Structural Geotechnical Report

Retaining Wall Structure No. 099-0907
F.A.P Route: 856
Section: (99-1HB-1) R-1
Sta. 3105+56 to 3106+88
I-55 Northbound
Will County, Illinois

Prepared for

Illinois Department of Transportation

Job Number: D 91-009-14
Contract Number: PTB 169-017
Design Section Engineer Team:
Knight E/A, Inc.

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July 23, 2015
Revised: February 29, 2016

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February 29, 2016

Mr. John Murillo, PE
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Structural Geotechnical Report – Retaining Wall
Proposed Structure Number: 099-0907
I-55 Northbound
Sta. 3105+56 to 3106+88
County: Will
Job Number: PTB 169-017

Dear Mr. Murillo:

Attached is a copy of the Structural Geotechnical Report for the above referenced project. The report provides a brief description of the site investigation, site conditions and foundation recommendations. The site investigation included advancing two (2) soil borings to depths of 25 feet.

Should you have any questions or require additional information, please call us at 312-733-6262.

Sincerely,

Kalyan Chandhuri, P.E.
Senior Engineer

LICENSED PROFESSIONAL ENGINEER
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License Expires: 11-30-2016

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

Structural Geotechnical Report
Proposed Structure Number: 099-0907
I-55 Northbound
Sta. 3105+56 to 3106+88

Will County, Illinois
Contract Number: PTB 169-017

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1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the construction of two new retaining walls at Weber Road along I-55 Northbound in Bolingbrook in Will County, Illinois. The purpose of the investigation was to explore the subsurface conditions, to determine engineering properties of the subsurface soil, and develop design and construction recommendations for the project.

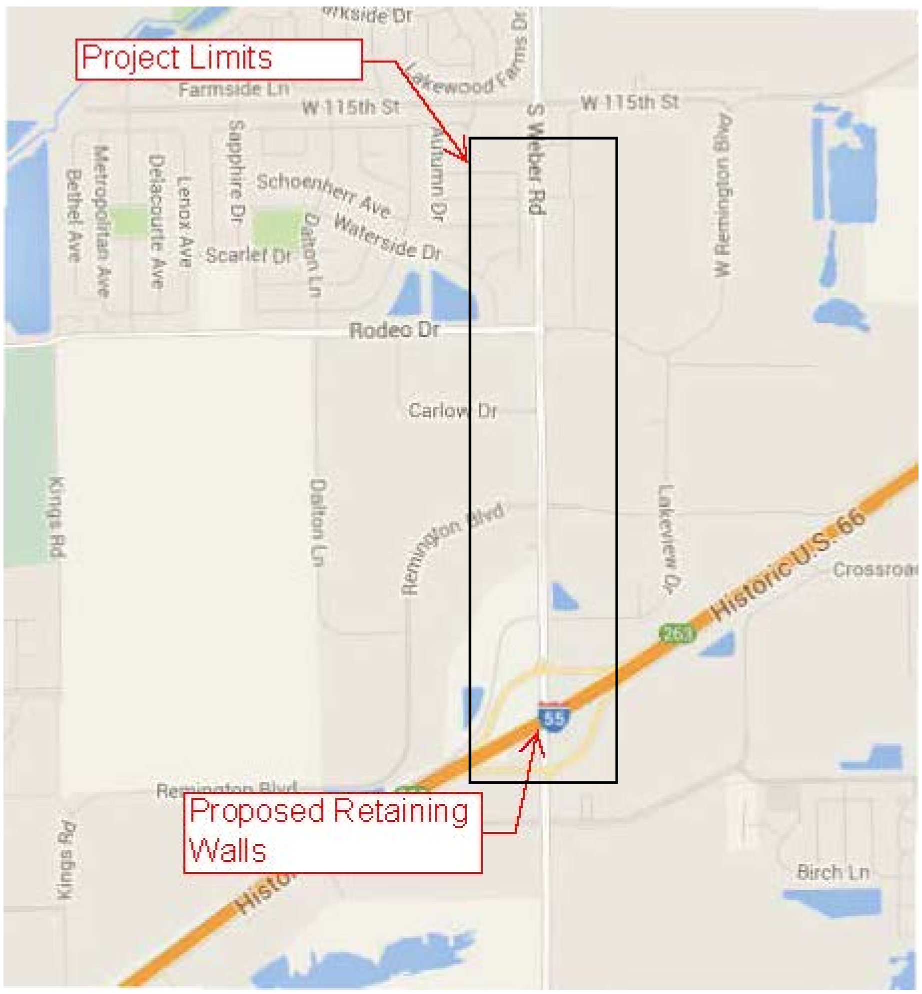


Figure 1: Project Location Map

1.1 Site Conditions

I-55 runs northeast-southwest and crosses under Weber Road between a residential area to the south and open undeveloped land to the north. Two retaining walls are proposed near I-55 northbound along the existing abutment of Weber Road.

Figure 2: A view to the east-Proposed retaining wall locations on I-55 northbound and Weber Rd abutment

1.2 Proposed Retaining Wall Information

The overall project will include provisions for a future widening of I-55 northbound to include an additional traffic lane and a shoulder, which will require re-grading of the existing slopes. Two retaining walls will be constructed; the first wall will be constructed along the face of the existing abutment below Weber Road, and the second wall will be constructed along the side slope of the abutment. GSG understands that Knight/IDOT determined that these walls will be solider pile and lagging walls. Table 1 presents a summary of the proposed retaining wall information at this location.

Table 1 –Retaining Walls information

Structure Designation	Wall Location	Wall Type	Approximate Length (ft)	Maximum Exposed Wall Height (ft)
099-0907	Sta. 10+09.00 to Sta. 11+20.00	Soldier Pile	111	8.25
099-0907	Sta. 11+21.75 to Sta. 11+75.25	Soldier Pile	46	9.6

1.3 Regional Geology

GSG reviewed several published documents in an effort to determine the regional geological setting in the area of the site. The subject area is located in the northwest portion of Will County, Illinois. The surficial geologic deposits in this area are typically glacial drift deposited during the Wisconsin Glacial Age. This project is located geographically in the Wheaton Moraine, part of the Valparaiso Morainic System in the Wadsworth of the Wedron Formation. This moraine is primarily silty, sandy, or gravelly till with local areas of silty clayey till, many lenses of poorly sorted gravel, and abundant small kames. This formation overlies the Silurian Joliet Dolomite Bedrock Formation with limestone at approximately 28 feet to 75 feet below ground surface in the subject area.

2.0 SITE SUBSURFACE EXPLORATION PROGRAM

This section describes the subsurface exploration program and laboratory testing program completed as part of this project.

2.1 Subsurface Exploration Program

The proposed locations of the soil borings were provided by Knight, and were completed in the field based on field conditions and accessibility. The proposed depths of the soil borings were determined by GSG in accordance with the IDOT procedures and requirements. Based on the length of the final retaining wall configuration, a total of two (2) soil borings were required.

The site subsurface exploration was conducted on February 5, 2015 and included advancing a total of two (2) standard penetration test (SPT) borings to depths of 25 feet each. The locations of the soil borings are shown on the **Appendix A - Boring Location Diagram and Subsurface Profile**.

The soil borings were drilled using a D-50 all-terrain mounted drill rig using 3¼-inch I.D. hollow stem augers. 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. 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 were collected from each sample interval, and were placed in jars and 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 D 4318 / AASHTO T-89 / AASHTO T-90
- Organic Matter Content AASHTO T-194

The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (1999), 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 Conditions

This section provides a brief description of the soils encountered in the borings performed. 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 and are shown graphically in the subsurface profile.

The soil boring logs provide specific conditions encountered at each boring location. The soil boring logs include soil descriptions, stratifications, penetration resistance, elevations, location of the samples, and laboratory test data. Unless otherwise noted, soil descriptions indicated on boring logs are visual identifications. 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.

2.3.1 Soil Conditions

Borings RW-05 and RW-06 were completed in the shoulder of I-55 and noted 6 inches of asphalt and 12 inches of granular base material at the surface. Below the pavement section, the borings noted very stiff black and gray clay soils to a depth of 7 feet below grade (elevation 643 ft). Underlying this layer were very stiff to hard brown and gray silty clay soils to depths of 15 feet below grade (elevation 635 ft). Following this, the borings encountered stiff to hard gray silty clay soils to depths of 25 feet below existing grade (elevation 625 ft).

Generally, the native clay soils had unconfined compressive strength results ranging from 1.7 tsf to 4.6 tsf.

2.3.2 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. Groundwater was only encountered in boring RW-06 while drilling at a depth of 7 feet below grade (643 ft).

Based on the color change from brown to gray, it is anticipated that the long term groundwater level is near elevation 635 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 walls based on the results of the initial field exploration, laboratory testing, and geotechnical analysis. Subsurface conditions in unexplored locations may vary from those encountered at the boring locations.

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 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 efficiency of the automatic hammer used for this exploration was estimated to be approximately 80% based on previous efficiency testing of the drill rigs equipped with such equipment. The correction for hammer efficiency is a direct ratio of relative efficiencies as follows:

$$N_{60} = N * (80/60)$$

*Where the N value is the field recorded blow counts.

Table 2 presents the generalized soil parameters to be used for design:

Table 2 – Recommended Soil Parameters

Elevation (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (Degrees)	Cohesion c (psf)	Friction Angle ϕ (Degrees)
	New Engineered Granular Fill	120	n/a	30	n/a	30
	New Engineered Clay Fill	120	1000	0	50	26
671' to 648'	Existing Clay Fill	130	1000	0	0	30
648' to 643'	Black/Gray Stiff to Very Stiff Clay	130	1000	0	0	30
643' to 635'	Brown/Gray Stiff to Hard Silty Clay					
Below 635'	Gray Stiff to Very Stiff Silty Clay					

3.2 Seismic Parameters

The seismic hazard for the site was analyzed per the IDOT Geotechnical Manual, IDOT Bridge Design Manual, and AASHTO LRFD Bridge Design Specifications.

The Seismic Soil Site Class was determined per the requirements of All Geotechnical Manual Users (AGMU) Memo 9.1, Design Guide for Seismic Site Class Determination, and the "Seismic Site Class Determination" Excel spreadsheet provided by IDOT. A global Site Class Definition was determined for this project, and was found to be Soil Site Class D. The Seismic Performance Zone (SPZ) was determined using Figure 2.3.10-2 in the IDOT Bridge Manual, and was found to be Seismic Performance Zone 1.

The AASHTO Seismic Design Parameters program was used to determine the peak ground acceleration coefficient (PGA), and the short (S_{DS}) and long (S_{D1}) period design spectral acceleration coefficients. The S_{DS} was determined to be 0.165g and the S_{D1} was determined to be 0.093g.

Based on the information provided in the IDOT Bridge Manual Section 2.3.10 and in the TS&L plans provided by the client, seismic evaluation is not required for the retaining walls being proposed for this project

4.0 GEOTECHNICAL RECOMMENDATIONS

This section provides recommendation regarding design parameters for the proposed retaining walls. The recommendations were developed based on the project information provided by Knight and the results of the site investigation. 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. The foundation design recommendations were completed per the AASHTO LRFD 7th Edition (2014).

4.1 Retaining Wall Design Analysis

GSG understands that Knight/IDOT has selected using soldier pile with lagging wall along the abutment face, and along the west slope of the abutment. Both the walls will be constructed in cut areas.

GSG evaluated global stability for the proposed walls to determine the suitability of the proposed construction.

4.1.1 Embankment Settlement

Construction of the soldier pile wall along the abutment face would include removal of the existing concrete wall in front of the bridge abutment. It is not anticipated that the existing grades behind the face of the wall will be changed; therefore, any settlement due to these activities is considered negligible.

The proposed soldier pile wing wall that is to be installed in the existing side slope will not require any additional embankment fill materials and will include a minimal riprap cover for erosion control at the top of the wall. The anticipated settlement in these areas is also considered to be negligible.

4.1.2 Slope Stability Analyses

The wall contractor should confirm stability requirements based on the final wall configurations. The soil parameters listed in Table 2 were used in the stability evaluations of each of the walls. The anticipated wall heights used in the slope stability model are provided below in Table 3:

Table 3– Wall Descriptions

Station Range	Wall Type	Remarks
Sta. 10+09.00 to Sta. 11+20.00	Maximum exposed height of soldier pile wall	8.25 feet*
	Estimated total height of soldier pile retaining wall (including minimum embedment)	13 feet
Sta. 11+21.75 to Sta. 11+75.25	Maximum exposed height of soldier pile wall	9.6 feet*
	Estimated total height of soldier pile retaining wall (including minimum embedment)	24 feet

*Based on design information provided by Knight

Slide 6.0, which is a comprehensive slope stability analysis software that performs finite element analysis, was used to evaluate the proposed retaining walls geometries for the project. The proposed designs were analyzed based on the proposed grading and the soils encountered while drilling. Plans of the proposed retaining walls can be found in **Appendix B**, **Retaining Wall General Plan**. Based on the geometry of each of the walls, and the soil borings, global stability analyses were performed for both circular and block failure analysis using the simplified Bishop method.

Circular and block failure analyses were evaluated using simplified Bishop method for a short term (undrained) condition and long term (drained) condition for each of the proposed retaining wall geometry. The analysis for the soldier pile wall was performed at Station 10+64.00; the analysis for the soldier pile wing wall was performed at Station 11+75.00. Table 4 provides a summary of the stability analyses results at both wall locations.

Table 4– Stability Analyses Results

Analysis Exhibit	Wall Type and Station	Failure Type	Factor of Safety	Required Minimum Factor of Safety
Exhibit 1	Soldier pile wall at 10+64.00	Circular – Short Term	2.1	1.5
Exhibit 2		Circular – Long Term	2.1	1.5
Exhibit 3		Block (Sliding) – Short Term	1.9	1.5
Exhibit 4		Block (Sliding) – Long Term	1.6	1.5
Exhibit 5	Soldier pile wing wall at 11+75.00	Circular – Short Term	2.2	1.5
Exhibit 6		Circular – Long Term	1.9	1.5
Exhibit 7		Block (Sliding) – Short Term	1.8	1.5
Exhibit 8		Block (Sliding) – Long Term	1.6	1.5

Based on the soil parameters in Table 2 and anticipated wall embedment depths in Table 3, the proposed retaining walls meet the minimum factor of safety of 1.5. **Appendix E** includes copies of each the slope stability analyses.

4.2 Soldier Pile Wall Design Recommendations

Soldier pile and lagging walls are generally constructed at 6 to 8 foot centers along the retaining wall alignment into the bearing stratum. The soldier piles could be either driven or installed in pre-drilled holes. The lagging should be designed to resist 100% of the earth pressure based on structural analysis. Solider pile and lagging could be should be designed and constructed in accordance with the IDOT Guide Bridge Special Provisions (GBSP) No. 42, Drilled Soldier Pile Retaining Wall. Due to the low headroom, combined with the vibration that may affect both the axial and lateral capacity of the existing abutment piles, driven soldier piles do not appear to be a feasible option.

Resistance to lateral movement or overturning of the soldier piles is furnished by passive resistance of the soil below the depth of excavation. The passive pressure between piles should act over an effective width equal to twice the width of the soldier piles for the stiff cohesive soils noted at the site. The total width of the soldier pile should be taken as the diameter of the borings drilled and backfilled with concrete.

The soil parameters, derived based on the soil conditions encountered in the borings and shown in Table 2, should be used in the design of the wall. The simplified earth pressure distributions shown in Section 3.11.5.6 of the AASHTO Standard Specifications for Highway Bridges should be used. Since the proposed soldier pile wall will be installed within the existing embankment, GSG anticipates that no drainage will be provided behind the wall and therefore the hydrostatic pressure should also be considered in short term design of the wall. The top 3.5 feet of soil in front of the wall should not be considered for passive pressures due to the soil disturbance during installation of concrete facing, drainage system and frost-heave condition. Construction equipment surcharge loads should be added to the lateral earth pressure.

Section 11, which outlines geotechnical criteria for retaining walls, of the AASHTO Specifications requires the evaluation of overturning at the strength limit state and excessive vertical displacement, excessive lateral displacement, and overall stability at the service limit state. Table 5 outlines the load factors used in evaluation of the retaining wall in accordance with AASHTO Tables 3.4.1-1 and 3.4.1-2.

Table 5 - LRFD Load Factors for Retaining Wall Analyses

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

4.3 Lateral Earth Pressures and Loading

The walls shall be designed to withstand the lateral pressures from earth and live loads. 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 flexible and such the earth loads may be calculated using active earth pressure for load above the design grade in front of the wall and both active and passive earth pressures below this grade elevation. The at-rest earth pressure coefficient (Ko), active earth pressure coefficient (Ka), and the passive earth pressure coefficient (Kp) were determined in accordance with AASHTO Sections 3.11.5.2 through 3.11.5.4, respectively.

Table 6 presents the recommended lateral earth pressures soil parameters to be used for the proposed wall design based on the inclination of the backfill behind the wall and the anticipated soil types at this site. Table 6 also provides the lateral soil modulus and soil strain parameters that could be used for laterally loaded pile analysis via the p-y curve method.

Table 6 – Lateral Earth Pressure Soil Parameters

<table>
<tr><th>Elevation from/to (feet)</th><th>Soil Type</th><th>In-situ Moist Unit Weight (pcf) (γ)</th><th>Angle of Internal Friction (ϕ)</th><th>Active Earth Pressure Coefficient (Ka)</th><th>Passive Earth Pressure Coefficient (Kp)</th><th>Soil Modulus K (pci)</th><th>Soil Strain Parameter E50</th></tr>
<tr><td></td><td>New Engineered Granular Fill</td><td>120</td><td>30</td><td>0.50</td><td>3.00</td><td>100</td><td>N/A</td></tr>
<tr><td></td><td>New Engineered Clay Fill</td><td>120</td><td>26</td><td>0.54</td><td>2.56</td><td>500</td><td>0.007</td></tr>
<tr><td>671’ to 648’</td><td>Existing Clay Fill</td><td>130</td><td>30</td><td>0.50</td><td>3.00</td><td>500</td><td>0.007</td></tr>
<tr><td>648’ to 643’</td><td>Black/Gray Stiff to Very Stiff Clay</td><td rowspan="3">130</td><td rowspan="3">30</td><td rowspan="3">0.50</td><td rowspan="3">3.00</td><td rowspan="3">500</td><td rowspan="3">0.007</td></tr>
<tr><td>643’ to 635’</td><td>Brown/Gray Stiff to Hard Silty Clay</td></tr>
<tr><td>Below 635’</td><td>Gray Stiff to Very Stiff Silty Clay</td></tr>
</table>

Traffic and other surcharge loads should be included in the retaining wall design. 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 Article 3.11.6.4 of AASHTO LRFD Bridge Design Specifications. The live load surcharge may be estimated as a uniform horizontal earth pressure due to an equivalent height (Heq) of soil. Table 7 provides the equivalent heights of soils for vehicular loadings on retaining walls.

Table 7 - Equivalent Height of Soil for Vehicular Loading on Retaining Walls Parallel to Traffic (Table 3.11.6.4-2)

Retaining Wall Height (ft)	H_{eq} Distance from Wall Back face to Edge of Traffic	
	0 feet	1.0 feet or Further
5	5.0 feet	2.0 feet
10	3.5 feet	2.0 feet
≥20	2.0 feet	2.0 feet

GSG recommends designing the soldier pile wall retaining wall using the drained condition. This could be accomplished by placing a Geo-composite wall drain over the entire length of the front face of the wall, in between the untreated timber lagging and concrete wall facing, connected to 6-inch diameter perforated underdrain pipe, and backfilling with free drainage materials behind the timber lagging the entire width of the soldier pile to allow for drainage. Free draining materials should consist of open grade stone such as crushed aggregate meeting IDOT CA-7 gradation requirements. The backfill should be placed in accordance with the IDOT SSRBC. Heavy compaction equipment should not be allowed closer than five (5) feet to the retaining wall to prevent inducing high lateral earth pressures and causing wall yielding and/or other damage.

If drainage is not provided as recommended, hydrostatic pressure should be included in the design and the horizontal earth pressure should be determined in accordance with article 3.11.3, 3.11.5.1, and 3.11.5.3. The top 3.5 feet of soil in front of the wall should not be considered for passive pressures due to the soil disturbance during installation of concrete facing, drainage system and frost-heave condition. Construction equipment surcharge loads should be added to the lateral earth pressure.

5.0 CONSTRUCTION CONSIDERATIONS

All work performed for the proposed project should conform to the requirements in the IDOT SSRBC (2012) and Guide Bridge Special Provisions (GBSP) No 42. Any deviation from the requirements in the manuals above should be approved by the design engineer.

5.1 Site Preparation

GSG understands that prior to any construction activity for the proposed retaining walls, all live loads are to be eliminated from the existing bridge and the dead loads are to be minimized by removal of the existing bridge deck.

During the wing wall construction, all vegetation and surface topsoil should be cleared and removed from the vicinity of the proposed wall area. For the wall construction in front of the abutment, the existing concrete slope wall and the existing fill in front of the wall should be completely removed to match the proposed finish grade in front the of the wall. Extreme care should be taken as to not affect, impact or expose the existing piles for the abutment. After the clearing activities, all areas intended to support either new wall elements or new engineered fill should be carefully evaluated by a geotechnical engineer. The subgrade for the fill areas will require proof-rolling with a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proof-rolling is to locate soft, weak, or excessively wet soils present at the time of construction. Proof-rolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. Any unsuitable materials observed during the evaluation and proof-rolling operations should be undercut and replaced with compacted structural fill and/or stabilized in-place. The possible need for, and extent of, undercutting and/or in-place stabilization required can best be determined by the geotechnical engineer at the time of construction. Once the site has been properly prepared, at grade construction may proceed.

5.2 Existing Utilities

Before proceeding with construction, any existing underground utility lines that will interfere with construction should be completely rerouted or removed from beneath the proposed construction areas. GSG understands there is an existing storm sewer utility line that is to be abandoned in place below Weber Road and will be plugged with cement grout. Any excavations resulting from underground utilities 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 Excavations

The contractor will be responsible to provide a safe excavation during the construction activities. 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 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 for all excavation activities.

5.4 Borrow Material and Compaction Requirements

If borrow material is to be used for onsite construction, it should conform to Section 204 "Borrow and Furnish Excavations" of the IDOT SSRBC. The fill material should be free of organic matter and debris, and should be placed and compacted in accordance with Section 205, Embankment, of the IDOT SSRBC. Earth-moving operations should be avoided during excessively cold or wet weather to avoid freezing of softening subgrade soils.

Suitable structural fill materials shall be of a nature that will compact and develop stability satisfactory to the geotechnical engineer. Structural fill shall consist of CLSM or crushed limestone or recycled concrete consistent with IDOT CA-6 gradation or medium plasticity silty clays. Suitable structural fill should have the following soil properties:

Table 8 – Structural Fill Soil Properties

REQUIRED TEST	AASHTO METHOD	PERMISSIBLE LIMIT
Standard Dry Density (SDD)	T 99 (Method C)	90 pcf min.*
Organic Content	T 194	10 % max.*
Percent Silt and Fine Sand	T 88	65 % max. **
Plasticity Index	T 90	12 % min. **
Liquid Limit	T 89	50 % max.
Shear Strength (c) at 95 %	T 208 or T 234	1,000 psf min.***

* As per IDOT Standard Specifications.

** Frost Susceptibility Criteria

If CLSM is to be used as structural fill, then it should conform to the requirements of Section 1019 of the IDOT SSRBC. All other structural fill should be placed in lifts not to exceed 8 inches in loose thickness, and compacted to a minimum of 95% of the material's standard proctor maximum dry density obtained according to the ASTM D698/AASHTO T 99 method.

Materials unsatisfactory for use as structural fill include soils classified as silt or organic silt (ML, MH, PT, OL, and OH) in the Unified Classification System (ASTM D2847). Soils with these classifications may be used for general purpose landscaping and in areas where uncontrolled settlement is acceptable.

Structural fill should not be placed upon wet or frozen subgrade soils. If the subgrade or structural fill becomes frozen, desiccated, wet, disturbed, softened, or loose, the affected materials should be scarified, dried and moisture conditioned, and compacted to the full depth of the affected area or the soils should be removed. . If water seepage occurs while excavating and backfilling procedures, or where wet conditions are encountered such that the water cannot be removed with conventional sump and pump procedures, GSG recommends placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation. The CA-7 stone should be placed to 12 inches above the water level, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation should be backfilled using approved engineered fill.

GSG recommends that subgrade preparation, and structural fill placement and compaction be inspected by a GSG geotechnical engineer to verify the type and strength of soil materials present at the site and their conformance with the geotechnical recommendations in this report.

5.5 Groundwater Management

It is anticipated that the long term water table is greater than 10 feet below the existing ground surface. GSG does not anticipate groundwater related issues during construction activity; however, water may become perched in the existing fill material encountered at 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. Grades should be sloped away from the excavations to minimize runoff from entering the areas.

6.0 LIMITATIONS

This report has been prepared for the exclusive use of the Illinois Department of Transportation and its structural 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 areas. The analyses 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

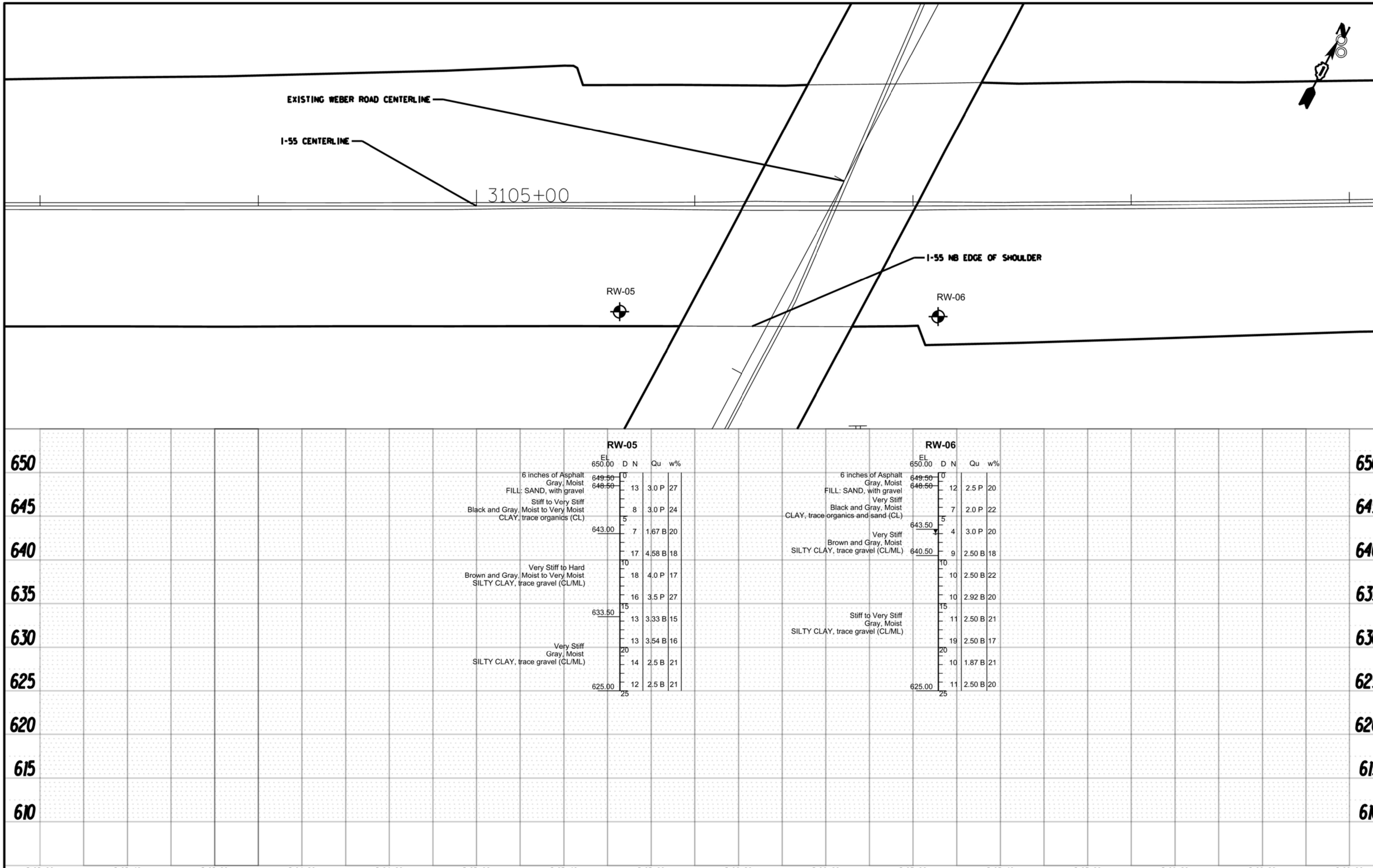
BORING LOCATION MAP & SUBSURFACE PROFILE

PLAN

NOTE BOOK	SURVEYED	BY	DATE
NO.	PLOTTED		
	ALIGNMENT CHECKED		
	R/T. OF WAY CHECKED		
	CADD FILE NAME		

PROFILE

NOTE BOOK	SURVEYED	BY	DATE
NO.	PLOTTED		
	GRADES CHECKED		
	B.M. NOTED		
	STRUCTURE NOTATIONS CHKD		



RW-05

EL	Description	D	N	Qu	w%
650.00		0			
649.50	6 inches of Asphalt				
648.50	Gray, Moist FILL: SAND, with gravel		13	3.0 P	27
	Stiff to Very Stiff Black and Gray, Moist to Very Moist CLAY, trace organics (CL)		8	3.0 P	24
		5			
643.00			7	1.67 B	20
			17	4.58 B	18
		10			
	Very Stiff to Hard Brown and Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)		18	4.0 P	17
			16	3.5 P	27
		15			
633.50			13	3.33 B	15
			13	3.54 B	16
		20			
	Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)		14	2.5 B	21
625.00			12	2.5 B	21
		25			

RW-06

EL	Description	D	N	Qu	w%
650.00		0			
649.50	6 inches of Asphalt				
648.50	Gray, Moist FILL: SAND, with gravel		12	2.5 P	20
	Very Stiff Black and Gray, Moist CLAY, trace organics and sand (CL)		7	2.0 P	22
		5			
643.50			4	3.0 P	20
640.50	Very Stiff Brown and Gray, Moist SILTY CLAY, trace gravel (CL/ML)		9	2.50 B	18
		10			
			10	2.50 B	22
			10	2.92 B	20
		15			
	Stiff to Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)		11	2.50 B	21
			19	2.50 B	17
		20			
			10	1.87 B	21
625.00			11	2.50 B	20
		25			

GSG CONSULTANTS, INC.
855 West Adams, Suite 200
Chicago, Illinois 60607
tel: 312.733.6262 • fax: 312.733.5612

USER NAME = $USER$	DESIGNED - NE	REVISED -	
	DRAWN - KNIGHT E/A	REVISED -	
PLOT SCALE = $SCALE$	CHECKED - KC	REVISED -	
PLOT DATE = $DATE$	DATE - 2/9/15	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

WEBER ROAD /I-55 REDESIGN
RET WALL SOIL BORING PLAN & PROFILE

SCALE: 20 | SHEET 1 OF 1 SHEETS | STA. 3103+00 TO STA. 3109+00

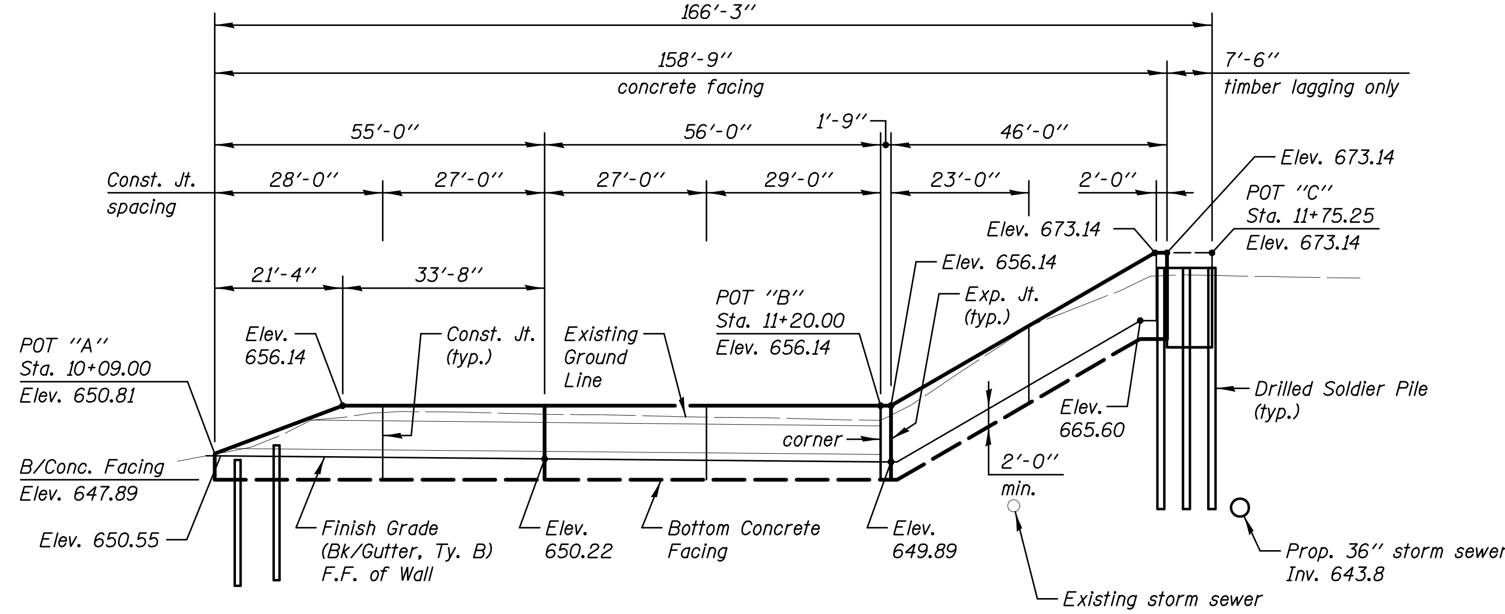
F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
FAI 55	WEBER ROAD FROM NORMANTOWN RD TO 135TH ST	WILL		
		CONTRACT NO. 60X10		
		ILLINOIS FED. AID PROJECT		

APPENDIX B

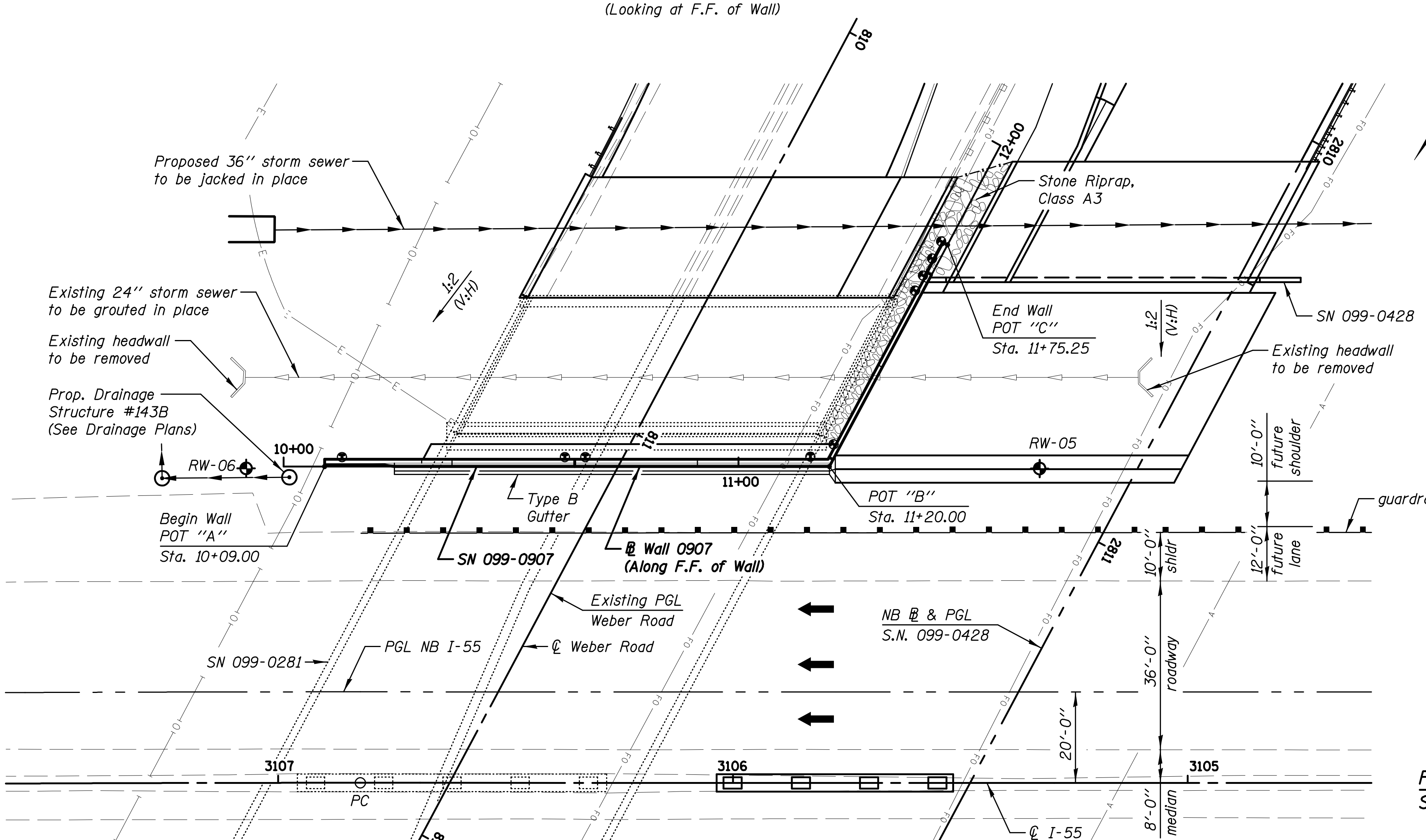
RETAINING WALL GENERAL PLAN

Bench Mark: BM Lin17 Chiseled "X" on south bolt of round light pole foundation between I-55 southbound and existing I-55 ramp to Weber Road
Mile marker 263.71 sign. Elev. 654.37

Existing Structure: None.



DEVELOPED ELEVATION
(Looking at F.F. of Wall)



PLAN

HIGHWAY CLASSIFICATION

F.A.P. Route 856 - Weber Road
Functional Class: Other Principal Arterial
ADT: 34,100 (2010); 52,000 (2040)
DHV: 5,200
ADTT: 8%
Design Speed: 35 mph
Posted Speed: 30 mph
Directional Distribution: 60:40

F.A.I. Route 55 - I-55
Functional Class: Interstate
ADT: 136,400 (2010); 146,000 (2040)
DHV: 8,040
ADTT: 12%
Design Speed: 70 mph
Posted Speed: 65 mph
Directional Distribution: 60:40

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 7th Edition with 2015 Interims

DESIGN STRESSES

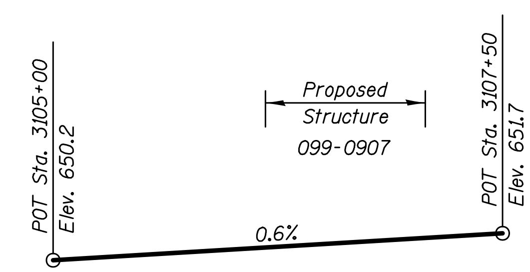
FIELD UNITS

f'_c = 3,500 psi
f_y = 60,000 psi (reinforcement)
f_y = 50,000 psi (AASHTO M270 Gr. 50)

CURVE DATA

℄ I-55
Curve I-55-2
Δ = 5° 33' 40" (LT)
D = 0° 21' 17"
R = 16,149.49'
T = 784.36'
L = 1,567.49'
E = 19.04'
SE = normal crown
PC STA. 3106+81.93
PT STA. 3122+49.42
PI STA. 3114+66.30

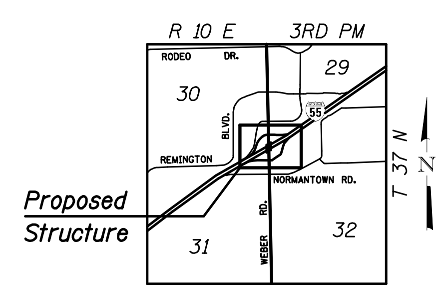
℄ Wall 0907
(Offsets from ℄ I-55 and ℄ Weber Road to F.F. of wall)
POT "A"
Sta. 10+09.00 - ℄ Wall 0907 =
Sta. 3106+89.77, 69.54' Rt. - ℄ I-55
Sta. 811+38.54, 56.97' Rt. - ℄ Weber Road
POT "B"
Sta. 11+20.00 - ℄ Wall 0907 =
Sta. 3105+78.81, 69.56' Rt. - ℄ I-55
Sta. 810+86.35, 41.0' Lt. - ℄ Weber Road
POT "C"
Sta. 11+75.25 - ℄ Wall 0907 =
Sta. 3105+52.84, 118.33' Rt. - ℄ I-55
Sta. 810+31.10, 41.0' Lt. - ℄ Weber Road



I-55 N.B. - EXISTING PROFILE GRADE LINE

Legend

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



LOCATION SKETCH

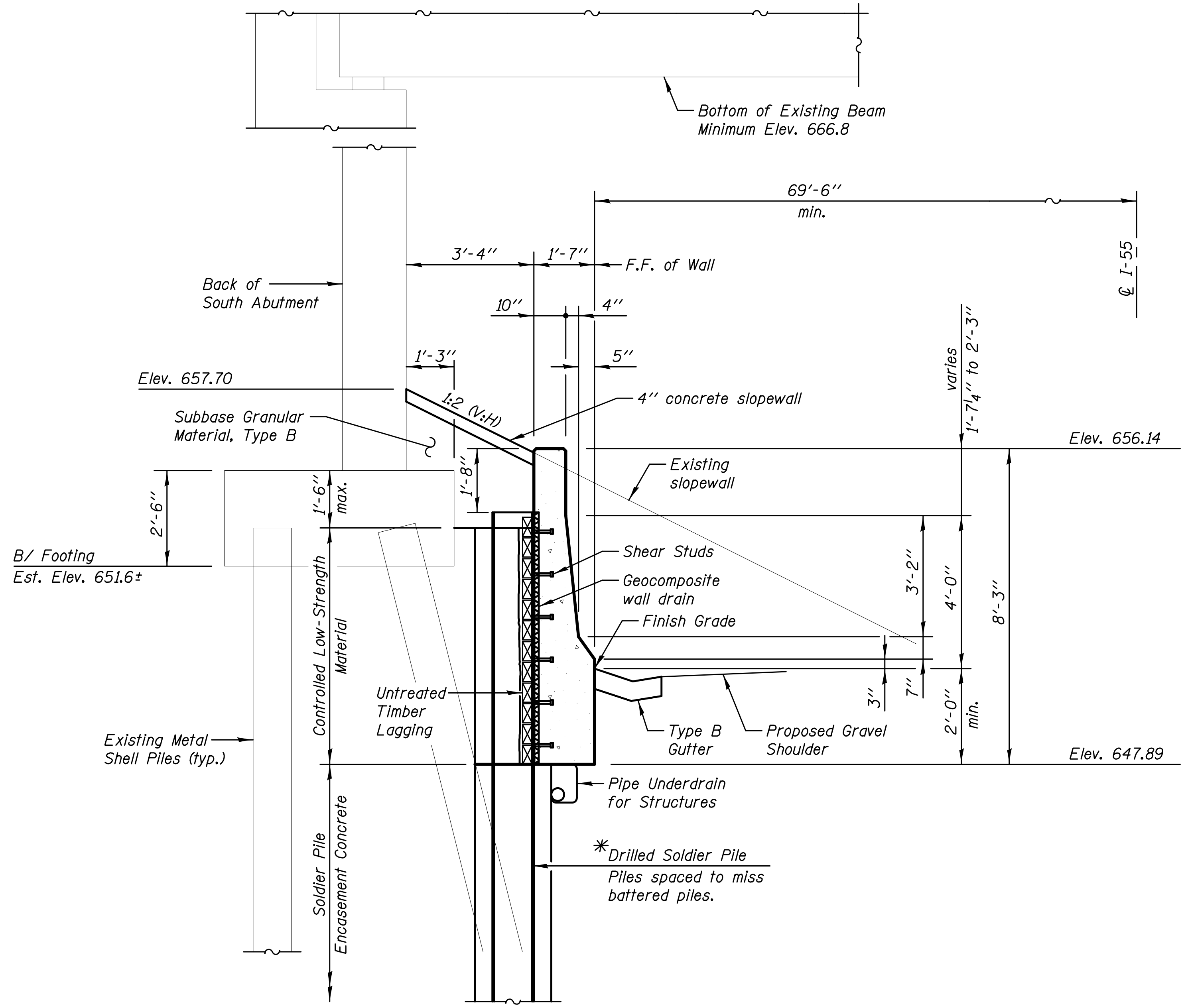
GENERAL PLAN & ELEVATION
WEBER ROAD
F.A.P. RTE. 856 SEC. (99-1HB-1) R-1
WILL COUNTY
STA. 3105+53 TO 3106+90
STRUCTURE NO. 099-0907

KNIGHT Engineers & Architects		DESIGNED - TB	REVISED	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
		CHECKED - WPM	REVISED	
	SCALE - NONE	DRAWN - TB	REVISED	
	DATE - 9/14/2015	CHECKED - WPM	REVISED	

SHEET NO. 1 OF 2 SHEETS

F.A.I./P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
*	(99-1HB-1) R-1	WILL		
		CONTRACT NO. 60X10		

* FAI 55, FAP 856 ILLINOIS FED. AID PROJECT

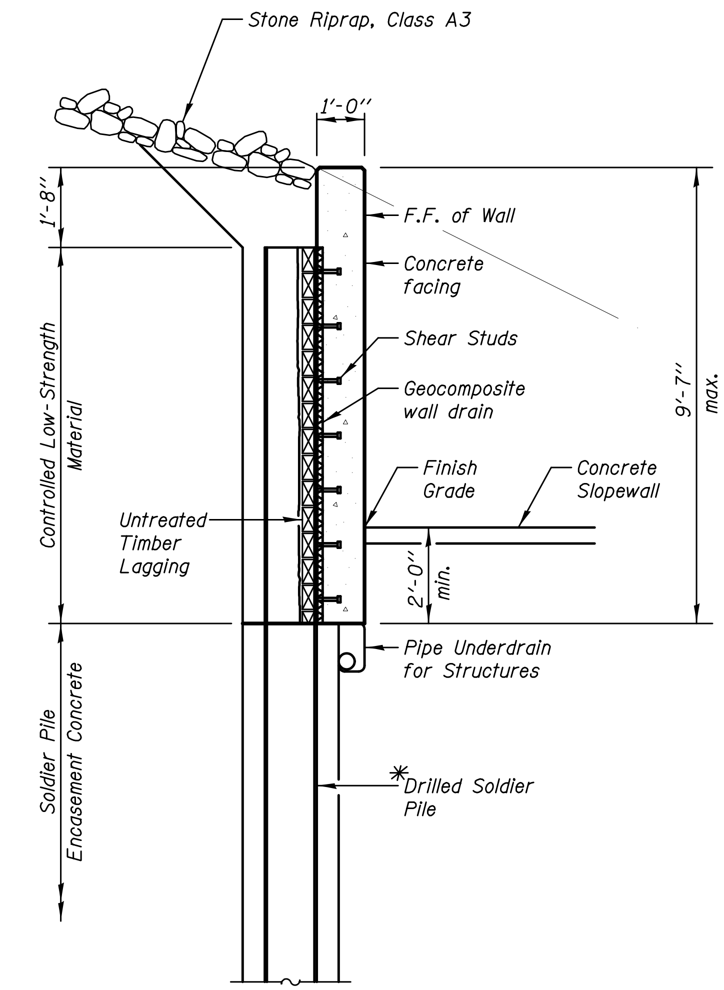


TYPICAL WALL SECTION

Parallel to I-55

(Horiz. dim @ Rt. ∟'s)

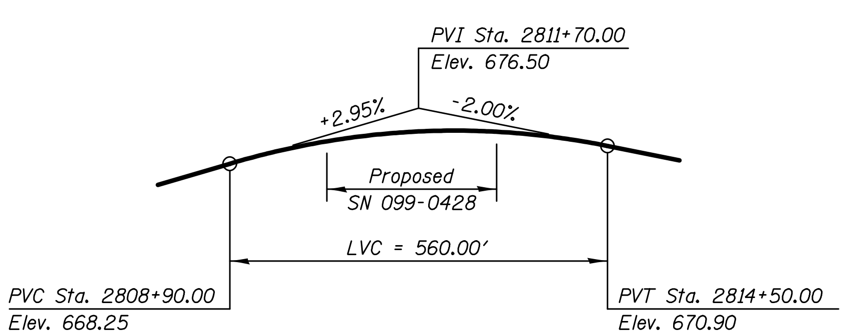
*Pile section, spacing, shaft diameter, and tip elevation to be determined during final design.



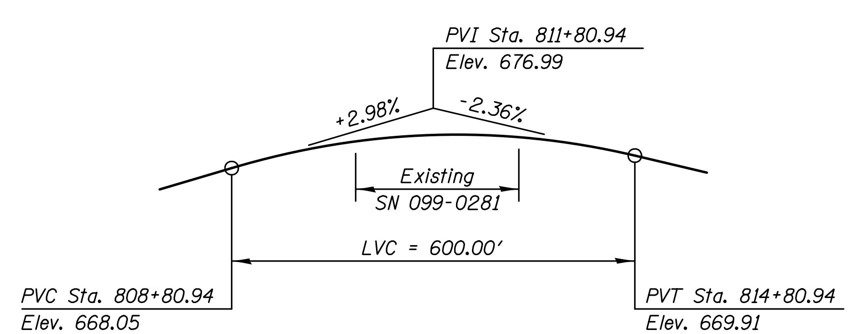
TYPICAL WALL SECTION

Parallel to Weber Road

(Horiz. dim @ Rt. ∟'s)



℄ NORTHBOUND WEBER ROAD - PROPOSED PROFILE GRADE LINE



℄ WEBER ROAD - EXISTING PROFILE GRADE LINE

Suggested Sequence of Construction

1. Remove existing slopewall
2. Excavate in front of existing abutment 1'-6" (max.) below top of footing. Estimated B/excavation Elev. 652.6±.
3. Auger holes for soldier pile wall under bridge.
4. Construct wall.

DETAILS
WEBER ROAD
F.A.P. RTE. 856 SEC. (99-1HB-1) R-1
WILL COUNTY
STA. 3105+53 TO 3106+90
STRUCTURE NO. 099-0907

KNIGHT Engineers & Architects		DESIGNED - TB	REVISED
		CHECKED - WPM	REVISED
	SCALE - NONE	DRAWN - TB	REVISED
	DATE - 9/14/2015	CHECKED - WPM	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 2 SHEETS

F.A.I/P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
*	(99-1HB-1) R-1	WILL		
		CONTRACT NO. 60X10		

* FAI 55, FAP 856 ILLINOIS FED. AID PROJECT

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation
Division of Highways
GSG Consultants

SOIL BORING LOG

Date 2/6/15

ROUTE Weber Road **DESCRIPTION** Proposed Weber Road & I-55 Improvements **LOGGED BY** JJR

SECTION Normantown Road to 135th Street/Romeo Road **LOCATION** Retaining Wall, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Will County **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-0907
Station NA

BORING NO. RW-05
Station 810+65
Offset 82.00ft LT
Ground Surface Elev. 650.00 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft

Groundwater Elev.:
First Encounter None ft
Upon Completion None ft
After NA **Hrs.** NA ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Asphalt	649.50				
Gray, Moist FILL: SAND, with gravel	648.50		13		
Stiff to Very Stiff Black and Gray, Moist to Very Moist CLAY, trace organics (CL)			5 8	3.0 P	27
			3 4 4	3.0 P	24
		-5			
	643.00		2 3 4	1.7 B	20
Very Stiff to Hard Brown and Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)			4 8 9	4.6 B	18
		-10			
			7 8 10	4.0 P	17
			7 8 8	3.5 P	27
		-15			
	633.50		3 6 7	3.3 B	15
Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)			3 5 8	3.5 B	16
		-20			
Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*			5 6 8	2.5 B	21
			3 5 7	2.5 B	21
	625.00	-25			
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

SOIL BORING LOG

Date 2/6/15

ROUTE Weber Road **DESCRIPTION** Proposed Weber Road & I-55 Improvements **LOGGED BY** JJR

SECTION Normantown Road to 135th Street/Romeo Road **LOCATION** Retaining Wall, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY Will County **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-0907
Station NA

BORING NO. RW-06
Station 811+47
Offset 72.00ft RT
Ground Surface Elev. 650.00 ft

Surface Water Elev. NA ft
Stream Bed Elev. NA ft

Groundwater Elev.:
First Encounter 643.0 ft ▼
Upon Completion None ft
After NA **Hrs.** NA ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Asphalt	649.50				
Gray, Moist FILL: SAND, with gravel	648.50		6		
Very Stiff Black and Gray, Moist CLAY, trace organics and sand (CL)			5 7	2.5 P	20
			5 3 4	2.0 P	22
		-5			
	643.50		2		
Very Stiff Brown and Gray, Moist SILTY CLAY, trace gravel (CL/ML)		▼	2 2	3.0 P	20
			4 4 5	2.5 B	18
		-10			
			4 4 6	2.5 B	22
			2 4 6	2.9 B	20
	635.00	-15			
Stiff to Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)			2 4 7	2.5 B	21
			6 9 10	2.5 B	17
		-20			
Stiff to Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*			3 4 6	1.9 B	21
			3 5 6	2.5 B	20
	625.00	-25			
End of Boring					
		-30			
		-35			
		-40			

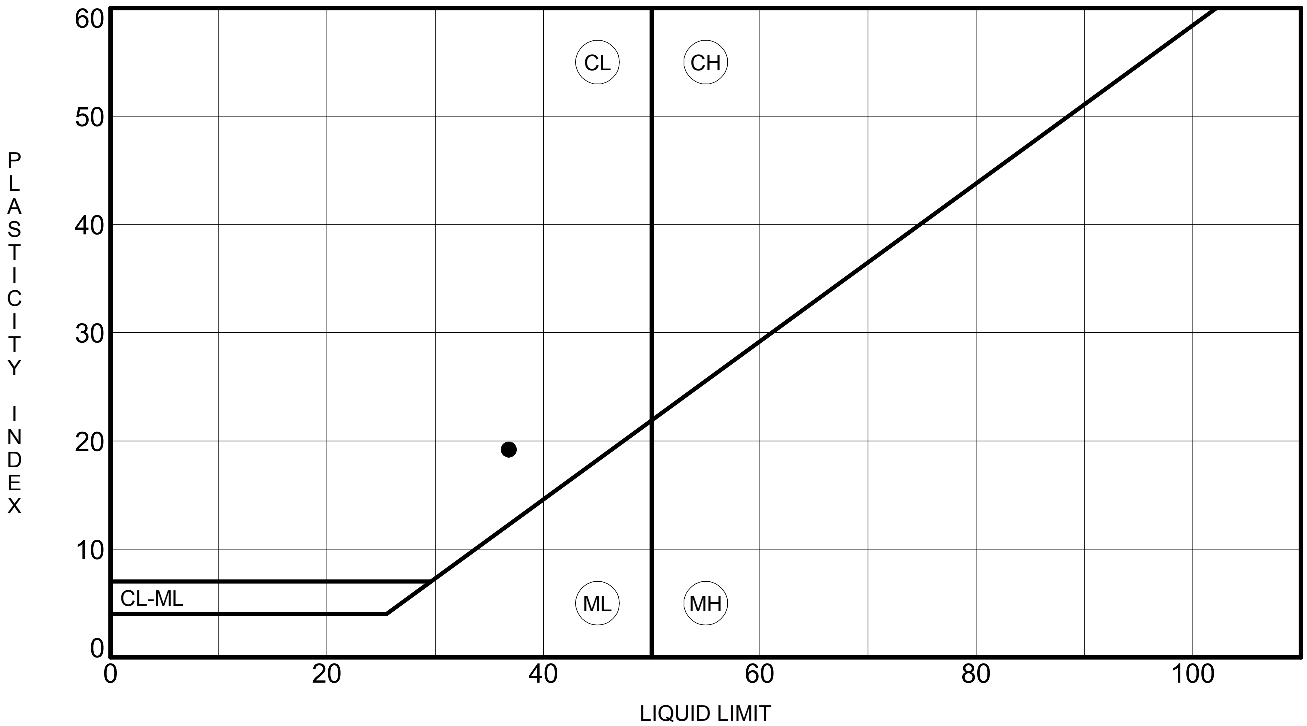
The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

APPENDIX D

LABORATORY TEST RESULTS TABLES

Organic Content Results				
Boring ID	Sample Number	Sample		Organic Content
		Top	Bottom	
RW-06	SS-3	6	7.5	1.4

Atterberg Limit Results						
Boring ID	Sample Number	Sample		Liquid Limit	Plastic Limit	Plasticity Index
		Top (ft.)	Bottom (ft.)			
RW-05	SS-3	6	7.5	36.8	17.6	19.2



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-05**	**6.00**	**36.8**	**17.6**	**19.2**		

ATTERBERG LIMITS' RESULTS

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

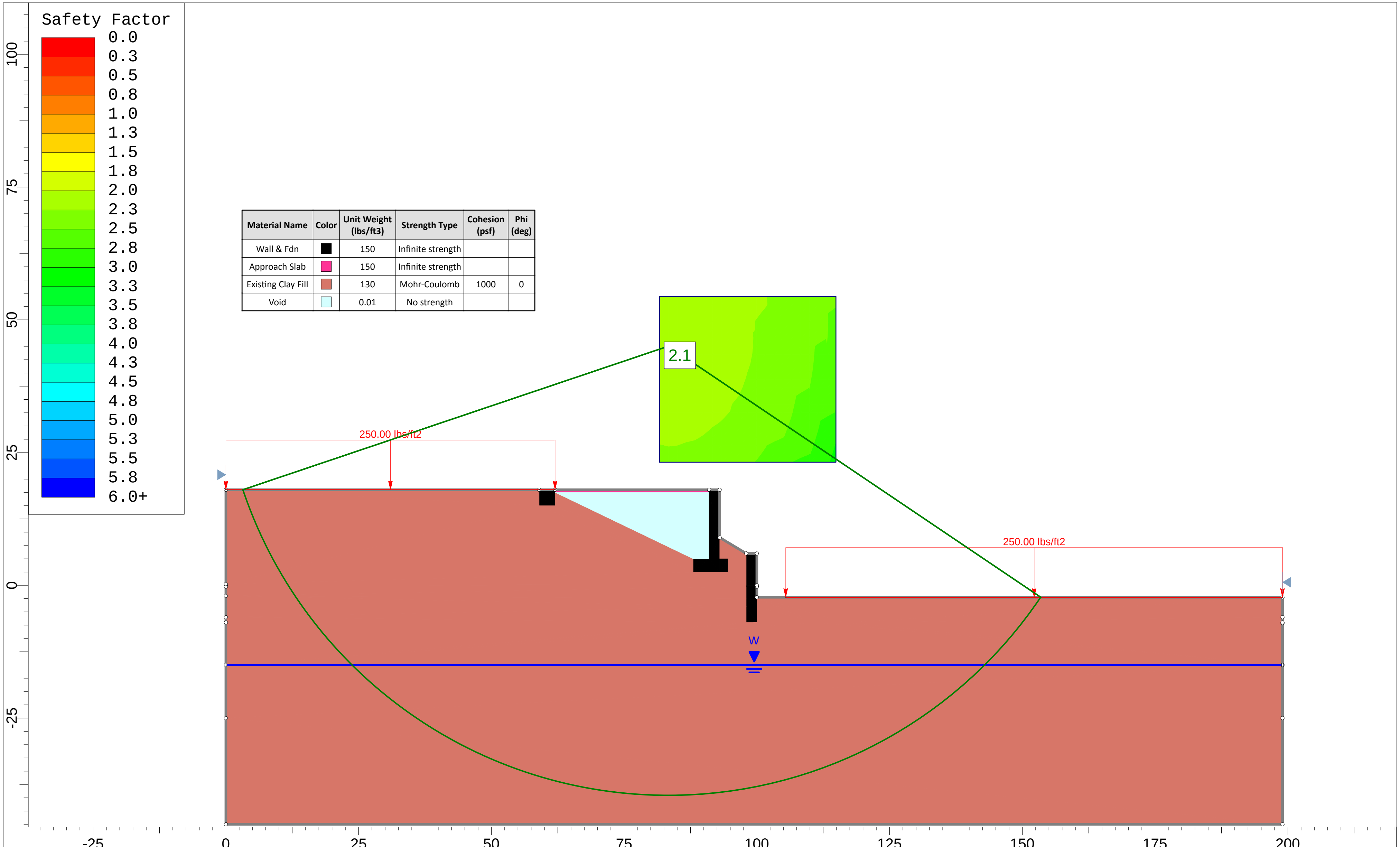
Route: Weber Road

Section: Normantown Road to 135th Street/Romeo Road

County: Will County

APPENDIX E

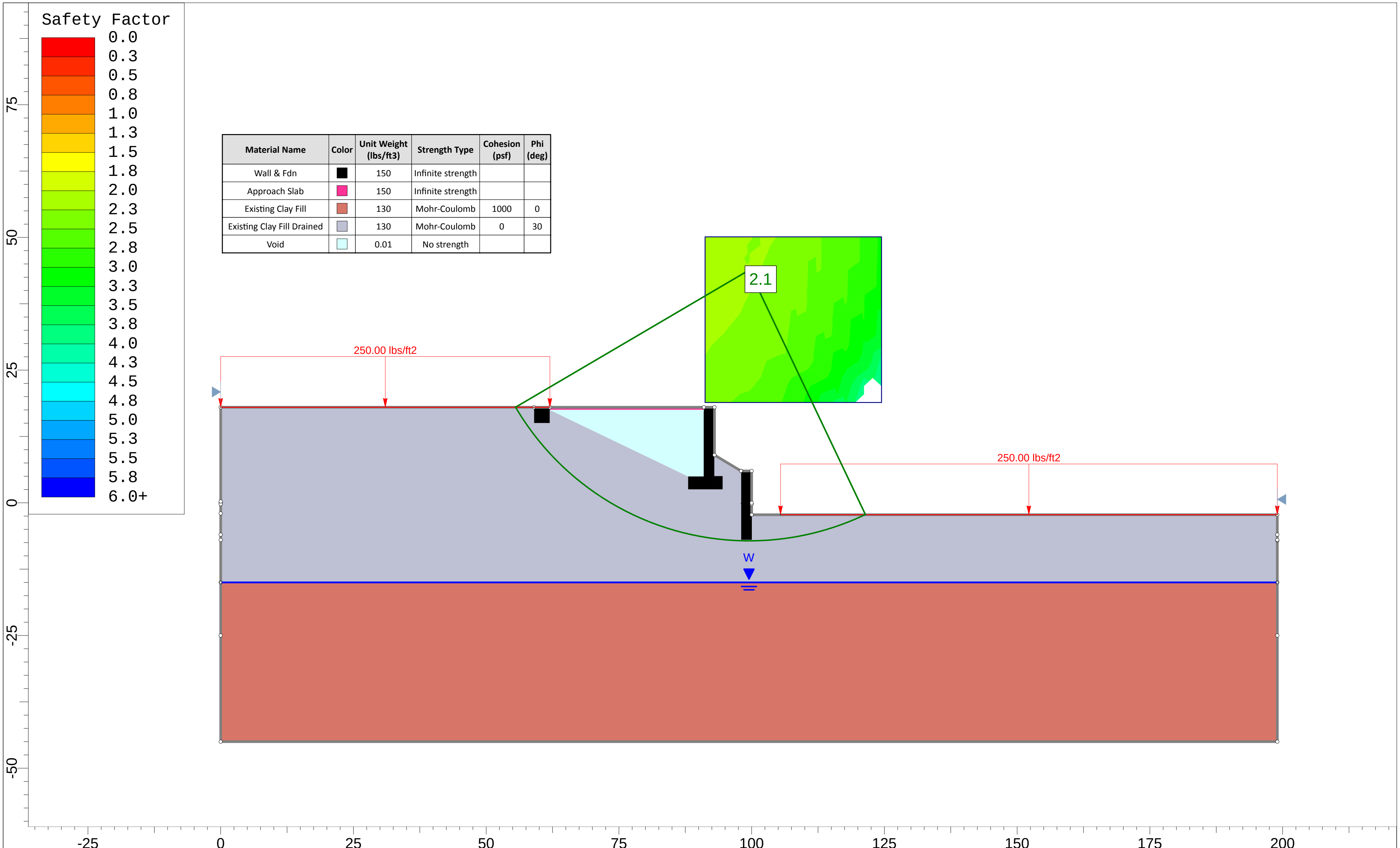
SLOPE STABILITY ANALYSES



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn		150	Infinite strength		
Approach Slab		150	Infinite strength		
Existing Clay Fill		130	Mohr-Coulomb	1000	0
Void		0.01	No strength		

SLIDEINTERPRET 6.038

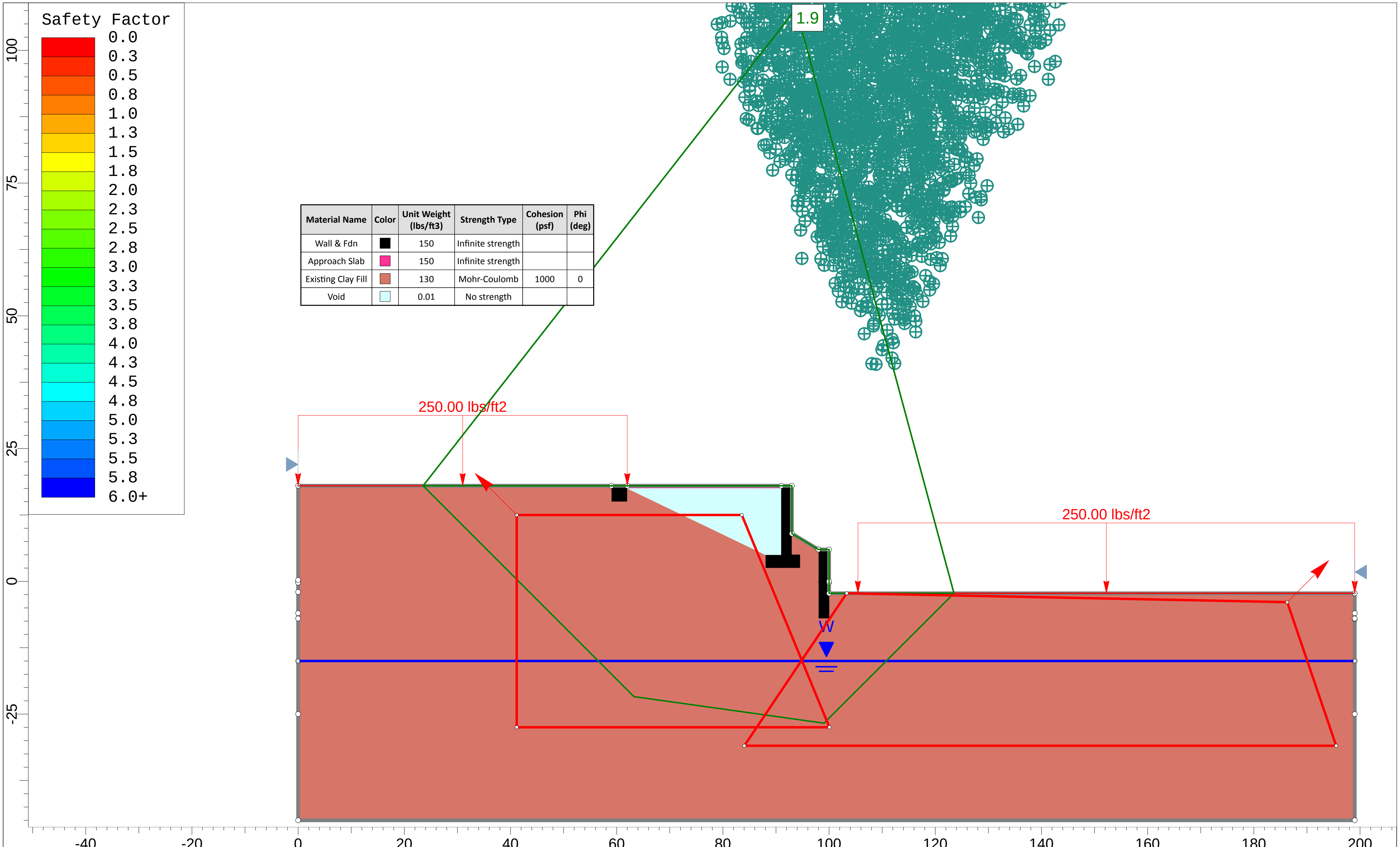
Project	I-55 NB Soldier Pile - Structure # 099-0907
Analysis Description	Circular Failure Short Term - Exhibit 1
Drawn By	KC
Scale	1:300
Company	GSG Consultants, Inc.
Date	
File Name	099-0907 NB Soldier Pile wall Circular Short Term.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn		150	Infinite strength		
Approach Slab		150	Infinite strength		
Existing Clay Fill		130	Mohr-Coulomb	1000	0
Existing Clay Fill Drained		130	Mohr-Coulomb	0	30
Void		0.01	No strength		

Project	I-55 NB Soldier Pile - Structure # 099-0907
Analysis Description	Circular Failure Long Term - Exhibit 2
Drawn By	KC
Scale	1:300
Company	GSG Consultants, Inc.
Date	
File Name	099-0907 NB Soldier Pile wall Circular Long Term.slim

SLIDEINTERPRET 6.038

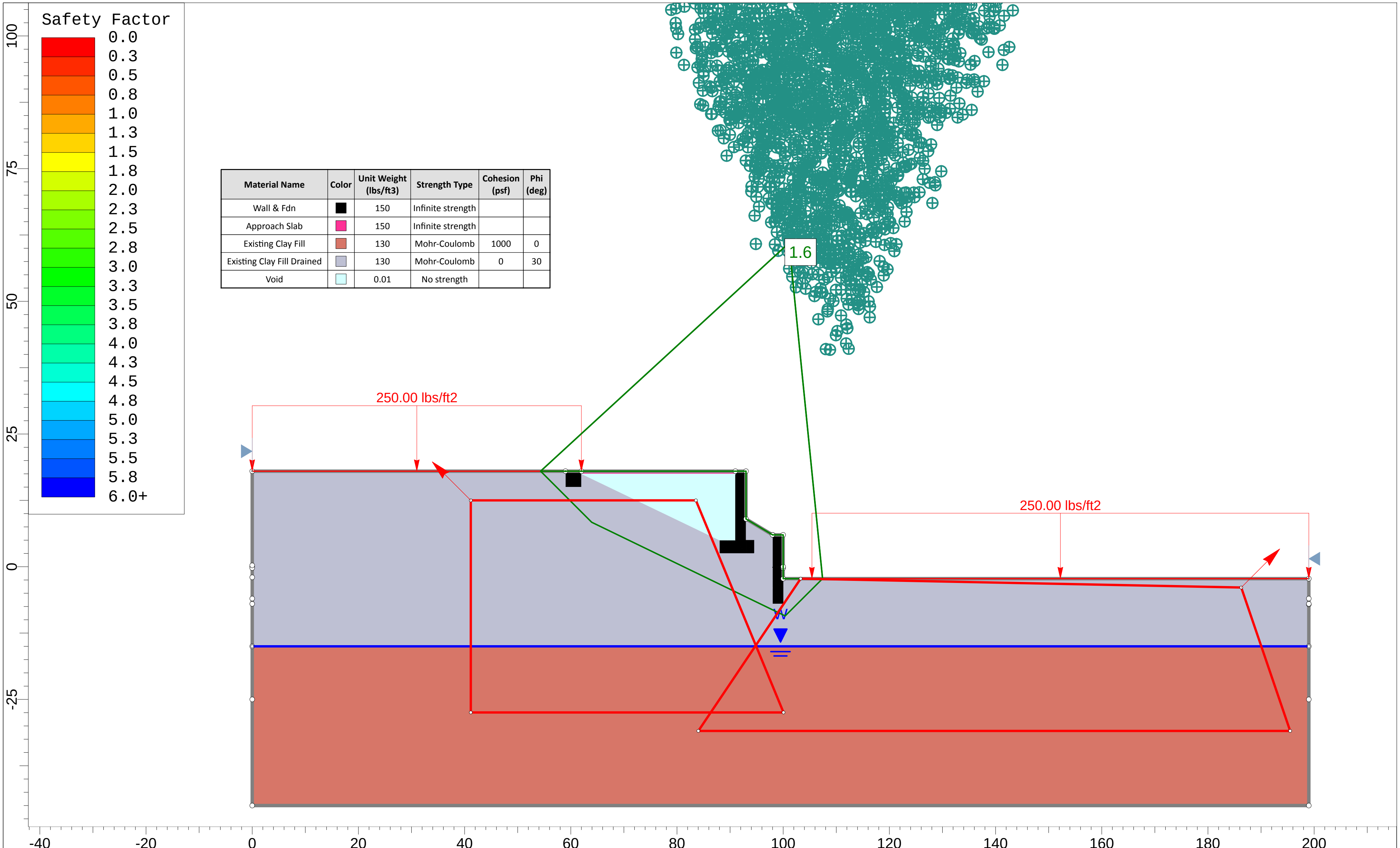


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn		150	Infinite strength		
Approach Slab		150	Infinite strength		
Existing Clay Fill		130	Mohr-Coulomb	1000	0
Void		0.01	No strength		

rocscience

SLIDEINTERPRET 6.038

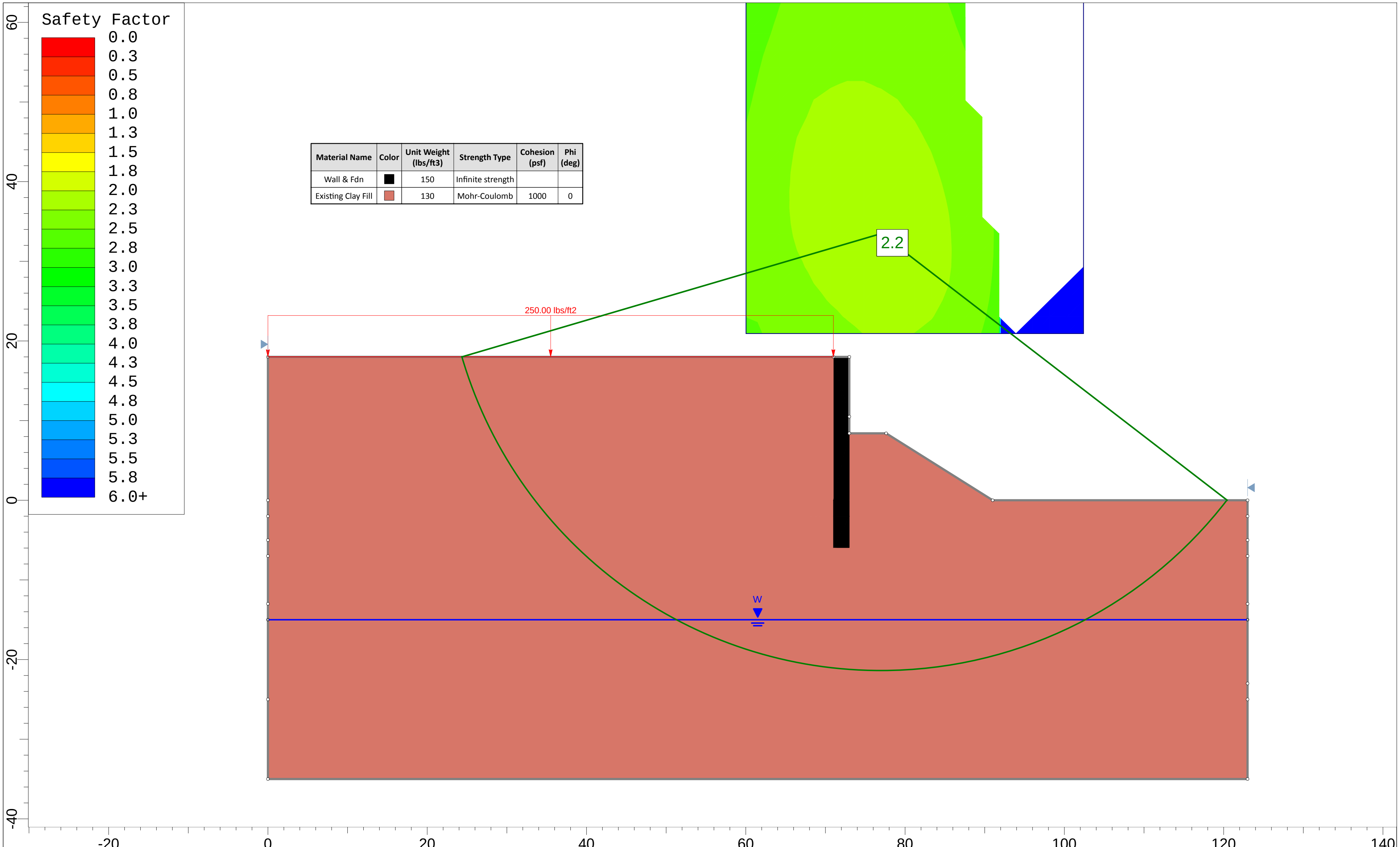
Project	I-55 NB Soldier Pile - Structure # 099-0907
Analysis Description	Block Failure Short Term - Exhibit 3
Drawn By	KC
Scale	1:300
Company	GSG Consultants, Inc.
Date	
File Name	099-0907 NB Soldier Pile wall Block Short Term.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn		150	Infinite strength		
Approach Slab		150	Infinite strength		
Existing Clay Fill		130	Mohr-Coulomb	1000	0
Existing Clay Fill Drained		130	Mohr-Coulomb	0	30
Void		0.01	No strength		

Project	I-55 NB Soldier Pile - Structure # 099-0907
Analysis Description	Block Failure Long Term - Exhibit 4
Drawn By	KC
Scale	1:300
Company	GSG Consultants, Inc.
Date	
File Name	099-0907 NB Soldier Pile wall Block Long Term.slim

SLIDEINTERPRET 6.038

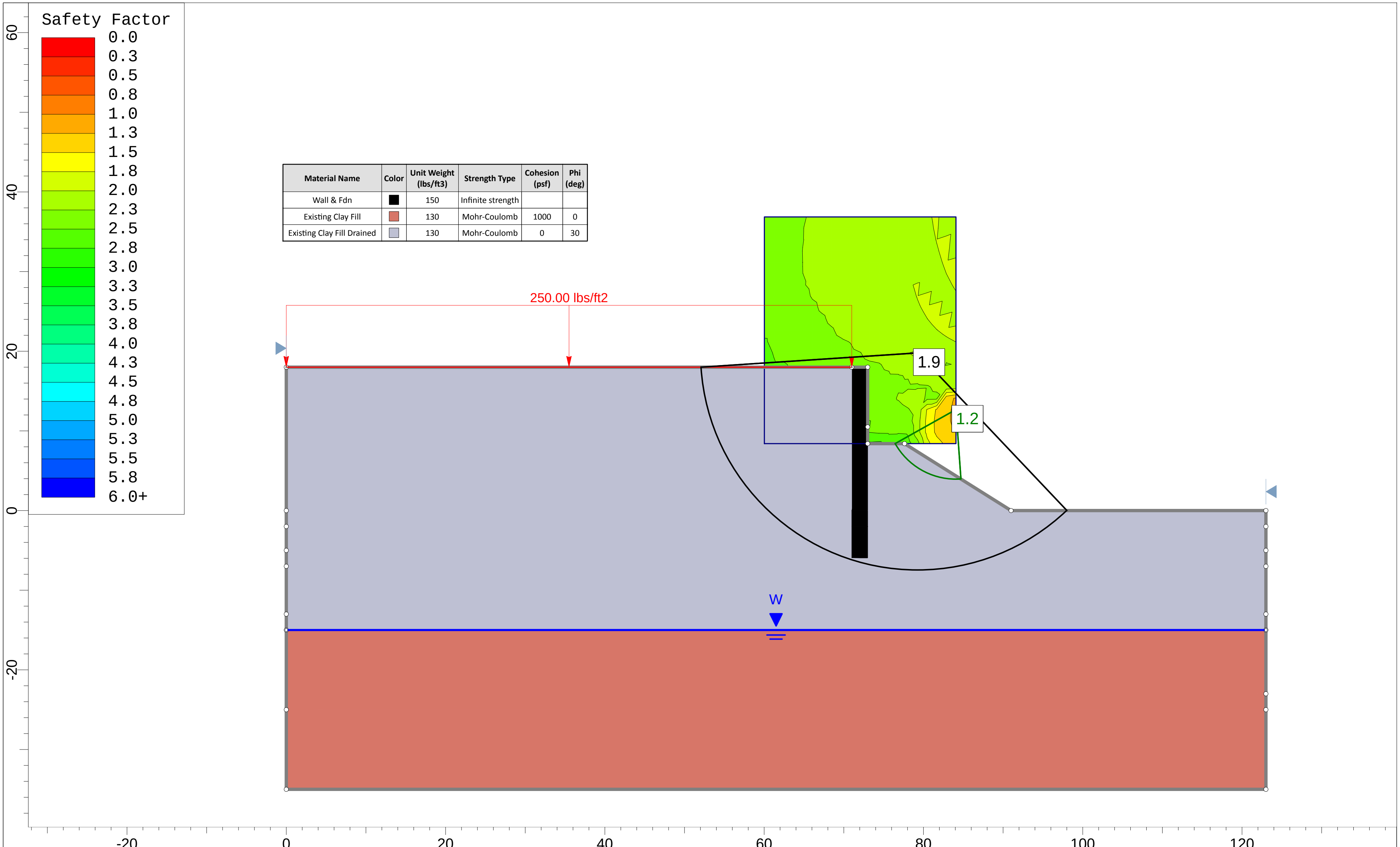


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn	■	150	Infinite strength		
Existing Clay Fill	■	130	Mohr-Coulomb	1000	0

rocscience

SLIDEINTERPRET 6.038

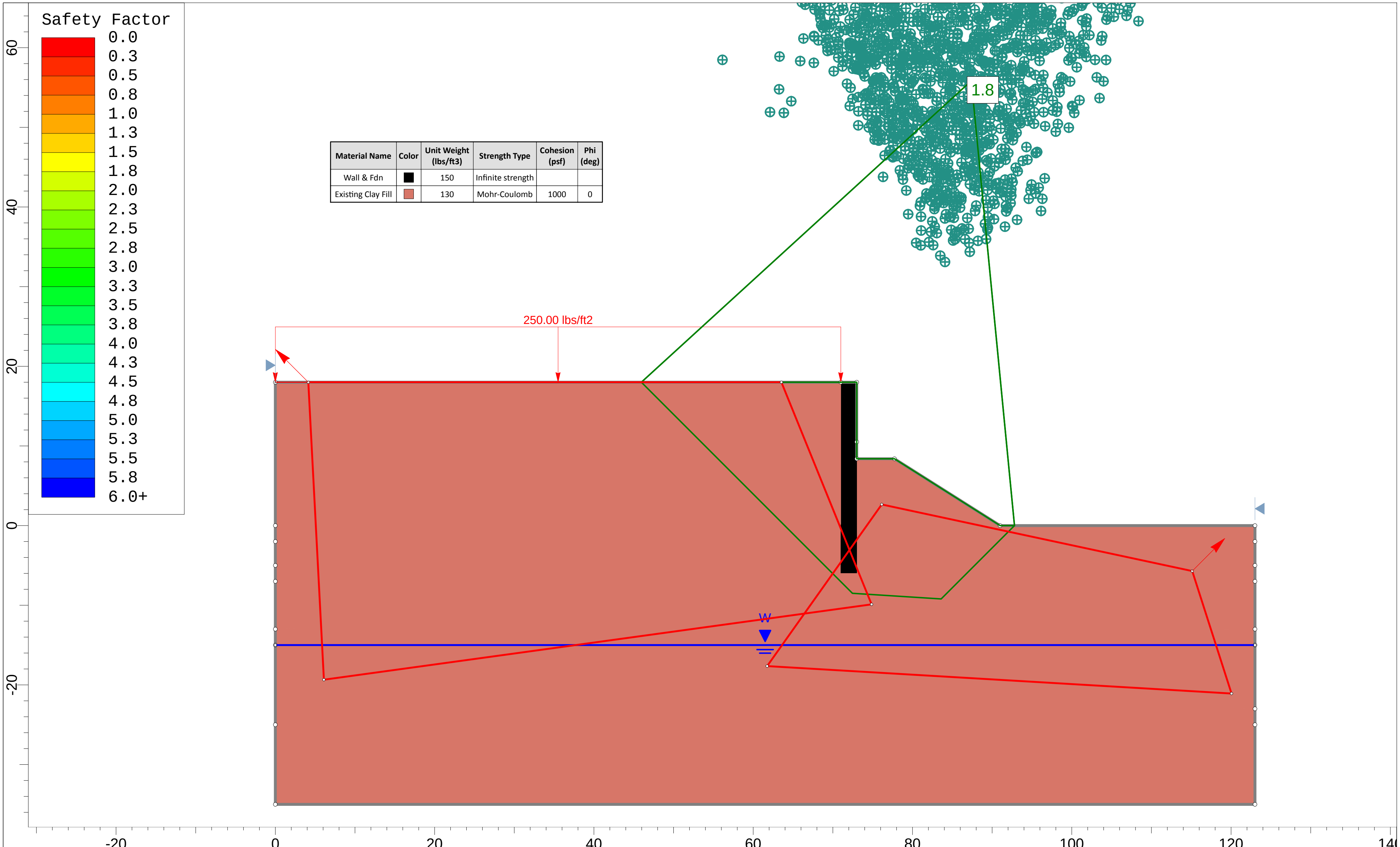
Project	I-55 NB Soldier Pile Wall - Station 11+75		
Analysis Description	Circular Failure Short Term - Exhibit 5		
Drawn By KC	*Scale* 1:200	*Company* GSG Consultants, Inc.	
Date		*File Name* 099-0907 Soldier Pile Wall Sta 11+75 Circular Short Term.slim	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn		150	Infinite strength		
Existing Clay Fill		130	Mohr-Coulomb	1000	0
Existing Clay Fill Drained		130	Mohr-Coulomb	0	30

Project	I-55 NB Soldier Pile Wall - Station 11+75				
Analysis Description	Circular Failure Long Term - Exhibit 6				
Drawn By	KC	*Scale*	1:200	*Company*	GSG Consultants, Inc.
Date				*File Name*	099-0907 Soldier Pile Wall Sta 11+75 Circular Long Term.slim

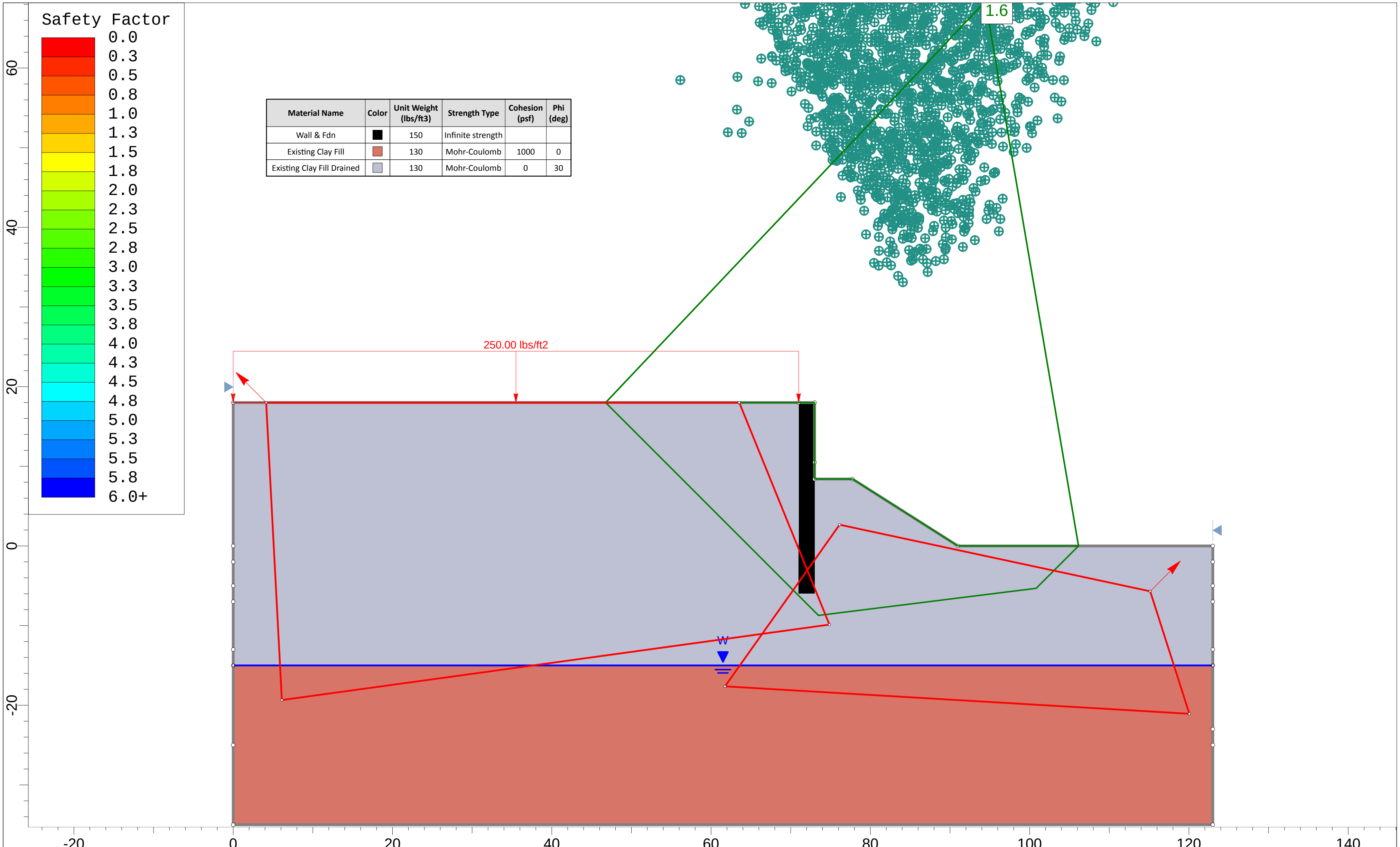
SLIDEINTERPRET 6.038



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn		150	Infinite strength		
Existing Clay Fill		130	Mohr-Coulomb	1000	0

Project	I-55 NB Soldier Pile Wall - Station - 11+75
Analysis Description	Block Failure Short Term - Exhibit 7
Drawn By	KC
Scale	1:200
Company	GSG Consultants, Inc.
Date	
File Name	099-0907 Soldier Pile Wall Sta 11+75 Block Short Term.slim

SLIDEINTERPRET 6.038



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Wall & Fdn		150	Infinite strength		
Existing Clay Fill		130	Mohr-Coulomb	1000	0
Existing Clay Fill Drained		130	Mohr-Coulomb	0	30

Project	I-55 NB Soldier Pile Wall - Station - 11+75
Analysis Description	Block Failure Long Term - Exhibit 8
Drawn By	KC
Scale	1:200
Company	GSG Consultants, Inc.
Date	
File Name	099-0907 Soldier Pile Wall Sta 11+75 Block Long Term.slim

SLIDEINTERPRET 6.038