSULTANTS, INC.

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011
I-55/ROUTE 59 WILL COUNTY
RETAINING WALL NO. 4 BORING PROFILE

SCALE: AS NOTED | SHEET 2 OF 4 SHEETS | STA. 321+50 TO STA. 324+00

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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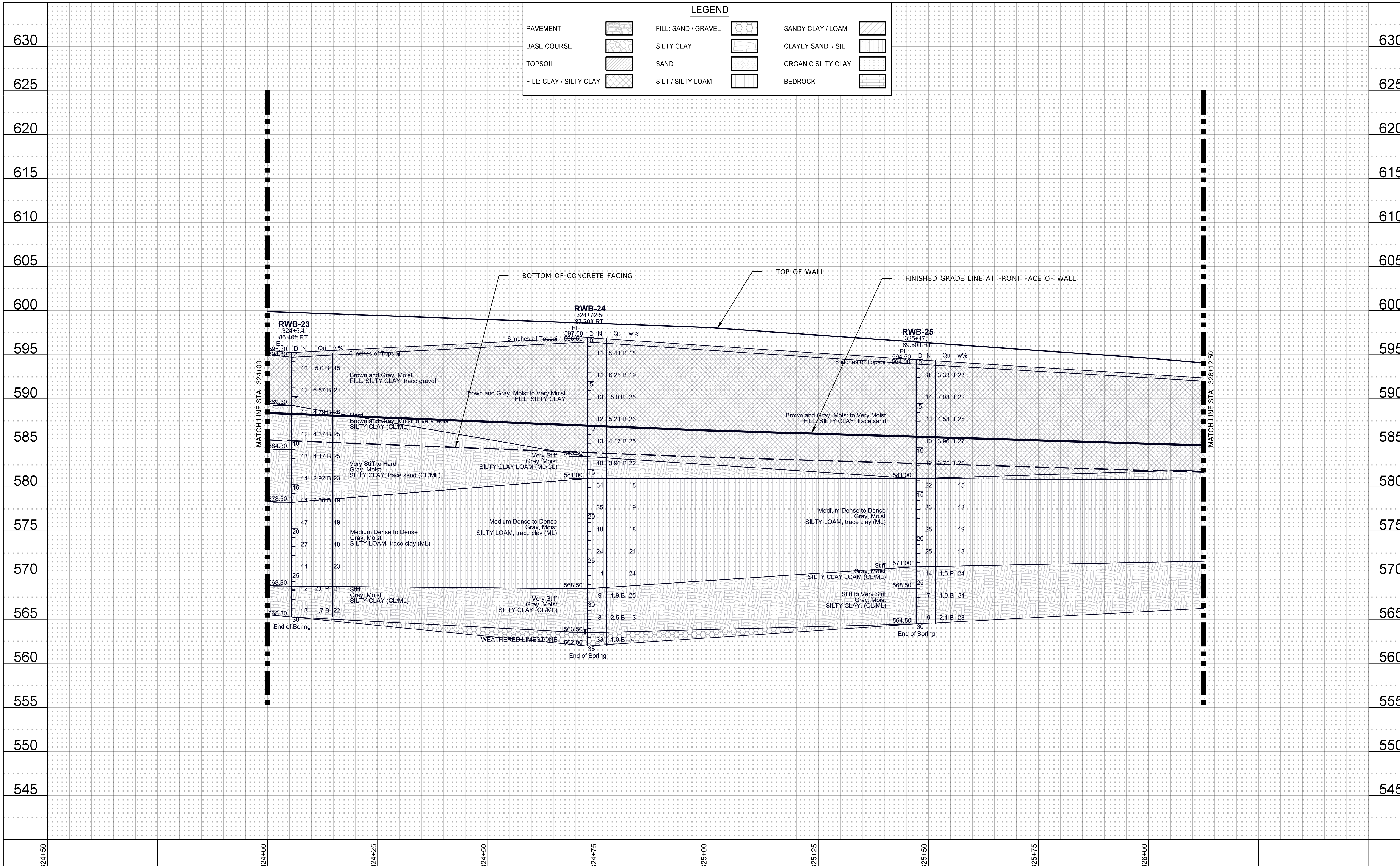
ILLINOIS | FED. AID PROJECT



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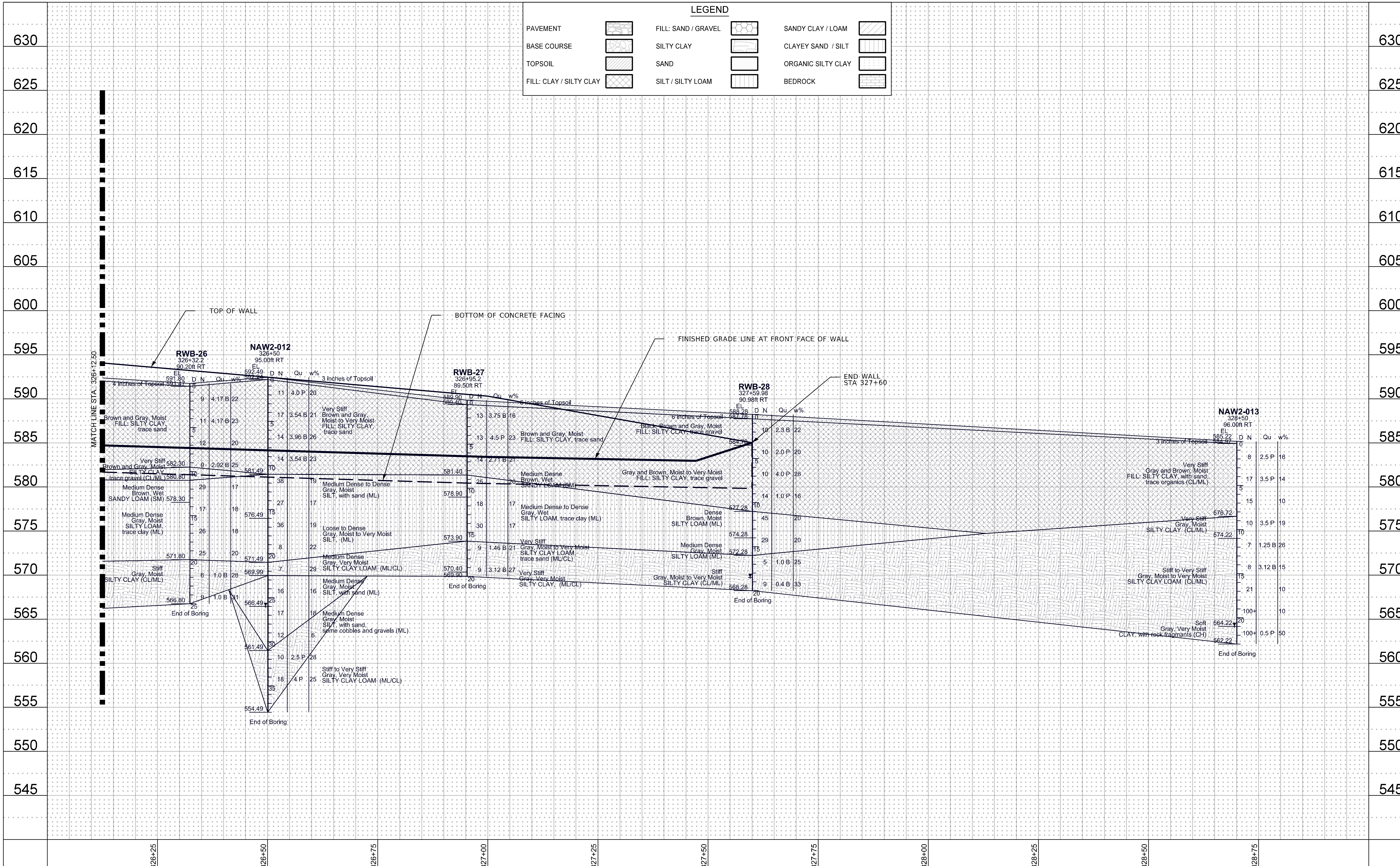
					CONTRACT NO. 189-011
					ILLINOIS FED. AID PROJECT



GSG CONSULTANTS, INC.

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011

I-55/ROUTE 59 WILL COUNTY
RETAINING WALL NO. 4 BORING PROFILE

SCALE: AS NOTED | SHEET 4 OF 4 SHEETS | STA. 326+12.50 TO STA. 329+00

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
I-55		WILL	5	5

CONTRACT NO. 189-011

ILLINOIS | FED. AID PROJECT

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/26/19

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-18
Station 320+26.5
Offset 87.50ft RT
Ground Surface Elev. 600.00 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	599.50				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand and gravel			2 3 5	4.6 B	21
		-5	2 3 5	5.6 B	17
	594.00				
Very Stiff to Hard Brown and Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)			2 4 7	4.6 B	24
		-10	3 4 7	3.1 B	23
	589.00				
Stiff Gray, Very Moist CLAY, high plasticity, trace sand (CH)	587.50		3 3 6	1.5 B	28
Stiff to Very Stiff Gray, Moist to Very Moist SILTY CLAY, trace sand (CL/ML)		-15	2 3 5	2.5 B	24
			4 6 9	2.1 B	23
	580.00	-20	3 3 6		24

End of Boring
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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/26/19

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-19
Station 321+6.7
Offset 88.30ft RT
Ground Surface Elev. 600.30 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 inches of Topsoil	599.97				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand and gravel			2 3 4	2.1 B	20
		-5	2 2 3	1.9 B	23
	594.30				
Very Stiff to Hard Brown and Gray, Moist to Very Moist SILTY CLAY (CL/ML)			2 4 6	4.6 B	22
			3 5 6	3.5 B	26
	590.80	-10			
Stiff to Very Stiff Gray, Moist to Very Moist SILTY CLAY, trace sand (CL/ML)			2 4 6	1.9 B	27
		-15	2 3 4	1.7 B	24
			5 7 7	2.9 B	25
	580.80		3 4 6		23
Loose	580.30	-20			

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray, Very Moist SILTY LOAM, trace clay (ML)				
End of Boring				
	-25			
	-30			
	-35			
	-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/3/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-20
Station 321+78.0
Offset 86.90ft RT
Ground Surface Elev. 600.00 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 inches of Topsoil	599.67				
Brown and Gray, Moist FILL: SILTY CLAY, trace gravel, rock fragments			4		
			7	6.5	15
			8	P	
			6		
			7	7.1	16
		-5	11	B	
	594.00				
Hard Brown and Gray, Moist to Very Moist SILTY CLAY, trace sand (CL/ML)			4		
			4	6.0	21
			7	B	
	591.50				
Hard Brown and Gray, Moist CLAY, high plasticity, trace sand (CH)			2		
			4	4.0	29
		-10	7	B	
	589.00				
Very Stiff Gray, Moist to Very Moist SILTY CLAY (CL/ML)			2		
			4	2.5	25
			7	B	
			2		
			3	2.9	27
		-15	5	B	
			3		
			6	4.4	22
			8	B	
	581.00		3		
			4		17
		-20	7		
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML) *(continued)*			10		
			18		14
			20		
			6		
			18		18
	575.00	-25	20		
End of Boring					
		-30			
		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/3/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-21
Station 322+55.6
Offset 87.40ft RT
Ground Surface Elev. 599.50 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 inches of Topsoil	599.17				
Brown and Gray, Moist to Very Moist FILL: SILTY CLAY, trace sand and gravel			2 3 4	1.5 P	29
		-5	2 5 8	9.2 B	20
	593.50				
Very Stiff to Hard Brown and Gray, Moist to Very Moist SILTY CLAY, trace sand (CL/ML)			4 5 8	4.8 B	24
		-10	2 5 7	4.4 B	25
			4 6 8	3.3 B	27
		-15	3 5 8	3.5 B	24
	583.50				
Hard Gray, Moist SILTY CLAY (CL/ML)			3 5 8	5.4 B	18
	579.50	-20	3 5 12	4.6 B	20

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Dense to Very Dense Gray, Moist SILTY LOAM (ML)			13 27 33		18
		-25	11 9 7		17
			14 12 11		21
	570.50				
Stiff Gray, Moist SILTY CLAY (CL/ML)	569.50	-30	2 6 9	1.3 B	21
End of Boring					
		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/3/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-22
Station 323+30.2
Offset 87.30ft RT
Ground Surface Elev. 598.80 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Bottom Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 inches of Topsoil	598.47				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand and gravel			4 5 8	4.4 B	17
		-5	3 5 7	5.4 B	17
	592.80				
Very Stiff to Hard Brown and Gray, Moist to Very Moist SILTY CLAY, trace sand and gravel (CL/ML)			3 4 7	3.8 B	26
		-10	3 4 7	5.0 B	25
			3 6 7	3.8 B	26
		-15	2 5 6	2.5 B	26
	582.80				
Hard Gray, Moist SILTY CLAY (CL/ML)			3 4 6	4.2 B	24
	579.80				
		-20	3 6 10		15
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML) *(continued)*			26 17 21		19
		-25	5 5 9		18
	572.80				
Stiff Gray, Moist SILTY CLAY LOAM (CL/ML)			2 3 5	1.9 B	22
	569.80				
Stiff Gray, Moist to Very Moist SILTY CLAY (CL/ML)	568.80	-30	4 6 5	1.0 B	30
End of Boring		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/1/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-23
Station 324+5.4
Offset 86.40ft RT
Ground Surface Elev. 595.30 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	594.80				
Brown and Gray, Moist FILL: SILTY CLAY, trace gravel			4 4 6	5.0 B	15
		-5	3 4 8	6.9 B	21
	589.30				
Hard Brown and Gray, Moist to Very Moist SILTY CLAY (CL/ML)			3 4 8	4.8 B	26
		-10	2 5 7	4.4 B	25
	584.30				
Very Stiff to Hard Gray, Moist SILTY CLAY, trace sand (CL/ML)			3 5 8	4.2 B	25
		-15	3 6 8	2.9 B	23
	578.30		3 6 8	2.5 B	19
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML)		-20	11 20 27		19

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML) *(continued)*			15 15 12		18
		-25	3 6 8		23
	568.80		2 4 8	2.0 P	21
Stiff Gray, Moist SILTY CLAY (CL/ML)					
	565.30	-30	2 3 10	1.7 B	22
End of Boring		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/1/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-24
Station 324+72.5
Offset 87.30ft RT
Ground Surface Elev. 597.00 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 563.5 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	596.50				
Brown and Gray, Moist to Very Moist FILL: SILTY CLAY			3 / 6 / 8	5.4 B	18
		-5	3 / 6 / 8	6.3 B	19
			3 / 5 / 8	5.0 B	25
		-10	4 / 5 / 7	5.2 B	26
			2 / 6 / 7	4.2 B	25
	583.50				
Very Stiff Gray, Moist SILTY CLAY LOAM (ML/CL)		-15	3 / 4 / 6	4.0 B	22
	581.00				
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML)			7 / 15 / 19		18
		-20	8 / 15 / 20		19
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML) *(continued)*			7 / 5 / 13		18
		-25	9 / 14 / 10		21
			2 / 3 / 8		24
	568.50				
Very Stiff Gray, Moist SILTY CLAY (CL/ML)		-30	2 / 4 / 5	1.9 B	25
			2 / 3 / 5	2.5 B	13
	563.50 ▼				
WEATHERED LIMESTONE			19 / 15 / 18		4
	562.00	-35			
End of Boring		-40			

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)

Illinois Department of Transportation
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GSG Consultants, Inc.

SOIL BORING LOG

Date 4/1/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-25
Station 325+47.1
Offset 89.50ft RT
Ground Surface Elev. 594.50 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	594.00				
Brown and Gray, Moist to Very Moist FILL: SILTY CLAY, trace sand			3 4 4	3.3 B	23
		-5	3 6 8	7.1 B	22
			3 5 6	4.6 B	25
		-10	3 4 6	4.0 B	27
	581.00		3 6 6	3.8 B	25
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML)		-15	3 9 13		15
			8 15 18		18
		-20	9 15 10		19
Medium Dense to Dense Gray, Moist SILTY LOAM, trace clay (ML) *(continued)*	571.00		10 15 10		18
Stiff Gray, Moist SILTY CLAY LOAM (CL/ML)	568.50	-25	3 6 8	1.5 P	24
Stiff to Very Stiff Gray, Moist SILTY CLAY, (CL/ML)			2 3 4	1.0 B	31
	564.50	-30	3 3 6	2.1 B	28
End of Boring		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/1/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-26
Station 326+32.2
Offset 90.20ft RT
Ground Surface Elev. 591.80 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 inches of Topsoil	591.47				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand			2 3 6	4.2 B	22
		-5	3 4 7	4.2 B	23
			4 5 7		20
	582.30	-10	2 3 6	2.9 B	25
Very Stiff Brown and Gray, Moist SILTY CLAY, trace gravel (CL/ML)	580.80				
Medium Dense Brown, Wet SANDY LOAM (SM)	578.30		5 11 18		17
Medium Dense Gray, Moist SILTY LOAM. trace clay (ML)		-15	6 8 9		18
			7 11 15		18
	571.80	-20	6 14 11		20
Stiff Gray, Moist SILTY CLAY (CL/ML)			2 3 3	1.0 B	28
	566.80	-25	2 2 7	1.0 B	31
End of Boring		-30			
		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/25/19

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-27
Station 326+95.2
Offset 89.50ft RT
Ground Surface Elev. 589.90 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	589.40				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand			2		
			5	3.8	16
			8	B	
			3		
			4	4.5	23
		-5	9	P	
			2		
			6	2.7	21
			8	B	
	581.40				
Medium Desne Brown, Wet SANDY LOAM (SM)			3		
			10		20
		-10	15		
	578.90				
Medium Dense to Dense Gray, Wet SILTY LOAM, trace clay (ML)			4		
			6		17
			12		
			9		
			15		17
		-15	15		
	573.90				
Very Stiff Gray, Moist to Very Moist SILTY CLAY LOAM, trace sand (ML/CL)			2		
			4	1.5	21
			5	B	
			3		
	570.40		4	3.1	27
Very Stiff	569.90	-20	5	B	
Gray, Very Moist SILTY CLAY, (ML/CL)					
End of Boring					
		-25			
		-30			
		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/1/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-28
Station 327+59.98
Offset 90.98ft RT
Ground Surface Elev. 588.28 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 569.8 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	587.78				
Black, Brown and Gray, Moist FILL: SILTY CLAY, trace gravel			4		
			4	2.3	22
			6	B	
	584.78				
Gray and Brown, Moist to Very Moist FILL: SILTY CLAY, trace gravel			2		
			4	2.0	20
		-5	6	P	
			3		
			4	4.0	26
			6	P	
Cobbles at 8.5 feet			4		
			4	1.0	16
		-10	10	P	
	577.28				
Dense Brown, Moist SILTY LOAM (ML)			10		
			21		20
			24		
	574.28		8		
Medium Dense Gray, Moist SILTY LOAM (ML)			13		20
		-15	16		
	572.28				
Very Soft to Stiff Gray, Moist to Very Moist SILTY CLAY (CL/ML)			2		
			2	1.0	25
			3	B	
		▼	2		
			2	0.4	33
	568.28	-20	7	B	

End of Boring

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/3/20

ROUTE I-55 and IL 59 **DESCRIPTION** I-55 NB RT **LOGGED BY** ES

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. Retaining Wall #4
Station

BORING NO. RWB-29
Station 319+50.52
Offset 91.92ft RT
Ground Surface Elev. 601.01 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	600.51				
Brown and Gray, Moist FILL: SILTY CLAY, trace gravel			4 5 8	5.8 B	9
			3 4 5	4.5 P	15
		-5			
	595.01				
Stiff to Very Stiff Brown and Gray, Very Moist SILTY CLAY, trace gravel (CL/ML)			2 3 5	3.3 B	27
			2 3 5	4.0 B	28
		-10			
			2 2 4	1.3 B	29
			2 3 4	1.5 B	28
		-15			
	584.51				
Very Stiff Gray, Moist SILTY CLAY (CL/ML)			2 5 7	4.0 B	21
			3 6 8	4.0 B	19
	581.01	-20			

End of Boring

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/3/20

ROUTE I-55 and IL 59 **DESCRIPTION** Noise Abatement Wall #2 **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NAW#2
Station

BORING NO. NAW2-010
Station 320+00
Offset 95.00ft RT
Ground Surface Elev. 601.15 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
2 inches of Topsoil	600.98				
Brown and Gray, Wet FILL: SAND and GRAVEL	599.65		5		
Brown and Gray, Moist FILL: SILTY CLAY LOAM, trace sand and gravel			4 4	3.3 B	19
			4 5 8	4.1 B	18
	595.15	-5			
Very Stiff to Hard Brown and Gray, Moist to Very Moist SILTY CLAY LOAM, trace sand and gravel (ML/CL)			4 8 9	6.3 B	21
			5 5 8	4.8 B	26
		-10			
			3 4 6	3.1 B	28
	587.65				
Very Stiff Gray, Moist to Very Moist SILTY CLAY LOAM, (ML/CL)			2 4 4	3.1 B	27
		-15			
			3 5 8	3.3 B	23
			3 6 15	3.0 P	21
	581.15	-20			

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Loose to Very Dense Gray, Moist to Very Moist SILT, with sand (ML)		21 29 27		19
		13 20 8		19
	-25			
		8 14 4		20
Silty Clay Seam at 29.5 feet		2 8 6		21
	-30			
		3 3 4		20
	-35			
Limestone Fragments at 39.0 feet		18 50/2"		13
	-40			

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)

Illinois Department of Transportation
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GSG Consultants, Inc.

SOIL BORING LOG

Date 11/3/20

ROUTE I-55 and IL 59 **DESCRIPTION** Noise Abatement Wall #2 **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NAW#2
Station

BORING NO. NAW2-010
Station 320+00
Offset 95.00ft RT
Ground Surface Elev. 601.15 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter None **ft**
Upon Completion N/A **ft**
After N/A **Hrs.** N/A **ft**

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Auger refusal at 40.0 feet 560.15				
End of Boring				
	-45			
	-50			
	-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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/3/20

ROUTE I-55 and IL 59 **DESCRIPTION** Noise Abatement Wall #2 **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NAW#2
Station

BORING NO. NAW2-011
Station 322+00
Offset 95.00ft RT
Ground Surface Elev. 601.11 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Brown and Gray, Moist FILL: SAND and GRAVEL	600.11				
Brown and Gray, Moist FILL: SILTY CLAY LOAM, trace sand and gravel			4 / 4 / 6	1.7 B	20
		-5	7 / 9 / 10	5.0 B	18
	595.11				
Stiff to Hard Brown and Gray, Moist to Very Moist SILTY CLAY LOAM, trace sand and gravel (ML/CL)			6 / 8 / 11	7.1 B	21
		-10	4 / 6 / 8	5.0 B	25
			3 / 5 / 7	2.5 B	23
	586.61	-15	3 / 5 / 6	4.6 B	25
Very Stiff to Hard Gray, Moist to Very Moist SILTY CLAY LOAM, trace sand (ML/CL)			4 / 7 / 10	3.8 B	24
	582.61				
Loose to Very Dense Gray, Moist to Very Moist SILTY LOAM, with sand (ML)		-20	4 / 18 / 21		16
Loose to Very Dense Gray, Moist to Very Moist SILTY LOAM, with sand (ML) *(continued)*			17 / 33 / 43		20
		-25	9 / 4 / 6		21
			15 / 28 / 25		18
	571.11	-30	4 / 8 / 9		21
End of Boring					
		-35			
		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/2/20

ROUTE I-55 and IL 59 **DESCRIPTION** Noise Abatement Wall #2 **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NAW#2
Station

BORING NO. NAW2-012
Station 326+50
Offset 95.00ft RT
Ground Surface Elev. 592.49 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 566.5 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
3 inches of Topsoil	592.24				
Very Stiff Brown and Gray, Moist to Very Moist SILTY CLAY, trace sand			4		
			5	4.0	20
			6	P	
			6		
			7	3.5	21
		-5	10	B	
			4		
			6	4.0	26
			8	B	
			3		
			6	3.5	23
		-10	8	B	
	581.49				
Medium Dense to Dense Gray, Moist SILT, with sand (ML)			9		
			16		19
			22		
			8		
			13		17
		-15	14		
	576.49				
Loose to Dense Gray, Moist to Very Moist SILT, (ML)			8		
			16		19
			20		
			3		
			4		22
		-20	4		
	571.49				
Medium Dense Gray, Very Moist SILTY CLAY LOAM (ML/CL)			3		
			3		29
	569.99		4		
Medium Dense Gray, Moist SILT, with sand (ML)			8		
			8		16
		-25	8		
	566.49 ▼				
Medium Dense Gray, Moist SILT, with sand, some cobbles and gravels (ML)			7		
			9		18
			8		
			4		
			5		6
		-30	7		
	561.49				
Stiff to Very Stiff Gray, Very Moist SILTY CLAY LOAM (ML/CL)			6		
			4	2.5	28
			6	P	
			4		
			7	4.0	25
		-35	11	P	
Auger refusal at 37 feet	554.49				
End of Boring		-40			

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)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/2/20

ROUTE I-55 and IL 59 **DESCRIPTION** Noise Abatement Wall #2 **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Frontage RD W, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. NAW#2
Station

BORING NO. NAW2-013
Station 328+50
Offset 96.00ft RT
Ground Surface Elev. 585.22 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 564.2 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
3 inches of Topsoil	584.97				
Very Stiff Gray and Brown, Moist SILTY CLAY, with sand, trace organics (CL/ML)			3 3 5	2.5 P	16
		-5	5 7 10	3.5 P	14
Cobbles at 6.5 feet			6 9 6		10
	576.72				
Very Stiff Gray, Moist SILTY CLAY (CL/ML)		-10	2 4 6	3.5 P	19
	574.22				
Stiff to Very Stiff Gray, Moist to Very Moist SILTY CLAY LOAM (CL/ML)			3 3 4	1.3 B	26
Sand Seam at 14.5 feet		-15	3 4 4	3.1 B	15
Cobbles at 16.0 feet			13 10 11		10
			50/2"		
		-20			10

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	564.22 ▼				
Soft Gray, Very Moist CLAY, with rock fragmants (CH)			11 14 50/2"	0.5 P	50
Auger refusal at 23.0 feet	562.22				
End of Boring					
		-25			
		-30			
		-35			
		-40			

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)

APPENDIX D

Laboratory Test Results

Table D1a–Retaining Wall #4 Test Results – Atterberg Limits

Boring ID	Sample Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Classification
RWB-18	11-12.5	53.8	22.6	31.2	CH
RWB-20	8.5-10	59.8	25.8	34.0	CH

Table D1b– Retaining Wall #4 Test Results – Organic Content

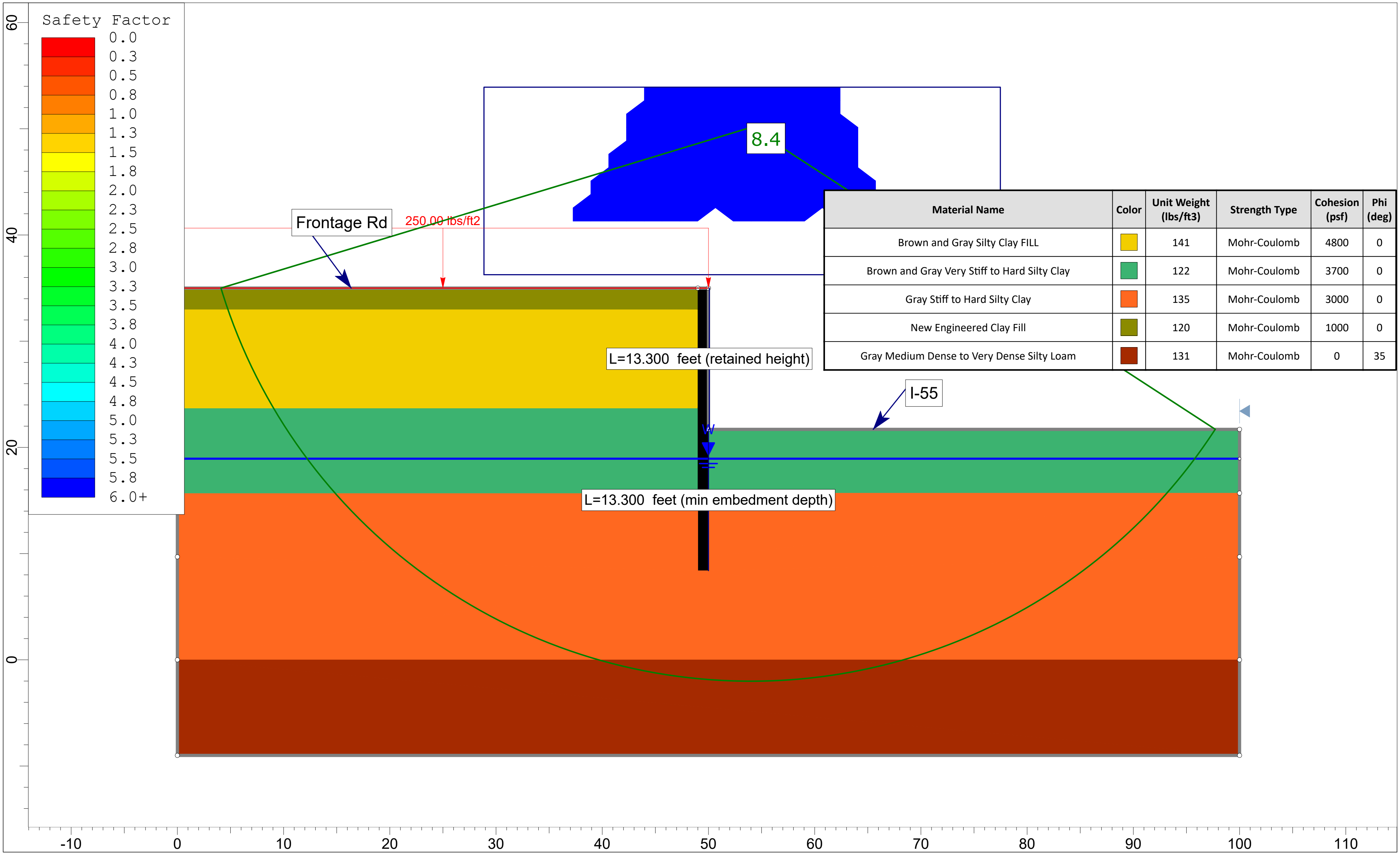
Boring ID	Sample Depth (ft)	Organic Content (%)	Soil Classification
RWB-20	8.5-10	6.7	CH

Table D1c– Retaining Wall #4 Test Results – Unit Weight

Boring ID	Sample Depth (ft)	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)	Soil Classification
RWB-18	11-12.5	120.6	124.1	CH
RWB-20	8.5-10	93.5	97.2	CH

APPENDIX D

SLOPE STABILTY ANALYSIS



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Brown and Gray Silty Clay FILL		141	Mohr-Coulomb	4800	0
Brown and Gray Very Stiff to Hard Silty Clay		122	Mohr-Coulomb	3700	0
Gray Stiff to Hard Silty Clay		135	Mohr-Coulomb	3000	0
New Engineered Clay Fill		120	Mohr-Coulomb	1000	0
Gray Medium Dense to Very Dense Silty Loam		131	Mohr-Coulomb	0	35

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Project	Contract IDOT\189-011 Wall #4
Analysis Description	Exhibit 3a: Circular Failure Short Term - Undrained
Drawn By	SI
Scale	1:150
Company	GSG Consultants, Inc.
Date	04/27/2020
File Name	323+00 Short Term

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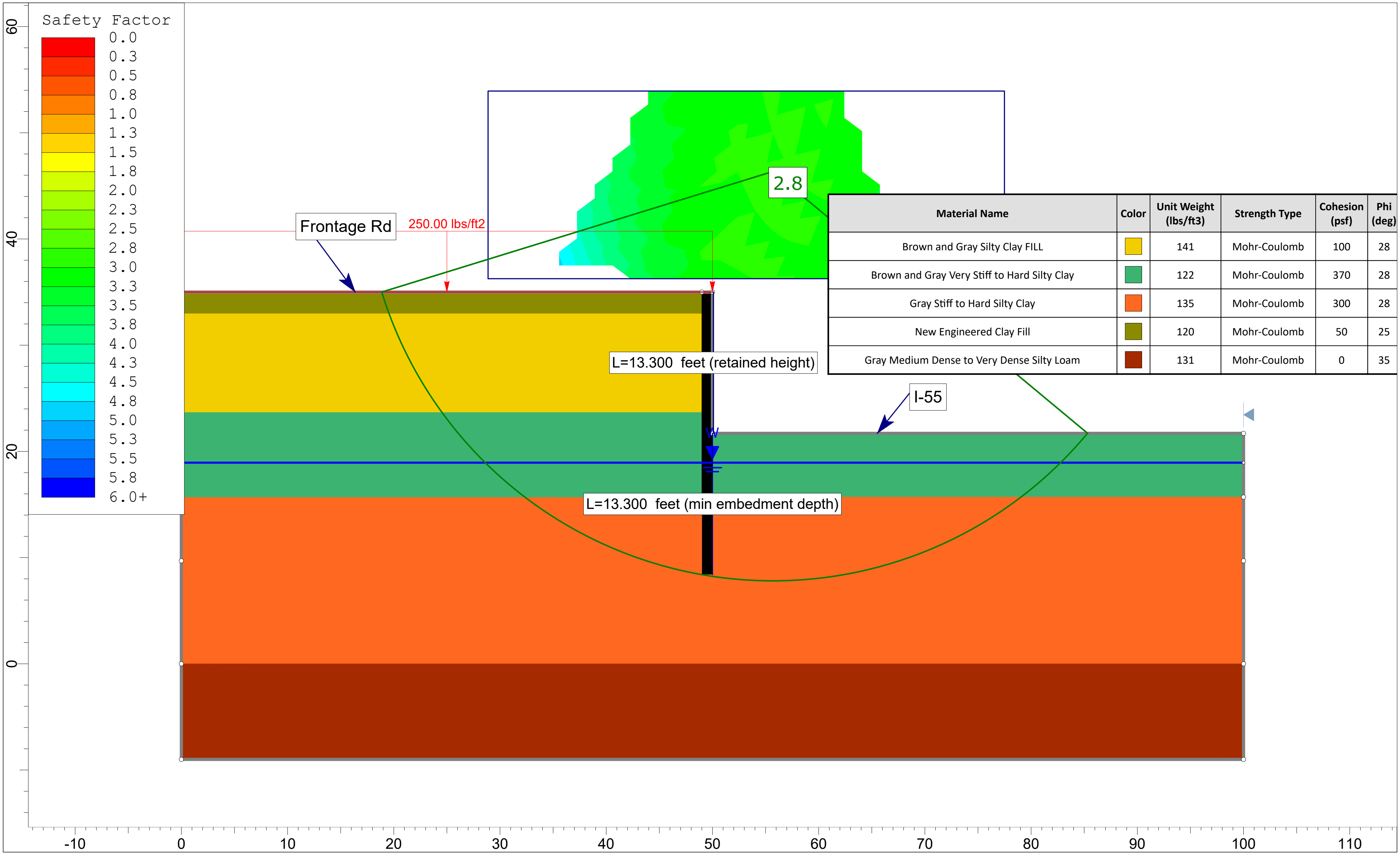

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Brown and Gray Silty Clay FILL		141	Mohr-Coulomb	100	28
Brown and Gray Very Stiff to Hard Silty Clay		122	Mohr-Coulomb	370	28
Gray Stiff to Hard Silty Clay		135	Mohr-Coulomb	300	28
New Engineered Clay Fill		120	Mohr-Coulomb	50	25
Gray Medium Dense to Very Dense Silty Loam		131	Mohr-Coulomb	0	35

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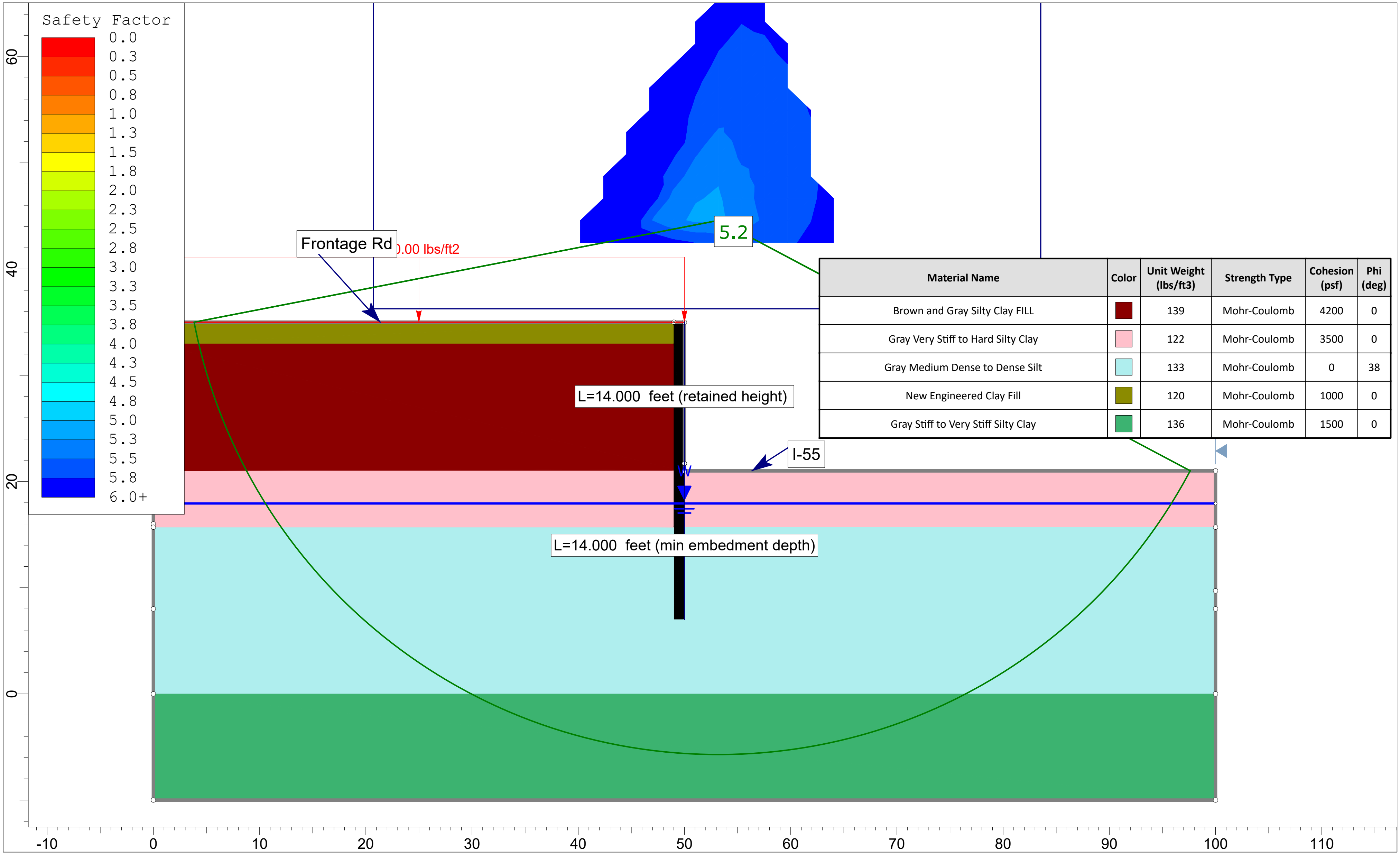
Project	Contract IDOT\189-011 Wall #4
Analysis Description	Exhibit 3a: Circular Failure Long Term - Drained
Drawn By	SI
Scale	1:150
Company	GSG Consultants, Inc.
Date	04/27/2020
File Name	323+00 Long Term



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Brown and Gray Silty Clay FILL		139	Mohr-Coulomb	4200	0
Gray Very Stiff to Hard Silty Clay		122	Mohr-Coulomb	3500	0
Gray Medium Dense to Dense Silt		133	Mohr-Coulomb	0	38
New Engineered Clay Fill		120	Mohr-Coulomb	1000	0
Gray Stiff to Very Stiff Silty Clay		136	Mohr-Coulomb	1500	0

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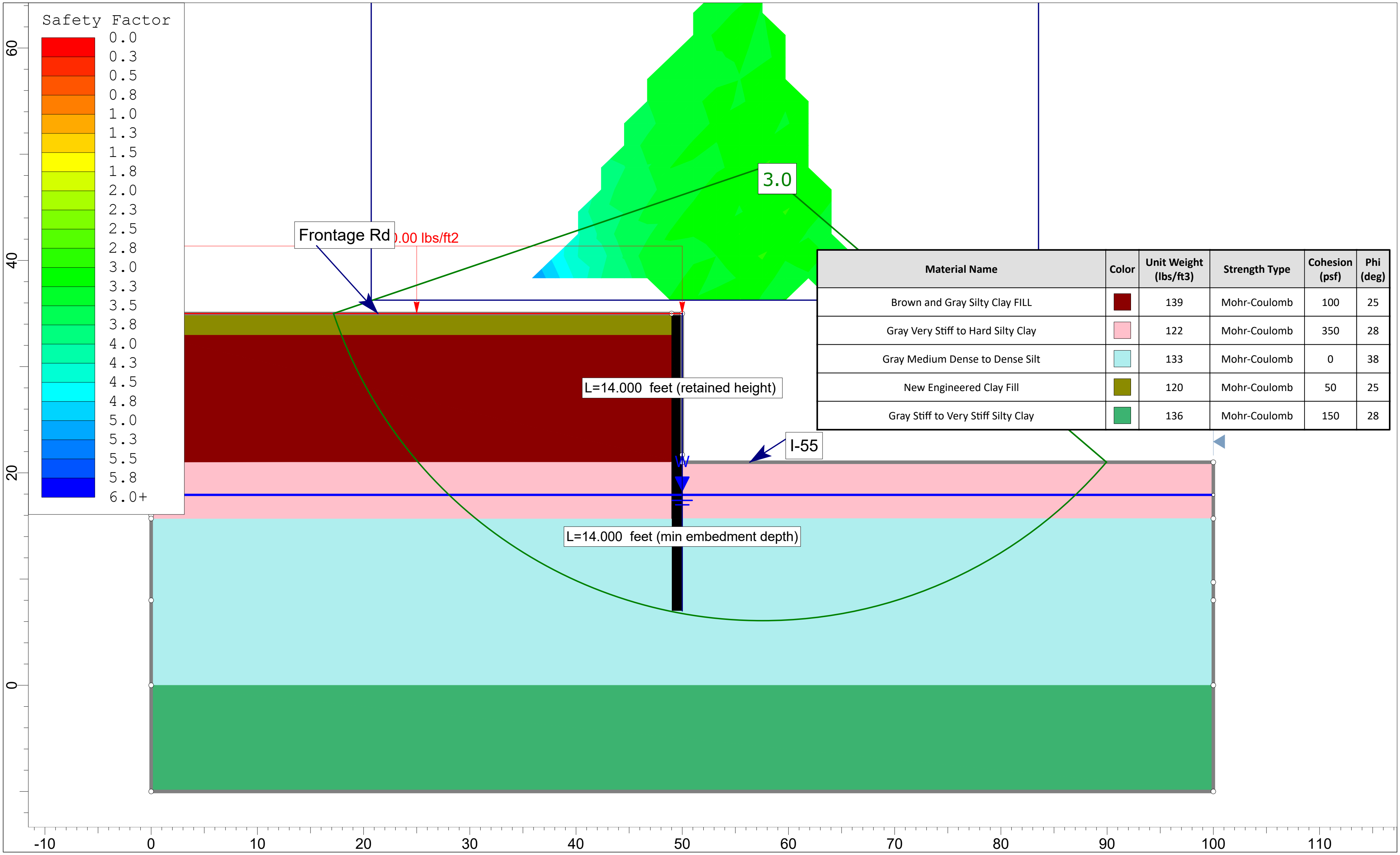
Project	Contract IDOT\189-011 Wall #4		
Analysis Description	Exhibit 4a: Circular Failure Short Term - Undrained		
Drawn By SI	*Scale* 1:150	*Company*	GSG Consultants, Inc.
Date 04/27/2020		*File Name*	325+00 Short Term



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Brown and Gray Silty Clay FILL		139	Mohr-Coulomb	100	25
Gray Very Stiff to Hard Silty Clay		122	Mohr-Coulomb	350	28
Gray Medium Dense to Dense Silt		133	Mohr-Coulomb	0	38
New Engineered Clay Fill		120	Mohr-Coulomb	50	25
Gray Stiff to Very Stiff Silty Clay		136	Mohr-Coulomb	150	28

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SLIDEINTERPRET 8.021

Project	Contract IDOT\189-011 Wall #4
Analysis Description	Exhibit 4b: Circular Failure Long Term - Drained
Drawn By	SI
Scale	1:150
Company	GSG Consultants, Inc.
Date	04/27/2020
File Name	325+00 Long Term

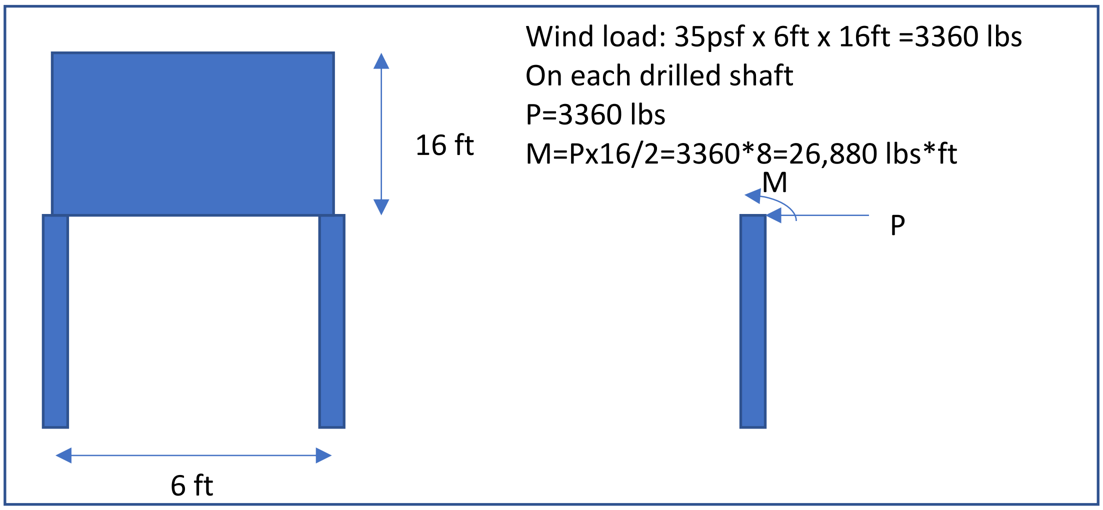
APPENDIX F

CALCULATION OF LOAD FROM DRILLED SHAFTS TO SOLIDER PILE WALL

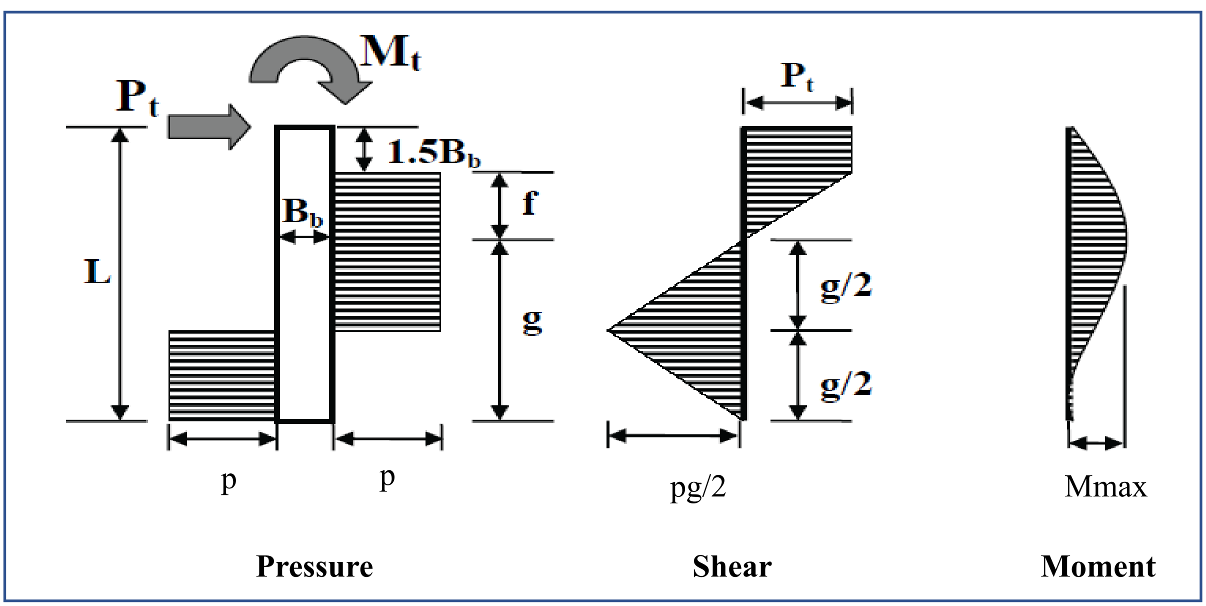
Broms Method for Additional Load from Drilled Shafts to Solider Pile Wall

According to FHWA Drilled Shafts construction Procedures and LRFD Design Methods section 12.3.4.1, Broms method can be used for simple analysis of relatively short, stiff drilled shafts subject to lateral shear and overturning moments. To perform this analysis, a simple soil passive pressure diagram along the shaft length is assumed and a limit equilibrium solution can be obtained through derivation of equations of static equilibrium of shear and moment in shaft. This method is suitable for simple applications in which shear and overturning are applied at the top of a shaft which is free to rotate. Regarding the load transfer from the drilled shafts to the Solider pile wall, strain wedge theory was used to develop the additional pressure on the wall from the drilled shaft' s load calculated using Broms method.

1. **Load information**



2. **Static equilibrium**
   P in the following graph is the passive soil pressure around the drilled shaft.



Limit equilibrium equations:

(1) $P_t = pf$
(2) $M_{max} = M_t + P_t(f + 1.5B_b) - (\frac{pf^2}{2})$
(3) $M_{max} = pg^2/4$
(4) $L = 1.5B_b + f + g$

In these equations,

Pt= 3360 /0.4 =8,400 lbs

Mt= 26,880 / 0.4 = 67,200 ft-lbs

Bb = 2 ft (drilled shaft diameter)

L = 12 ft (length of drilled shaft)

According to FHWA, a resistance factor of 0.4 is recommended for analysis of strength limit state of a drilled shaft using Broms method.

We have total four unknowns p, f, g and M_{max} and four equations. Solving these four equations, we can get the following values:

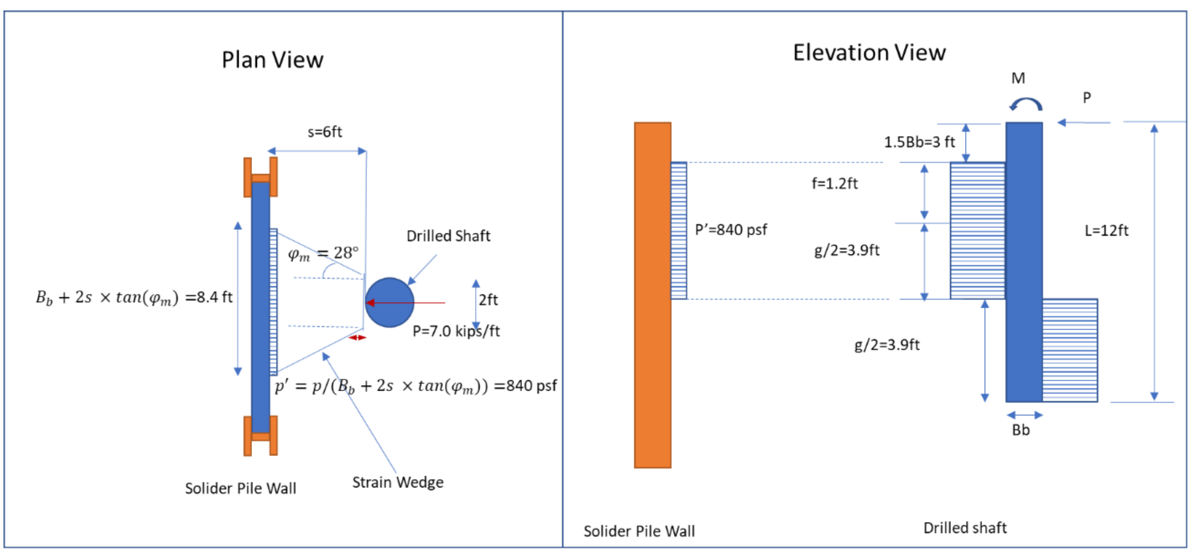
P= 7.0 kips/ft

f= 1.2 ft

g = 7.8 ft

3. Equivalent pressure on solider pile wall

When the drilled shaft is subjected to a lateral loading, there will be a strain wedge formed in front of the shaft between the shaft and the wall. Based on the horizontal force equilibrium for the strain wedge without considering the side resistance, the distribution of pressure acting on the wall is as shown below.



This exhibit shows the most critical condition. When the load on top of the drilled shafts changes directions, the additional pressure will act to a deeper depth on the wall, which is less critical than the condition shown above.