Structural Geotechnical Report

Proposed Culverts Replacement and Retaining Wall
Proposed West Culvert: SN 016-1668
Proposed East Culvert: SN 016-8300
Proposed Retaining Wall: SN 016-W2508

123rd Street Culverts over the West Branch of Mill Creek and Mill Creek
Village of Palos Park, Cook County, Illinois

Prepared for:

Illinois Department of Transportation
IDOT PTB 200-004
Work Order #9

Project Design Engineer:
Atlas Engineering Group

Prepared by:

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March 7, 2024

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Ms. Natalia Homedi, P.E.
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Structural Geotechnical Report
Proposed Culverts Replacement and Retaining Wall
123rd Street over the West Branch of Mill Creek and Mill Creek
Village of Palos Park, Cook County, Illinois
Job No. P-91-080-16

Dear Ms. Homedi:

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 geotechnical recommendations for the proposed improvements. The site investigation included advancing seven (7) borings to depths of 30 to 40 feet.

Should you have any questions or require additional information, please call us at 630-994-2600 or email at eshaheen@gsg-consultants.com.

Sincerely,

Brook Geletu, E.I.T.
Project Engineer

Dawn Edgell, P.E.
Geotechnical Department Manager

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1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the proposed replacement of two culverts and construction of a new retaining wall along 123rd Street over the West Branch of Mill Creek in the Village of Palos Park in Cook County. The purpose of this project is to remove and replace both culverts to reduce flooding and replace the deteriorated structures. The overall project limits along 123rd Street will extend from Sta. 114+00 to Sta. 117+20 and from Sta. 124+65 to Sta. 125+15 and along 93rd Avenue from the intersection with 123rd Street approximately 92 feet north. The purpose of this site investigation was to explore the subsurface conditions at each proposed structure location, to determine engineering properties of the subsurface soil, and to develop design and construction recommendations for the proposed culverts. **Exhibit 1** shows the general project location.

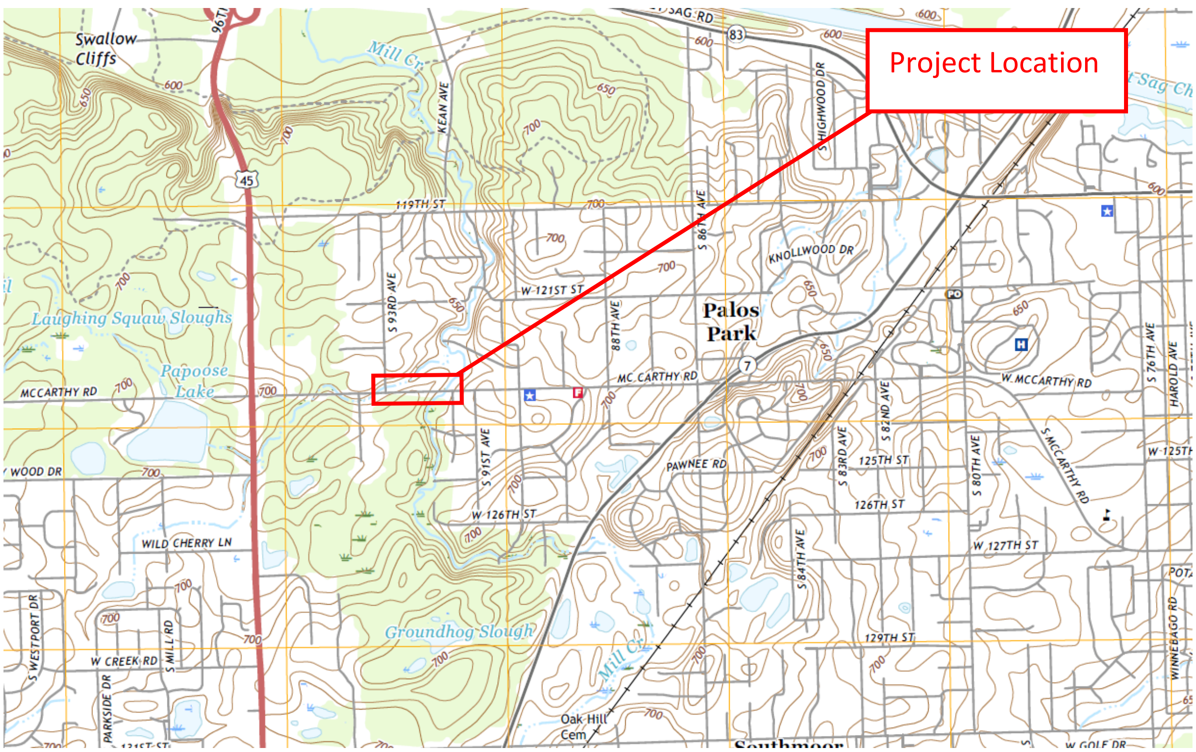

Exhibit 1 – Project Location Map
(Source: USGS Topographic Maps, usgs.gov)

1.1 Existing and Proposed Project Information

The existing west culvert is a 6.55-foot wide X 7-foot high concrete arch culvert (SN 016-0880) and will be replaced with a dual 12-foot wide X 9-foot high box culvert (SN 016-1668). The existing east culvert is a high dual box culvert (SN 016-1359) with 4-foot wide X 4-foot high and 5-foot wide X 4-foot high sections; this culvert will be replaced with a 12-foot wide X 7-foot high box culvert (SN 016-8300).

The vertical alignment of 123rd Street will be raised approximately 9 inches to accommodate the taller culvert structure and to provide increased freeboard. This will result in raising the alignment for approximately 320 feet along 123rd Street through the intersection with 93rd Avenue. Approximately 92 feet of the vertical alignment of 93rd Avenue will be raised until it ties back into existing grade. Traffic will be detoured around the existing culvert removal.

A retaining wall, SN 016-W2508, approximately 82 feet long with maximum 6 feet exposed height, is proposed at the northwest corner of the intersection 93rd Avenue and 123rd Street. There is an 8-inch water main that may conflict with the footings of the retaining wall and may have to be relocated. A summary of the proposed structures is shown in **Tables 1a thru 1c**.

Table 1a – Summary of Proposed Culverts

Structures	Existing Structure	Proposed Structure	Project Limit	Invert Elevation (ft.)	Length (ft.)
West Culvert	SN: 016-0880 (6.55' W X 7' H Concrete Arch)	SN: 016-1668 (Dual 12' W X 9' H Box)	Sta. 114+13.42 to Sta. 114+14.06	651.5	44.0
East Culvert	SN: 016-1359 (Dual 4' W X 4' and 5' W X 4' H Box)	SN: 016-8300 (12' W X 7' H Box)	Sta. 124+72.77 to Sta. 125+5.85	641.5	45.0

Table 1b – Summary of Proposed Wingwalls

Structure SN	Proposed Structure	Approximate Length (ft)	Anticipated Exposed Height (ft)
West Culvert SN 016-1668	North: Horizontal Cantilever Wingwalls	12.5 to 20	14.0
	South: Two-way Cantilever L-type Wingwalls		
East Culvert SN 016-8300	Permanent Sheet Pile Wingwalls	10.5 to 12.0	10.0

Table 1c – Summary of Proposed Retaining Wall

Proposed Structure Number	Proposed Structure Type	Project Limit	Approximate Length (ft)	Anticipated Wall Retained Height (ft)	Anticipated Maximum Exposed Wall Height (ft)
SN: 016-W2508	Soldier Pile Wall	Sta. 114+70.66 to Sta.115+52.72	82.0	9.0	6.0

1.2 Project and Scope of Services

The site investigation included completing the following:

1. Advance a total of seven (7) soil borings to evaluate the general condition and physical characteristics of the subsurface soil.
2. Perform geotechnical laboratory testing on representative soil samples to evaluate relevant engineering parameters of the subsurface soils.
3. Perform engineering analysis and evaluation of the data collected during the field investigation and laboratory testing to develop geotechnical engineering design recommendations for the proposed improvements.

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. The borings were completed in the field based on field conditions and accessibility.

2.1 Subsurface Exploration Program

The initial field exploration was completed between July 18 and July 20, 2022 and included advancing six (6) standard penetration test (SPT) borings at both ends of the proposed culverts and along the retaining wall alignment. One additional SPT borings were drilled on August 29, 2023 on top of the slope on the northwest side of the culvert. 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 analysis.

Table 2 – Summary of Subsurface Exploration Borings

Boring	Station	Offset	Northing	Easting	Existing Ground Elevation (ft)	Depth (ft)
B-1	114+13.42	9.71 RT	1821597.670	1116857.719	663.4	40.0
B-2	114+14.06	9.84 LT	1821617.227	1116917.644	662.2	40.0
B-3	115+14.66	8.70 LT	1821619.382	1116958.310	661.5	30.0
B-4	115+57.30	9.10 LT	1821621.187	1117000.925	661.1	30.0
B-5	124+72.77	10.09 RT	1821632.013	1117916.519	651.6	40.0
B-6	125+05.85	7.82 LT	1821650.998	1117948.991	651.2	40.0
B-7	114+15.54	35.91RT	1821643.330	1116858.349	665.3	40.0

The soil borings were drilled using truck-mounted CME-75 (hammer efficiency 91%) or Geoprobe (hammer efficiency 102%) 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 a depth of 30 feet, and at 5-foot intervals thereafter to the soil boring 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 and surface patching with asphalt.

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. 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
- Sieve Analysis AASHTO T-27

The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (2020), 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 in the vicinity of the proposed culverts and 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 B**). 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.

The borings were drilled in the vicinity of the proposed culverts and retaining wall along 123rd Street. The surface elevations of the borings ranged from 651.1 to 665.3 feet. The borings initially encountered 5 to 13 inches of asphalt/concrete pavement followed by silty clay fill materials, with the exception of boring B-7, which initially encountered 3 inches of topsoil. Beneath the fill materials, the borings then encountered medium stiff to very hard native silty clay/ silty clay loam interbedded with loose to medium dense silty sand/ silty loam/sandy loam to the termination depths of the borings.

The unconfined compressive strength values of the silty clay fill ranged between 0.4 tsf and 2.5 tsf. The unconfined compressive strength values of the native silty clay/ silty clay loam ranged between 0.5 tsf and 8.1 tsf. The SPT blow count 'N' values of the silty sand/sand/sandy loam, silt/silty loam ranged between 6 to 22 blows per foot (bpf).

2.4 Groundwater Conditions

Water level measurements were made at each boring locations 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. Groundwater was encountered in all of the borings at depths of 6 to 21 feet below grade (elevation of 656.4 to 644.3 feet) during drilling but was not encountered immediately after drilling. Perched water may also be present within the existing fill materials.

Based on the observed water and color change from brown to gray, the long-term groundwater level may be at an elevation of 654.0 to 645.0 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 heroin.

3.0 GEOTECHNICAL ANALYSIS AND RECOMMENDATIONS – CULVERTS

This section provides GSG's geotechnical analysis and recommendations for the design of the proposed structures based on the results of the field exploration, laboratory testing, and geotechnical analysis.

3.1 Settlement

The most common issues affecting the box portion of a culvert structure are mitigating differential settlement and ensuring constructability of the bottom slab. Box culverts are often located in existing stream channels where the new loading from a culvert and fill above will likely generate some settlement. It should be noted that the theoretical new loading at the base of the box is not as large as the new full height of soil fill loading adjacent to the box which can result in differential settlement along the roadway alignment. Since portions of the new box alignment are often located on previously unloaded channel sediments while other segments may be placed through preloaded existing embankment, concern for differential settlement along the box alignment should also be considered.

Table 3 presents the estimated settlement of the proposed culverts based on the anticipated bearing elevations and soil conditions.

Table 3 – Estimated Settlement of Proposed Culverts

Proposed Structure	Anticipated Bearing Elevation (feet)	Estimated Settlement at Culvert Inlet (inches)	Estimated Settlement at Culvert Outlet (inches)	Differential Settlement (inches)
SN 016-1668 West Box Culvert (12' X 9')	650.0	<1.0	<1.0	<0.5
SN 016-8300 East Box Culvert (12' X 7')	640.0	<1.0	<1.0	<0.5

3.2 Seismic Considerations

The seismic hazard for the site was analyzed per the IDOT Geotechnical Manual, IDOT Bridge Design Manual, and AASHTO LRFD Bridge Design Specifications. As per the Bridge Manual, seismic data is not typically needed for buried structures. Therefore, no additional analysis is warranted.

3.3 Scour Analysis

Scour analysis is not warranted for closed bottom box culvert per All Bridge Designers memo 14.2, dated November 7, 2014. Therefore, no additional scour analysis is warranted.

3.4 Culvert Foundation Recommendations

GSG evaluated the soils for the proposed culverts. The recommendations in this report are based on the preliminary plan drawings provided by the prime consultant. For the design of the foundations for the culverts, the total live load, impact loads, and dead loads, including the load of the overburden soils, should be considered. Design should be completed in accordance with the design hydraulics report and the IDOT Culvert Manual (2017).

The soil borings B-1 and B-2 encountered medium stiff to hard brown and gray silty clay at the invert depths of the west culvert (SN 016-1668) at an elevation 650.0 feet. Soil borings B-5 and B-6 encountered very stiff to hard brown and gray silty clay at the invert depth of the east culvert (SN 016-8300) at elevation 640.0 feet. Due to the presence of unsuitable low strength materials at the invert elevations of the west culvert at boring B-1 (less than 0.5 tsf), undercuts to reach suitable soil will be required at the proposed culvert location. Following undercutting to suitable native soils, the over-excavations should be backfilled to the design bearing grade with structural fill. The structural fill should be placed in accordance with the Construction Considerations section of this report. It is anticipated that 3 feet of undercut is necessary below the proposed invert elevations. The undercut depths shall be field verified during construction.

Table 4 – Anticipated Undercut Depths – West Culvert, SN 016-1668

Boring #	Invert Elevation (ft. MSL)	Anticipated Bearing Elevation*	Recommended Undercut Elevation	Maximum Undercut Depth (ft)	Comment/Reason for Remediation
B-1	651.5	650.0	647.0	3.0	Medium Stiff Silty Clay Qu = 0.5 tsf

*Note: Assuming culvert slab thickness of 1.5 foot

The wingwalls are anticipated to be constructed as cantilever L-type walls at south and horizontal wingwall at north of the west culvert and permanent sheet pile walls at the east culvert. Wingwalls should be designed based on the information and typical sections shown in Section 4.2 of the IDOT Culvert Manual (IDOT 2017) and Section 4.0 of this report. Headwalls should be designed based on the information provided in Section 4.1.5 of the IDOT Culvert Manual (IDOT 2017).

4.0 GEOTECHNICAL ANALYSIS AND RECOMMENDATIONS – WINGWALLS

This section provides wing wall design parameters including recommendations on foundation type, bearing capacity, settlement, and lateral earth pressures. The foundation for the proposed wing walls must provide sufficient support to resist the dead and live loads. The foundation design recommendations presented within this section were completed per the AASHTO LRFD 9 Edition (2020).

4.1 Wingwall Type Recommendations

It is anticipated that the wingwalls will have a maximum height of 12 feet and will be in a cut section along the existing roadway alignment. There are various types of wingwalls that could be utilized for retaining earth embankments in excavation slopes in cut areas. Based on the design drawings (**Appendix A**), a two-way Cantilever L-type wall is considered for the south wingwalls and a horizontal cantilever wall for the north wingwalls of the west culvert. A permanent sheet pile wall is considered for the east culvert in this project. Design plans indicate that the wall location would require cutting into the base of the existing embankment, with minimal fill for final grading to reach the proposed roadway subgrade.

A two-way concrete cantilever L-type wall is constructed with a footing that extends laterally behind the wall and vertically below the footing. They can be designed to resist horizontal loading with or without tie-backs by changing the geometry of the foundation. This type of wall type of wall typically requires that the area behind the wall is excavated to facilitate construction or constructed where new fill embankments are necessary. A horizontal cantilever wall is constructed without a footing behind the wall and it is supported by the culvert itself not the soil under the culvert. Sheet pile walls are typically used in cut areas when continuous support must be provided to maintain existing structures or other adjacent facilities. 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. As the maximum height of the wingwalls will be close to 14 feet, tie-backs will not likely be required for design.

GSG evaluated the global and external stability of the proposed retaining wall to determine the suitability of the wingwalls for this section of the project. The wall sections should be analyzed to determine that adequate factors of safety relative to overturning failure are met. The wall should be designed, and constructed, in accordance with the 2020 AASHTO LRFD Bridge Design

Specification and IDOT requirements. The final wall design should be submitted to the structural design team for review prior to commencing construction of the wall.

4.2 Wingwall Design Recommendations

The engineering analyses performed for evaluation of the wing walls 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 5** outlines the load factors used in the evaluation of the retaining wall in accordance with AASHTO Specification Tables 3.4.1-1 and 3.4.1-2.

Table 5 - 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	

4.3 Lateral Earth Pressures and Loading

The walls should be designed to withstand earth and live lateral earth pressures. The lateral earth pressures on wingwalls 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. 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. **Table 6a and 6c** present soil design properties for the wingwalls based on soil types encountered at the site.

Table 6a – Lateral Soil Parameters – West Culvert wingwalls (B-1 to B-2)

Elevation Range (feet)	Soil Description	Long-term/Drained		
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)
	New Engineered Clay Fill	0.41	2.46	0.58
	New Engineered Granular Fill	0.33	3.00	0.50
1.0 – 9.5 (661.5 – 653.0)	FILL: Brown Silty Clay	0.41	2.46	0.58
9.5-30.0 (653.0-632.5)	Medium Stiff to Stiff Gray Silty Clay	0.36	2.77	0.53
9.5-30.0 (653.0-632.5)	Stiff to Very Stiff Gray Silty Clay	0.36	2.77	0.53
30.0-40.0 (632.5-622.5)	Very Stiff to Hard Gray Silty Clay	0.36	2.77	0.53
21.5 – 28.5 (642.0 – 635.0)	Medium Dense Gray Silty Sand	0.26	3.85	0.41

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Table 6b – Lateral Soil Parameters – East Culvert wingwalls (B-5 to B-6)

Elevation Range (feet)	Soil Description	Long-term/Drained		
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)
	New Engineered Clay Fill	0.41	2.46	0.58
	New Engineered Granular Fill	0.33	3.00	0.50
0.5 – 6.0 (651.0 – 645.5)	FILL: Brown Silty Clay	0.41	2.46	0.58
6.0 – 33.5 (645.5 – 618.0)	Medium Stiff to Very Stiff Gray Silty Clay	0.36	2.77	0.53
33.5 – 39.0 (618.0 – 612.5)	Stiff Gray Silty Loam	0.26	3.85	0.41
39.0 - 40.0 (612.5 – 611.5)	Very Stiff to Hard Gray Silty Clay	0.36	2.77	0.53

Traffic and other surcharge loads should be included in the 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. The live load surcharge may be estimated as a uniform horizontal earth pressure due to an equivalent height (Heq) of soil.

The wall design should include a drainage system to allow movement of any water behind the wall, and not allowing hydrostatic (seepage) pressures to develop in the active soil wedge behind the wall.

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. The passive lateral earth pressure coefficient (Kp) from the upper 3.5 feet of level backfill at the toe 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 wall toe should also be neglected, regardless of any surface protection.

4.4 Cantilever Wall Bearing Resistance – West Culvert (SN: 016-1668)

It is anticipated that the south wing walls of the west culvert will bear on the existing brown and gray native silty clay materials. Bearing resistance for the retaining wall shall be evaluated at the strength limit state using load factors (See **Table 4**), and factored bearing resistance. The bearing resistance factor, ϕb, is 0.5 for a gravity wall per AASHTO Table 11.5.7-1. The bearing resistance shall be checked for the extreme limit state with a resistance factor of 1.0. **Table 7** presents the proposed bearing elevation and recommended bearing resistances of suitable materials to support the wall system. Based on the provided cross sections, the anticipated footing for the CIP retaining wall has an approximate width of 4 feet.

The soil borings B-1 and B-2 encountered medium stiff to hard brown and gray silty clay at the proposed footing depths of the western culvert at an elevation 650.0 feet. Due to the presence of unsuitable low strength materials at the footing elevation at boring B-1 (less than 0.5 tsf), undercuts to reach suitable soil will be required at the proposed wingwall footing. Following undercutting to suitable native soils, the over-excavations should be backfilled to the design bearing grade with structural fill. The structural fill should be placed in accordance with the

Construction Considerations section of this report. It is anticipated that 3 feet of undercut is necessary below the proposed footing elevations. The undercut depths shall be field verified during construction.

Table 7 – Recommended Bearing Resistance – Cantilever Wall at Proposed West Culvert

Structure Number	Elevation* (feet)	Nominal Resistance (ksf)	Factored Bearing Resistance (ksf)	Bearing Resistance for 1-inch Settlement Service Limit (ksf)	Bearing Resistance for 1.5-inches Settlement Service Limit (ksf)	Anticipated Bearing Soil
SN: 016-1668	651.5 – 650.0	8.2	4.1	2.8	4.1	Granular Structural Fill

*Elevations estimated from Cross Sections dated 10/16/2023 (**Appendix A**)

4.5 Global Slope Stability for Wingwall

Based on the information provided by Atlas, the retaining wall should be designed for external stability of the wall system. The geometry in **Table 8a and Table 8b** was used to evaluate the proposed wingwalls at west and east culvert, respectively. For wingwall at the west culvert, the provided cross section (**Appendix A**) was used in the analysis.

Table 8a – Wall Description for L-type/horizontal Wingwall at West Culvert, SN 016-1668

Description	Value
Maximum total height of wing wall (H)	14 feet
Minimum width of shallow footing base (CIP wall)	4 feet
Unit weight of the retained soil (embankment)	138 pcf
Wing wall bearing elevation	650.0

*Additional embedment may be required for lateral pressures and structural design of the wall system

Table 8b – Sheet Pile Wingwall Geometry at East Culvert, SN 16-8300

Description	Sta. 124+90
Maximum total retained height of wingwall (H) (feet)	10.0
Estimated Embedment length below ground (feet)	10.0
Minimum pile tip elevation(s) (feet)	631.0

*Additional embedment may be required for lateral pressures and structural design of the wall system

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

Slide2 is a comprehensive slope stability analysis software used to evaluate the proposed wall for the project based on the limit equilibrium method. In addition to the proposed wall, the general stability of the slope was analyzed based on the preliminary grading and the soils encountered while drilling. Circular failure analyses were evaluated using the simplified Bishops analyses methods for the proposed wall geometries. Based on the proposed geometry and the soil boring, global stability analyses were performed.

4.5.1 Global Slope Stability Results

Circular failure analyses were evaluated for both a short term (undrained) and long term (drained) condition based on the proposed geometries (**Table 8**) for the proposed wing wall. The results of the analyses are shown in **Table 9.**

Table 9 – Wingwall Global Slope Stability Analyses Results

<table>
<tr><th>Analysis Exhibit</th><th>Location</th><th>Wingwall Type</th><th>Analysis Type</th><th>Factor of Safety</th><th>Minimum Factor of Safety</th></tr>
<tr><td>Exhibit 1</td><td rowspan="4">SN 016-1668 West Culvert Sta. 114+34</td><td rowspan="2">North Horizontal</td><td>Circular – Short Term</td><td>2.0</td><td>1.7</td></tr>
<tr><td>Exhibit 2</td><td>Circular – Long Term</td><td>1.7</td><td>1.7</td></tr>
<tr><td>Exhibit 3</td><td rowspan="2">South CIP L-type</td><td>Circular – Short Term</td><td>2.4</td><td>1.7</td></tr>
<tr><td>Exhibit 4</td><td>Circular – Long Term</td><td>1.7</td><td>1.7</td></tr>
<tr><td>Exhibit 5</td><td rowspan="2">SN 16-8300 East Culvert Sta. 124+90</td><td rowspan="2">Sheet Pile</td><td>Circular – Short Term</td><td>6.3</td><td>1.7</td></tr>
<tr><td>Exhibit 6</td><td>Circular – Long Term</td><td>2.6</td><td>1.7</td></tr>
</table>

Based on the analyses performed, the proposed wingwalls meet the minimum factor of safety of 1.7 per IDOT for cut sections. Copies of the slope stability analyses are included in the Slope Stability Analyses Exhibits (**Appendix E**).

4.6 Global Slope Stability for Slope Northwest of West Culvert

Based on the information provided by Atlas, the slope on the northwest side of the west culvert is proposed to be graded. Boring B-7 was drilled on top of this slope and the soil parameters developed based on B-7 were used in the slope stability analysis. The provided cross section (Appendix A) at 0+05.00, which has the maximum graded slope height, was used in the analysis.

Table 10 - Global Slope Stability Analysis Results for the Slope

Analysis Exhibit	Location	Analysis Type	Factor of Safety	Minimum Factor of Safety
Exhibit 7	Station 0+05.00	Circular – Short Term	7.2	1.7
Exhibit 8		Circular – Long Term	1.7	1.7

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

5.0 GEOTECHNICAL ANALYSIS AND RECOMMENDATIONS – RETAINING WALL

This section provides GSG's geotechnical analysis and recommendation for the design of the proposed retaining wall (SN 016-W2508) 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. The foundation design recommendations presented within this section were completed per the AASHTO LRFD 9th Edition (2020).

5.1 Retaining Wall Type Recommendations

It is anticipated that the proposed retaining wall will be in a cut section along the existing roadway alignment. There are various types of retaining walls that could be utilized for retaining earth embankments in excavation slopes in cut areas. Based on the proposed grading plan and location of the wall within a cut area, and the presence of the existing watermain along the alignment, a soldier pile wall has been considered for this project. 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. Design plans indicate that the wall location would require cutting into the base of the existing embankment, with minimal fill for final grading to reach the proposed roadway subgrade.

GSG evaluated the global and external stability, 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 sliding and overturning failure were met.

5.2 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 the Tollway. 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 5** 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.

5.3 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. 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. **Table 11** presents soil design properties for the retaining wall for the anticipated soil types at the site and 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 11 – Lateral Soil Parameters – Retaining Wall (B-2 to B-4)

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	0.007	Stiff Clay w/o free water (Reese)
	New Engineered Granular Fill	0.33	3.00	0.50	90	N/A	Sand (Reese)
0.5 - 9.5 (660.5 – 652.0)	FILL: Black, Brown and Gray Silty Clay	0.41	2.46	0.58	500	0.007	Stiff Clay w/o free water (Reese)
9.5 – 16.0 (652.0 – 645.5)	Medium Stiff to Stiff Gray Silty Clay	0.36	2.77	0.53	1,000	0.005	Stiff Clay w/o free water (Reese)

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
16.0-40.0 (645.5-621.5)	Stiff to Hard Gray Silty Clay	0.36	2.77	0.53	1,000	0.005	Stiff Clay w/o free water (Reese)
16.0 – 21.5 (645.5 – 640.0) [B-3]	Loose to Medium Dense Gray Sandy Loam	0.32	3.12	0.48	20	N/A	Sand (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. The live load surcharge may be estimated as a uniform horizontal earth pressure due to an equivalent height (Heq) of soil. **Table 12** provides the equivalent heights of soils for vehicular loadings on retaining walls.

Table 12 - Equivalent Height of Soil for Vehicular Loading on Retaining Walls Parallel to Traffic

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

Reference: AASHTO LRFD Table 3.11.6.4-2

The retaining wall design should include a drainage system to allow movement of any water behind the wall, and not allowing hydrostatic (seepage) pressures to develop in the active soil wedge behind the wall. This could be accomplished by placing a Geocomposite Wall Drain over the entire length of the back face of the wall connected to a minimum of 4-inch diameter perforated drainpipe.

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. The passive lateral earth pressure coefficient (Kp) from the upper 3.5 feet of level backfill at the toe 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 wall toe should also be neglected, regardless of any surface protection.

5.4 Soldier Pile and Lagging Retaining Wall Design Recommendations

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 driven piles, pile shoes are recommended for driving thru the soil with cobbles. 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. 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 design should include a structural evaluation of the pile section to meet applied shear and moment, and an evaluation of overturning to determine embedment depth and other design requirements. The walls shall 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 flexible and such the earth loads may be calculated using active earth pressure for load 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) are shown in **Table 11**.

The simplified earth pressure distributions shown in the AASHTO Standard Specifications for Highway Bridges could be used for the wall design. **Table 11** also provides 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. The passive resistance in front of the wall should be ignored for the upper 3.5 feet due to excavation activities and frost-heave condition. Construction equipment surcharge loads should be added to the lateral earth pressure.

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.

Based on the preliminary information provided, the retaining wall should be designed for external stability of the wall system. The parameters in **Table 13** were used to evaluate the proposed soldier pile wall in order to reach a minimum Factor of Safety of 1.7. 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.

Table 13 – Soldier Pile Wall Geometry at Station 115+45

Description	
Maximum Exposed height of retaining wall (H)	6.0 feet
Maximum total retained height of retaining wall (H)	9.0 feet
Minimum Embedment length below bottom of concrete facing	9.0 feet

*Additional embedment may be required for lateral pressures and structural design of the wall system

The analyses were performed at Station 115+45. The results of the analyses are shown in **Table 14**.

Table 14 – Retaining Wall Global Slope Stability Analyses Results for Soldier Pile Wall

Analysis Exhibit	Location	Wall Type	Analysis Type	Factor of Safety	Minimum Factor of Safety
Exhibit 9	Station 115+45	Soldier Pile	Circular – Short Term	5.2	1.7
Exhibit 10			Circular – Long Term	2.5	1.7

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

5.5 Drainage Recommendations

The wall design should include a 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. If weep holes are to be used, it is recommended that a geocomposite wall drain be placed over the interlocks and area of the weep holes. If drainage is not provided, hydrostatic pressure should be included in the wall design and the horizontal earth pressure should be determined in accordance with AASHTO article 3.11.3.

6.0 CONSTRUCTION CONSIDERATIONS

All work performed for the proposed project should conform to the requirements in the in the IDOT Standard Specifications for Road and Bridge Construction (2022), the IDOT Culvert Manual (2017) and the IDOT Subgrade Stability Manual (2005). Any deviation from the requirements in the manuals above should be approved by the design engineer.

6.1 Site Preparation

All trees, pavements, vegetation, landscaping, and surface topsoil should be cleared and removed from the vicinity of the proposed construction. Where possible, the engineer may require proof-rolling of the subgrade with a 35-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.

Foundation aggregate 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. Rainfall and runoff can soften soils and affect the load bearing capacity of the soils. All water entering the foundation excavation should be removed prior to placement of backfill materials above the wall bottom.

6.2 Existing Utilities and Structures

Based on the existing site conditions, utilities exist along the project corridor. Before proceeding with construction, all existing underground utility lines or structures that will interfere with construction should be completely relocated from 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 utilities or structure 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.

6.3 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 for providing 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.

6.4 Foundation Preparation for Box Culverts

The foundation soil requirements for a culvert barrel vary depending on the size of the culvert, the fill height above the culvert, the current foundation soil loading, and whether the culvert is pre-cast or cast-in-place. Foundation soils supporting culvert wing walls on spread footings have specific strength requirements based on the applied loadings. Since the conditions encountered upon excavation can differ, the District Geotechnical Engineer and Field Construction Engineer may need to extend or reduce the limits to address the “as encountered conditions”. Unless otherwise noted, the limits and depth of removal and replacement should not be significantly altered by the inspector.

6.5 Scour Considerations

The design scour elevation should be taken at the bottom of the cutoff walls. To help prevent local erosion, it is recommended to place stone riprap at the end of the culverts. This will help prevent sediments from entering and accumulating in the culvert, reduce long term maintenance, and provide protection to the streambed at the interface.

Unsuitable materials are generally replaced with aggregate when soil strength and groundwater conditions dictate. A special provision for Aggregate Subgrade Improvement or Rockfill should be included in the plans to indicate the replacement material properties and capping requirements.

6.6 Groundwater Management

Based on the observed water and color change from brown to gray, it is anticipated that the long-term groundwater level may be at an elevation of 652.0 to 645.0 feet. Water may be perched in the existing fill layers. GSG does anticipate that groundwater related issues may occur during construction activity. If rainwater run-off or groundwater is accumulated at the base of excavations, 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 the excavations on the shorelines 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. The remaining portion of the excavation beneath the footings should be backfilled using approved structural fill.

6.7 Temporary Soil Retention

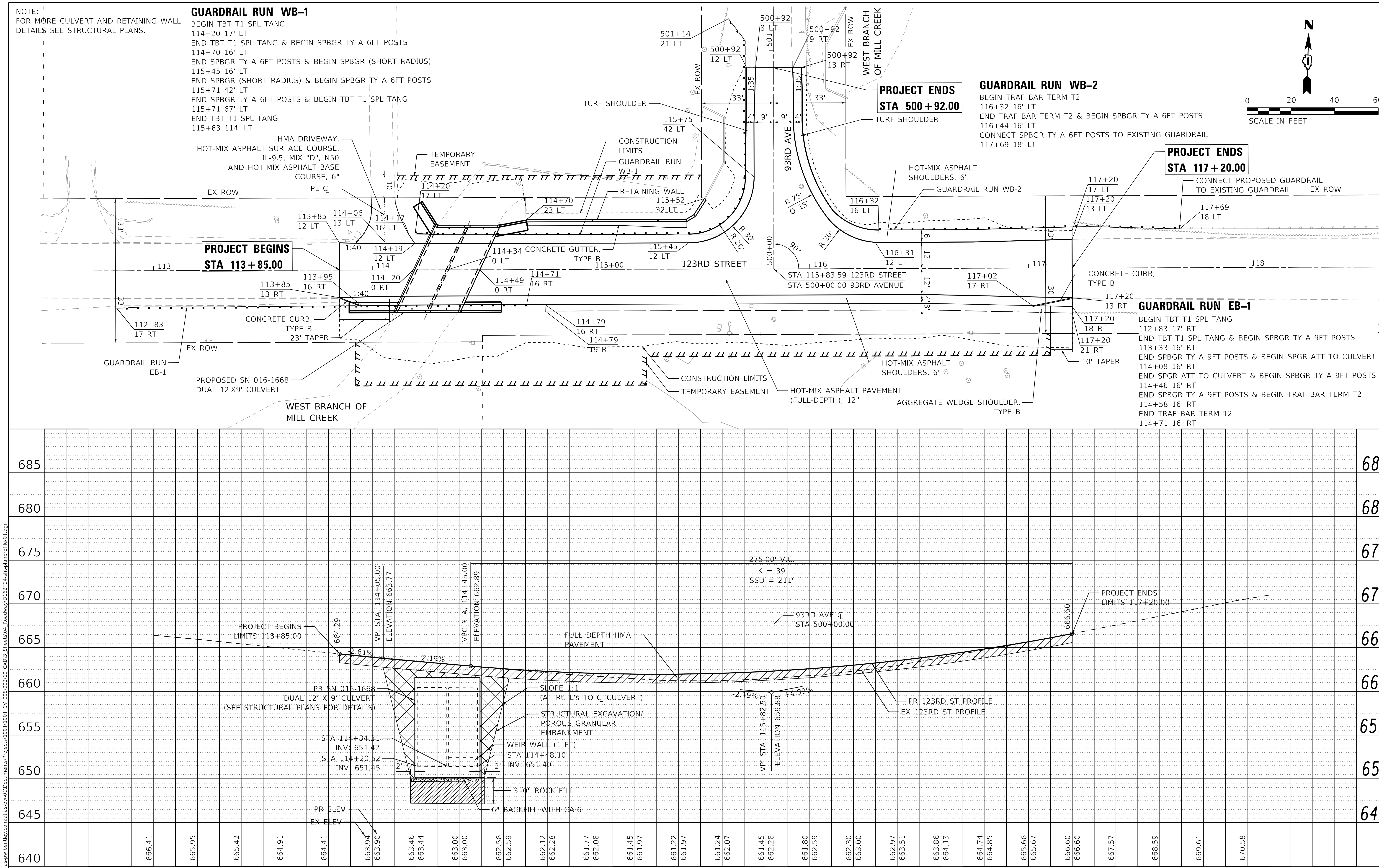
Temporary soil retention may be needed to install the proposed culverts. The Temporary Soil Retention System (TSRS) should be designed in accordance with the IDOT Bridge Design Manual, Section 3.13.1, Temporary Sheet Piling Design, Temporary Soil Retention Systems and Braced Excavations and the IDOT Design Guide. A temporary sheet piling may not be feasible due to the presence of cobbles in the vicinity of boring B-1 at a depth of 13 feet. A temporary soil retention system (TSRS) is recommended. The TSRS design is the responsibility of the contractor. The contractor should submit the TSRS plans to the structural design team for review prior to commencing construction of the TSRS.

7.0 LIMITATIONS

This report has been prepared for the exclusive use of the Illinois Department of Transportation and its consultant team. The recommendations provided in the report are specific to the project described herein and are based on the information obtained from the soil boring locations within the proposed project limits. 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

General Plan and Elevation (GPE) and Cross Sections



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PLOT DATE = 10/18/2023	DATE -	REVISED -	

ROADWAY PLAN AND PROFILE
123RD STREET

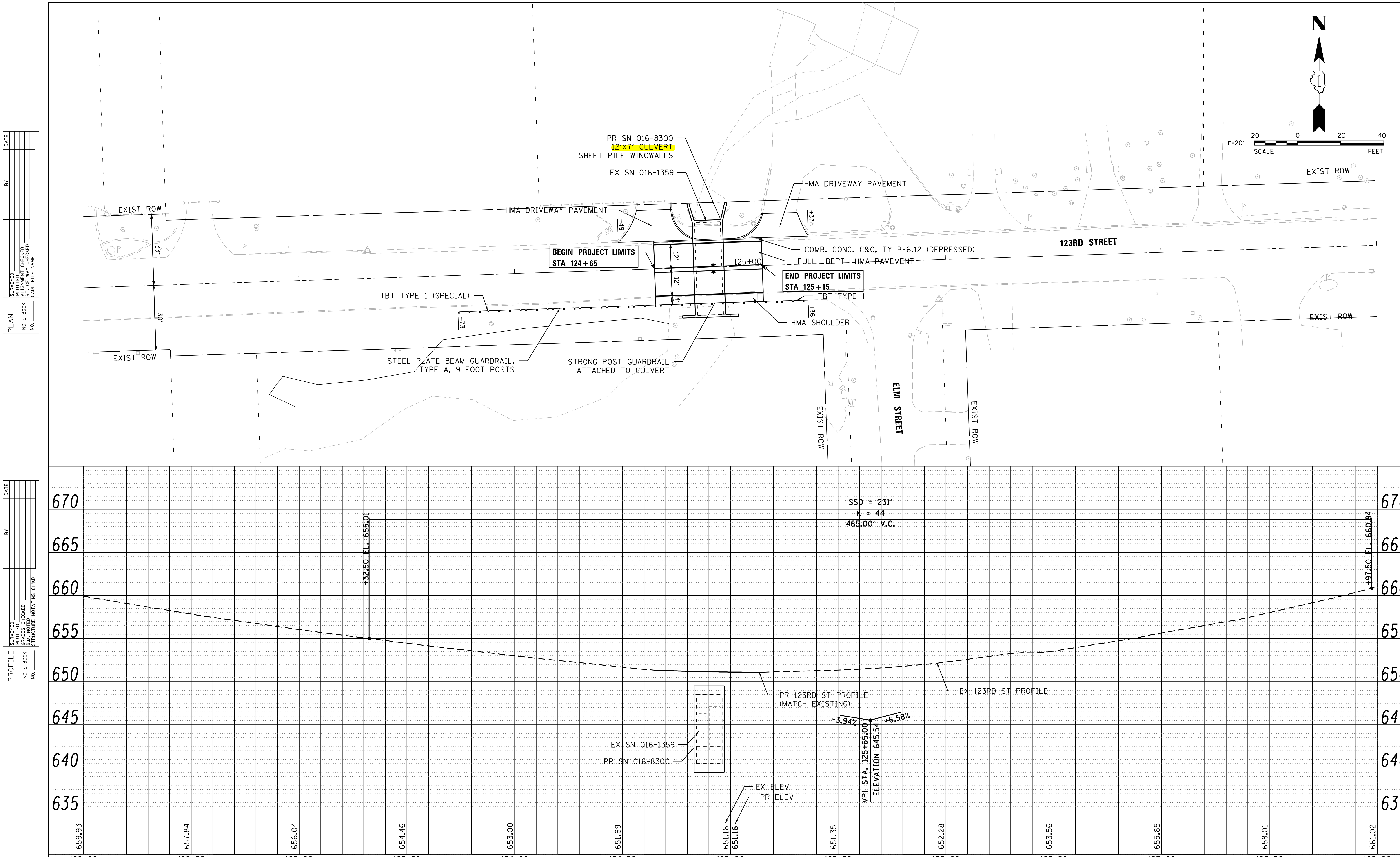
SCALE: 1" = 20' | SHEET 1 OF 3 SHEETS | STA. TO STA.

F.A.U RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1587	FAU 1587 22 CR	COOK	60	20

CONTRACT NO. 62T94

ILLINOIS FED. AID PROJECT

ATLAS ENGINEERING GROUP, LTD.



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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

123RD STREET
PLAN & PROFILE

SCALE: 1" = 20' | SHEET 2 OF 3 SHEETS | STA. 124+65 TO STA. 125+15

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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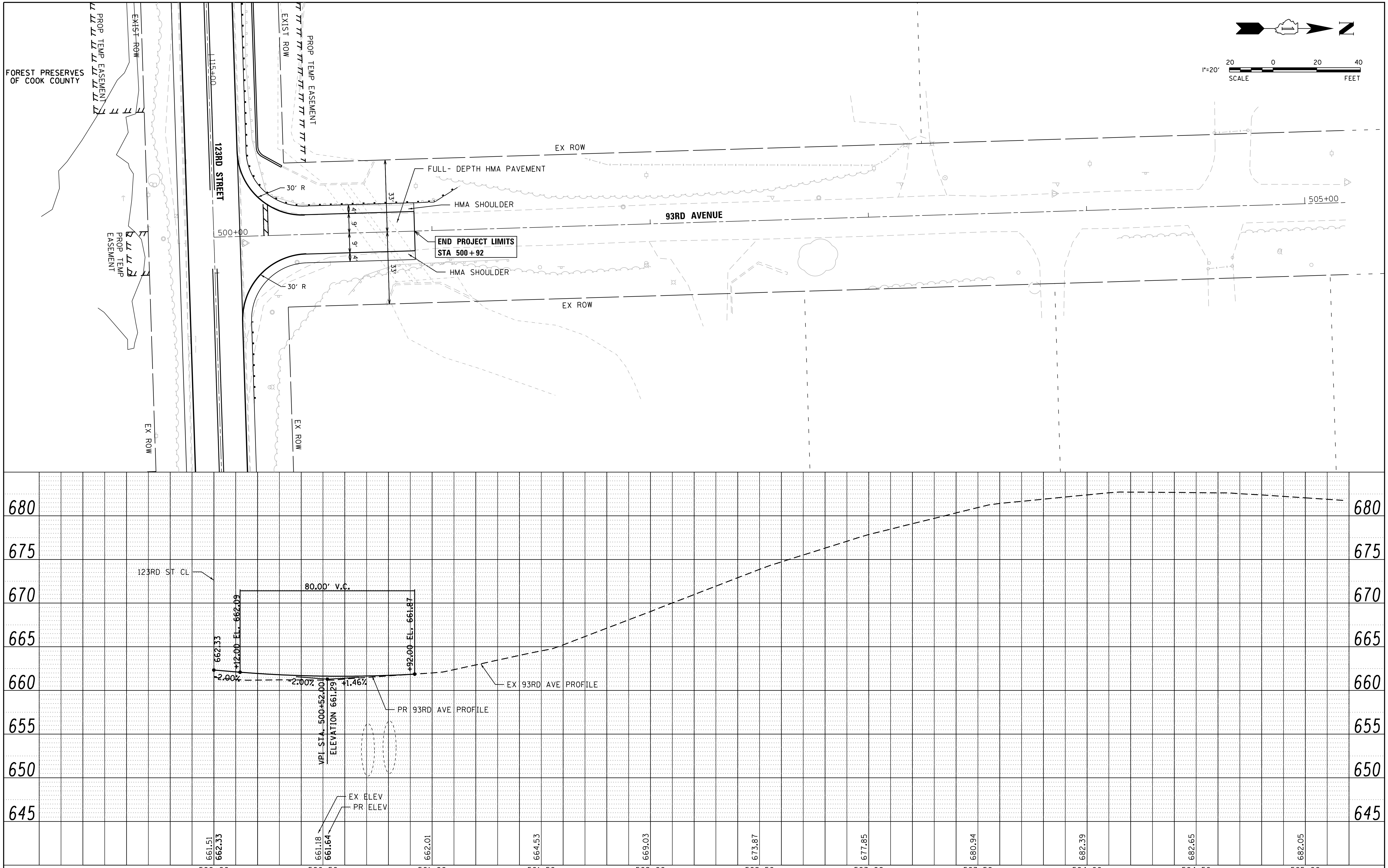
PROJ. NO. P-91-080-16

ILLINOIS FED. AID PROJECT



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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

93RD AVENUE
PLAN & PROFILE

SCALE: 1" = 20' SHEET 3 OF 3 SHEETS STA. 500+00 TO STA. 500+92

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1587		COOK		

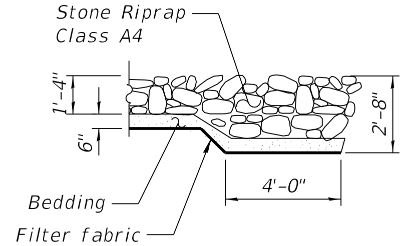
PROJ. NO. P-91-080-16
ILLINOIS FED. AID PROJECT

Benchmark: Cut X on east curb return at 123rd and 93rd St. Sta. 116+31.69 Offset 13.41' Lt. Elevation 662.61

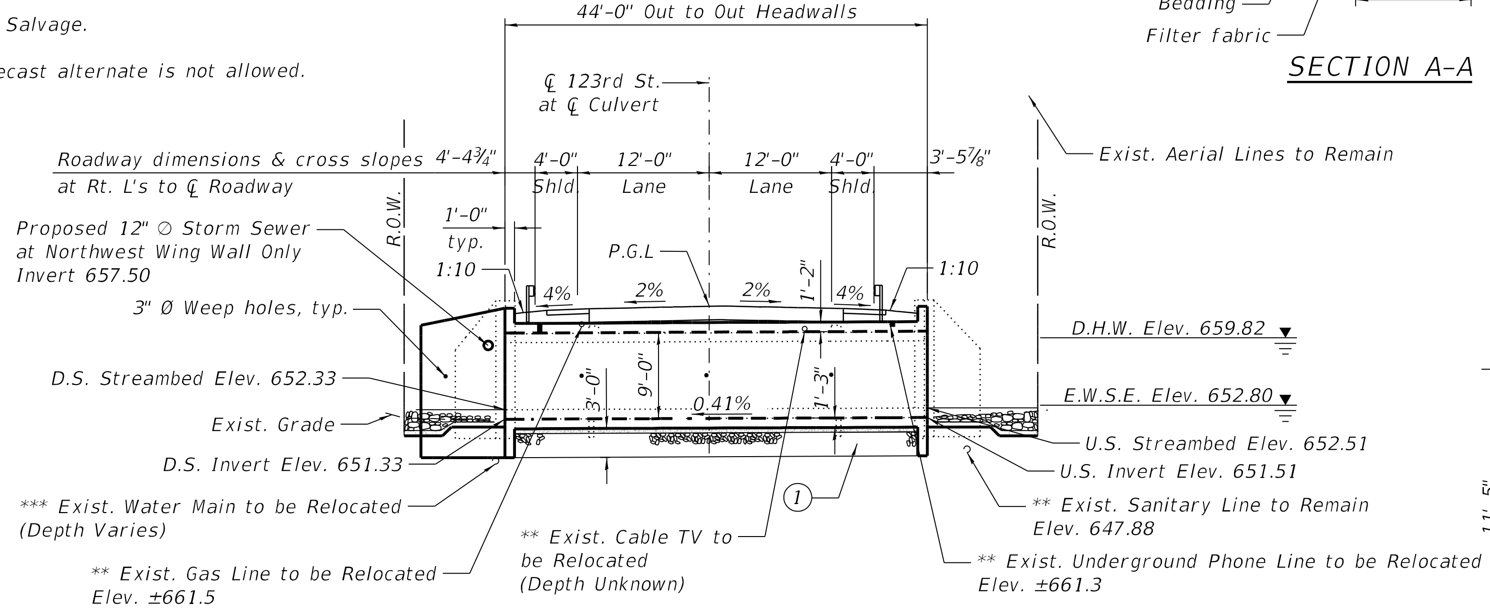
Existing Structure: S.N. 016-0880. Original construction year unknown. Structure consists of a 6.55-foot wide by 7-foot high reinforced concrete arch with 6.55-foot wide by 7-foot high concrete box culvert extensions. Skew is 25 degrees. In 1954, the original 26.6-foot long culvert was lengthened 8.9 feet on each end. Concrete L-type cantilever wingwalls were added. Existing structure will be removed and replaced using a detour to maintain traffic.

No Salvage.

Precast alternate is not allowed.



SECTION A-A



LONGITUDINAL SECTION

(Elevations and culvert dimensions along ℄ of culvert)

*Slab and wall thickness may be refined during final design

** Depth assumption provided by SUE Electronic Depth Data.

*** Depth assumption provided by Palos Pothole Elevation Data.

WATERWAY INFORMATION

Drainage Area= 3.08 square miles

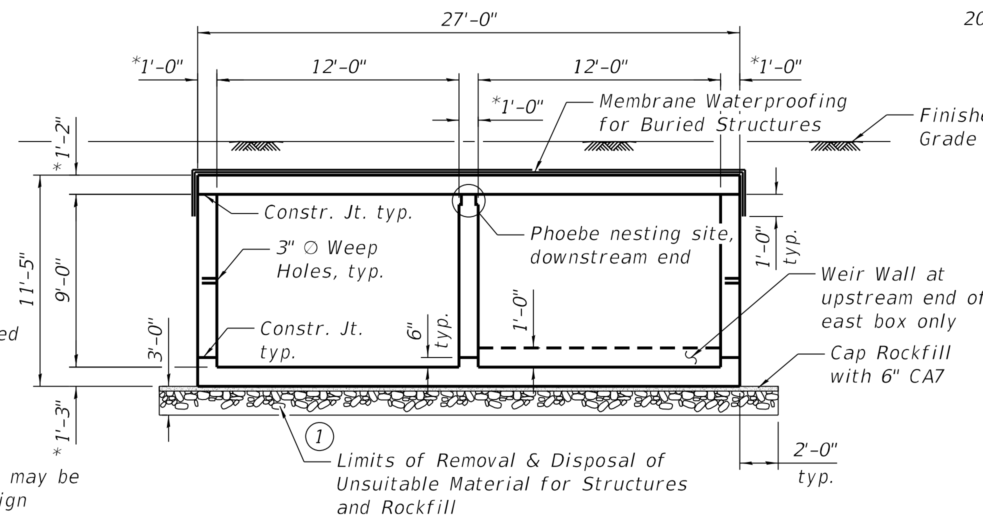
Existing Overopping Elev. = 661.22 at Sta 115+56

Proposed Overopping Elev. = 661.96 at Sta 115+30

Flood Event	Freq. Yr.	Discharge ft^3/s	Waterway Opening-ft^2 Existing	Waterway Opening-ft^2 Proposed	Natural H.W.E.- ft	Head -ft Existing	Head -ft Proposed	Headwater Elevation-ft Existing	Headwater Elevation-ft Proposed
	10	296	35.0	129.3	657.90	1.20	0.00	659.10	657.90
Design	50	614	42.0	171.7	659.82	1.96	0.00	661.78	659.82
Base	100	776	42.0	180.0	661.46	1.34	0.20	662.80	661.66
Scour Design Check	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Overtop Existing	39	527	42.0	N/A	N/A	N/A	N/A	661.22	N/A
Overtop Proposed	145	876	42.0	180.0	N/A	N/A	N/A	N/A	661.96
Max. Calc.	500	1665	42.0	180.0	663.21	0.85	0.78	664.06	663.99

10-Year Velocity through Existing Structure = 9 ft/s

10-Year Velocity through Proposed Structure = 2 ft/s



SECTION THRU BARREL

(Looking North)

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition.

LOADING HL-93

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

DESIGN STRESSES

FIELD UNITS (CULVERT)

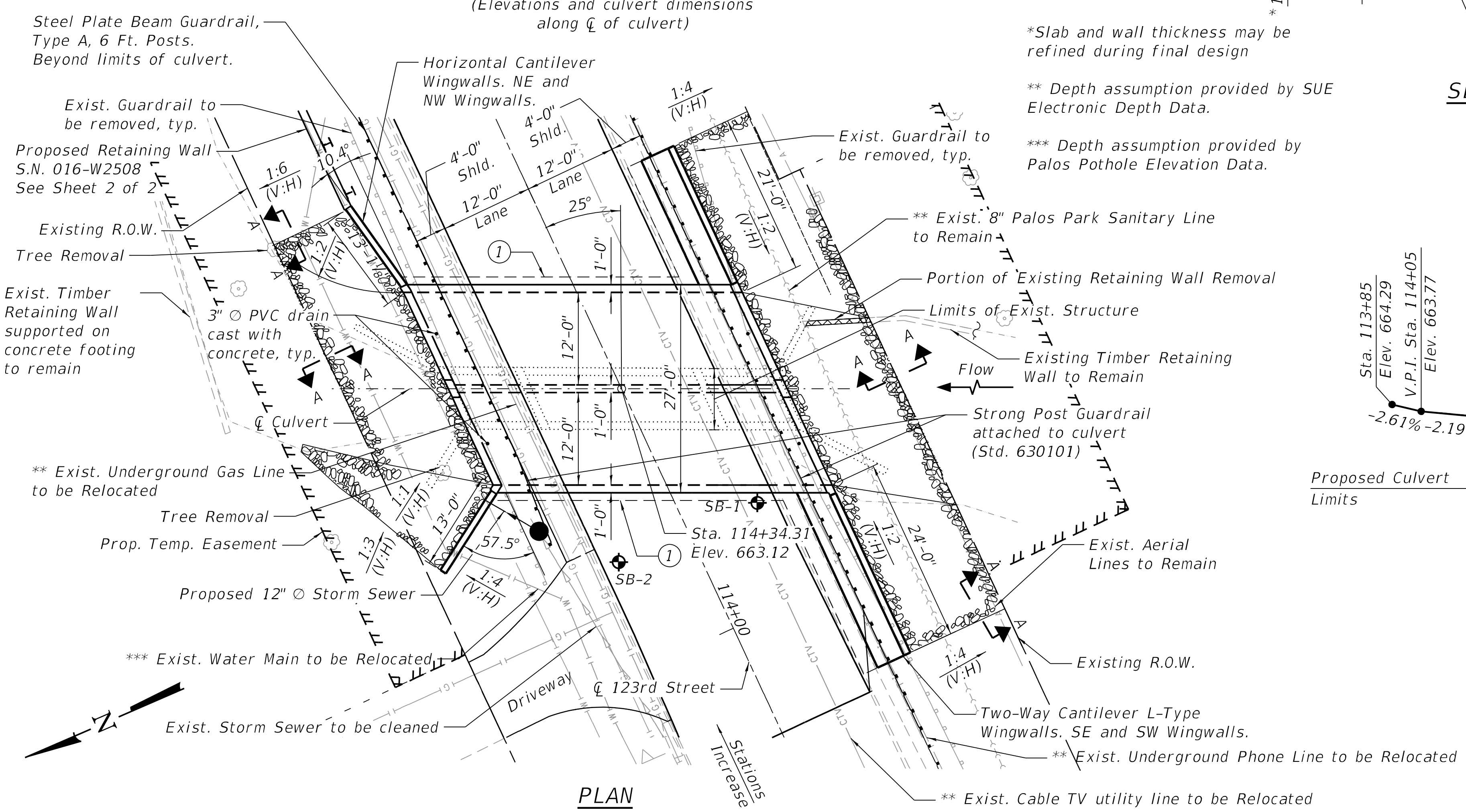
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

FIELD UNITS (RETAINING WALL)

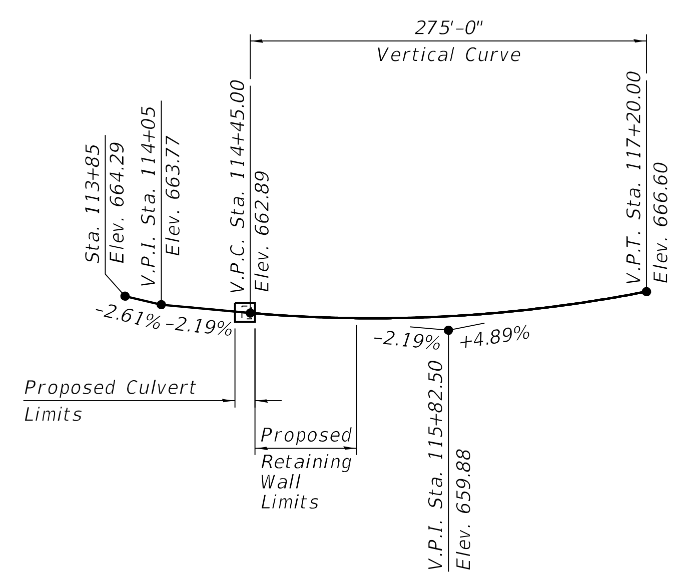
f'c = 4,000 psi
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)

HIGHWAY CLASSIFICATION

F.A.U. 1587 (W. 123rd Street)
Functional Class: Minor Arterial
ADT: 7,850 (2018); 9,000 (2040)
ADTT: 220 (2018); 254 (2040)
DHV: 780 (2018)
Design Speed: 40 m.p.h.
Posted Speed: 35 m.p.h.
Two-way Traffic
Directional Distribution: 50:50

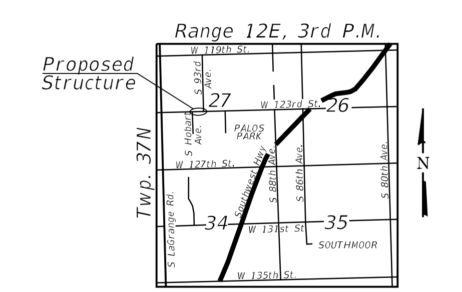


PLAN



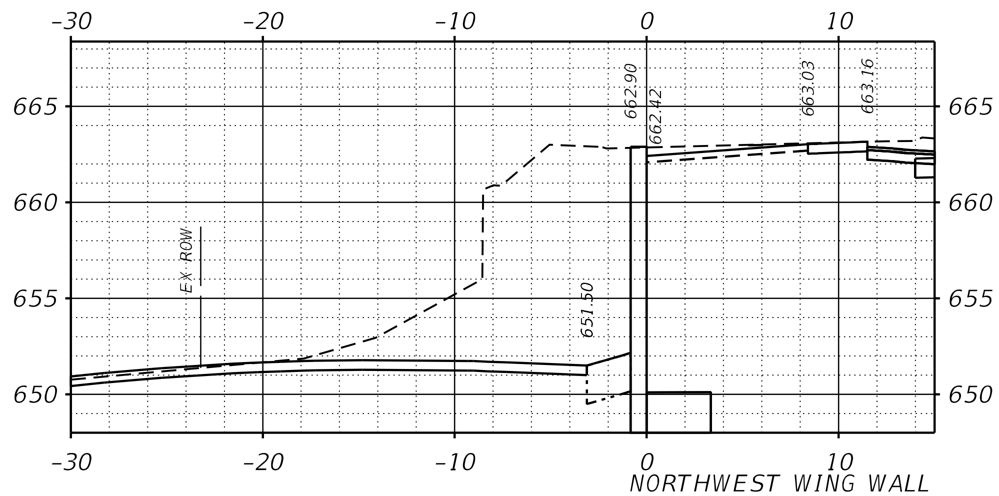
PROFILE GRADE

(Along ℄ 123rd Street)

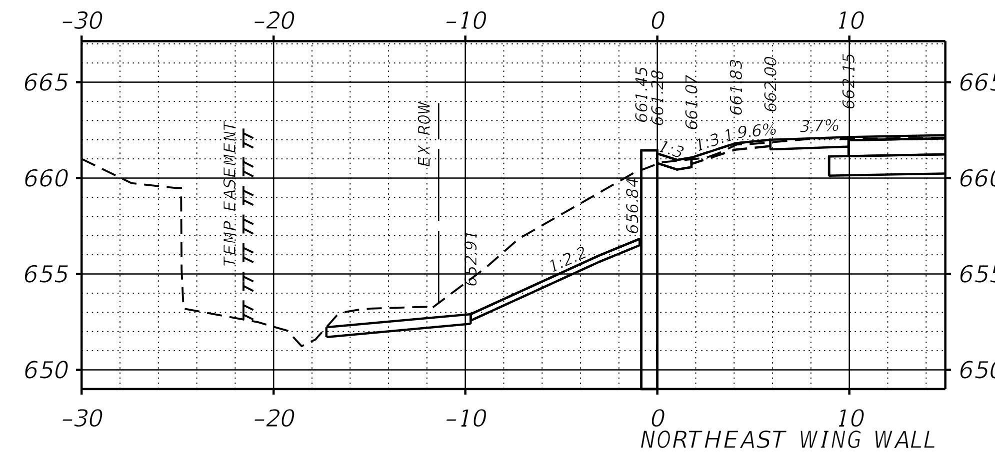


LOCATION SKETCH

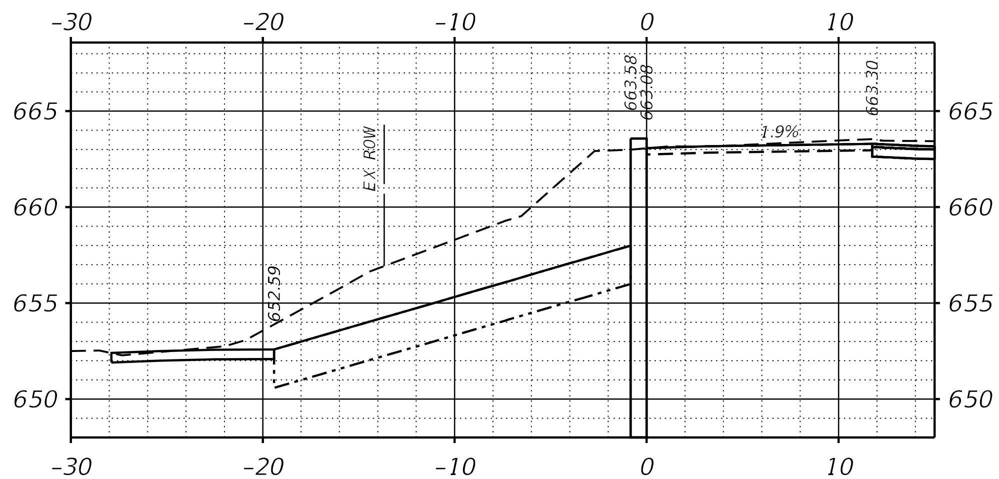
GENERAL PLAN AND ELEVATION
F.A.U. 1587 (W. 123rd STREET)
OVER WEST BRANCH OF MILL CREEK
SECTION F.A.U. 1587 22 CR
COOK COUNTY
STATION 114+34.31
STRUCTURE NO. 016-1668



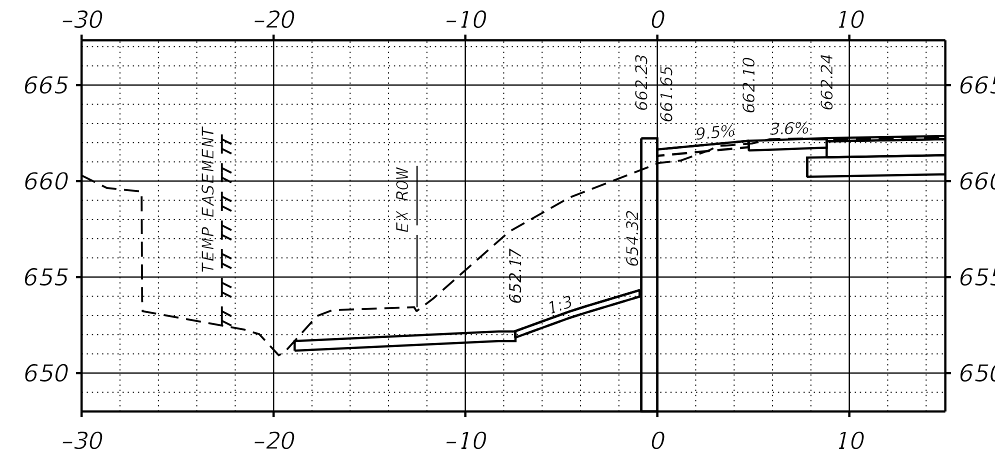
NORTHWEST WING WALL
(EAST END)



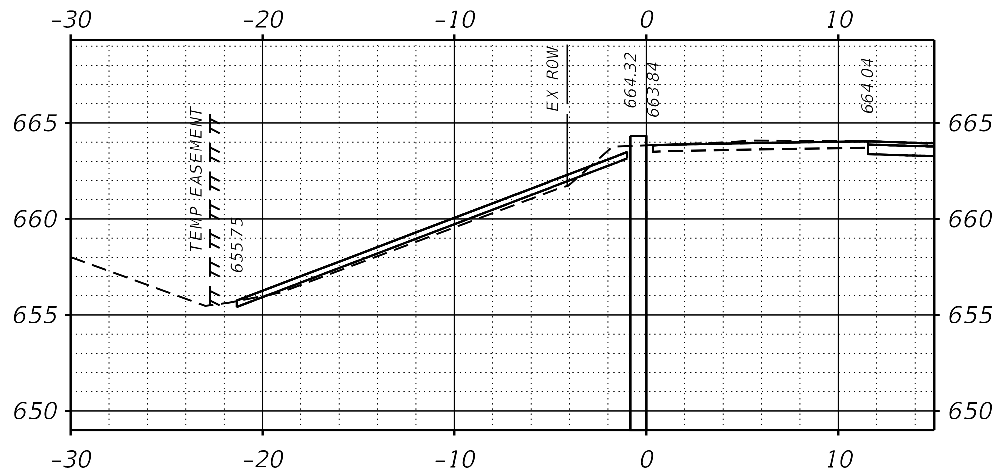
NORTHEAST WING WALL
(EAST END)



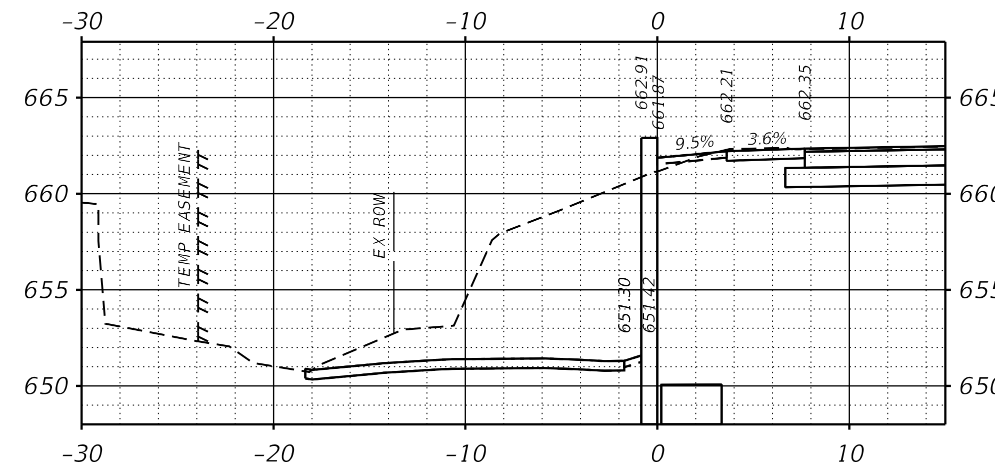
NORTHWEST WING WALL
(MIDDLE)



NORTHEAST WING WALL
(MIDDLE)



NORTHWEST WING WALL
(WEST END)



NORTHEAST WING WALL
(WEST END)

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AEG ATLAS ENGINEERING GROUP, LTD.

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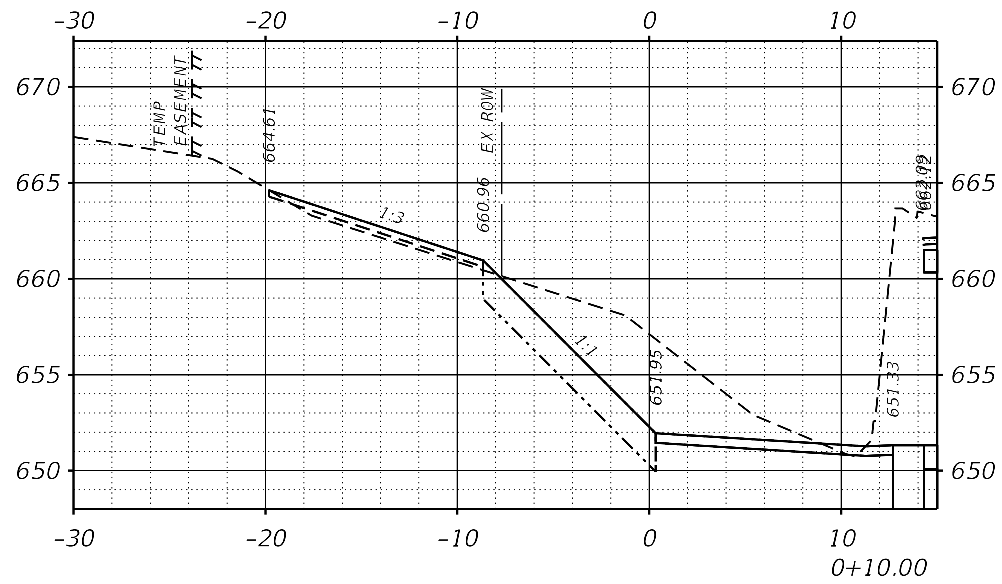
PLOT DATE = 12/14/2023	DATE -	REVISED -	

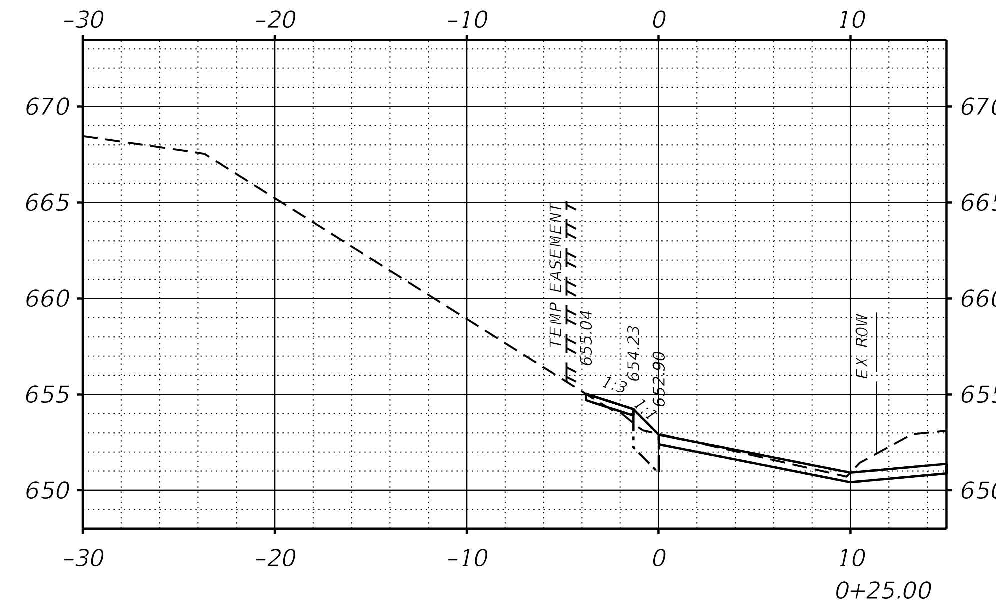
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

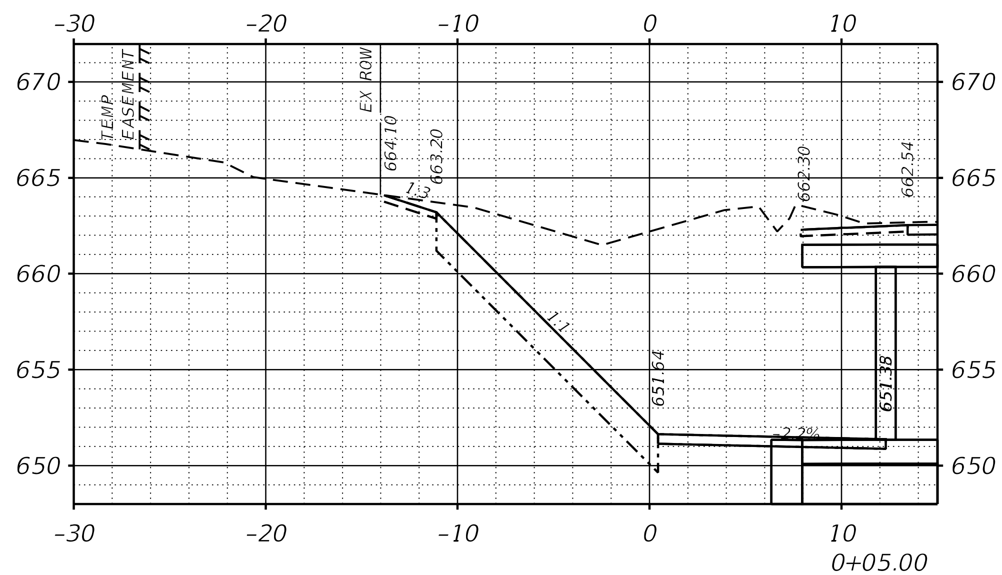
CROSS SECTIONS
NORTH WING WALLS OF WEST CULVERT AT 123RD STREET

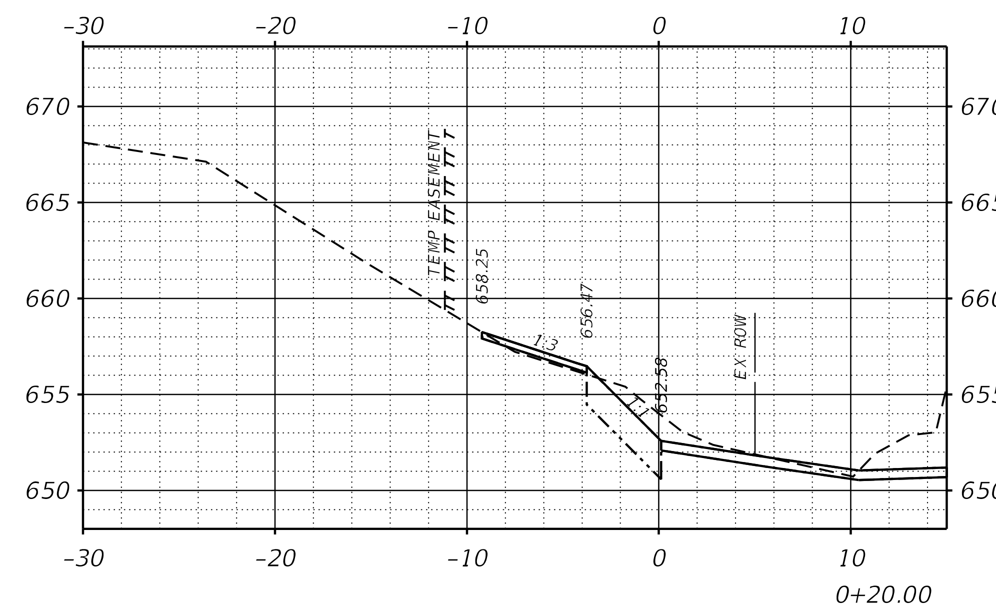
SCALE: 1"=5' | SHEET 2 OF 2 SHEETS | STA. TO STA.

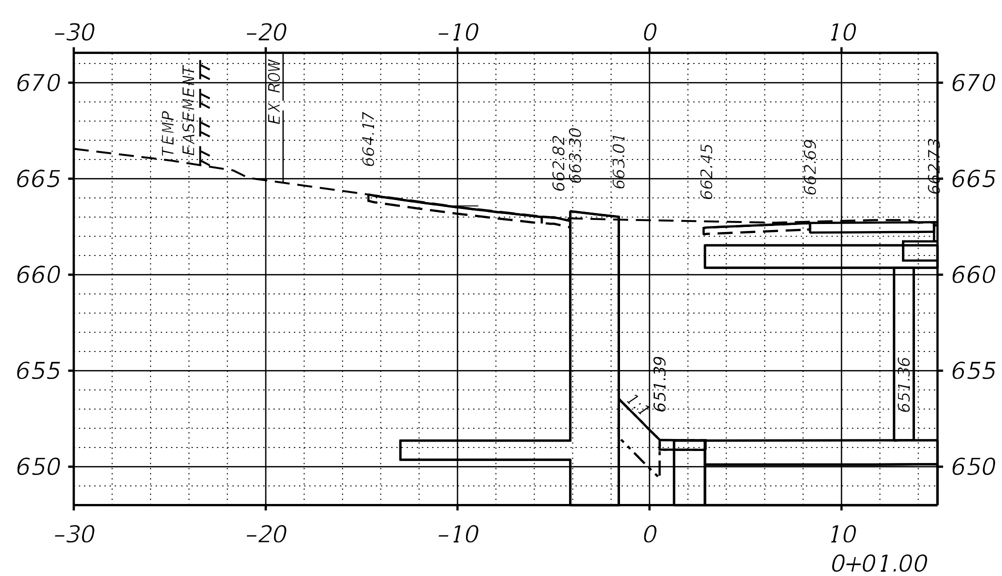
F.A.U RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1587	FAU 1587 22 CR	COOK	60	
		CONTRACT NO. 62T94		
		ILLINOIS	FED. AID PROJECT	

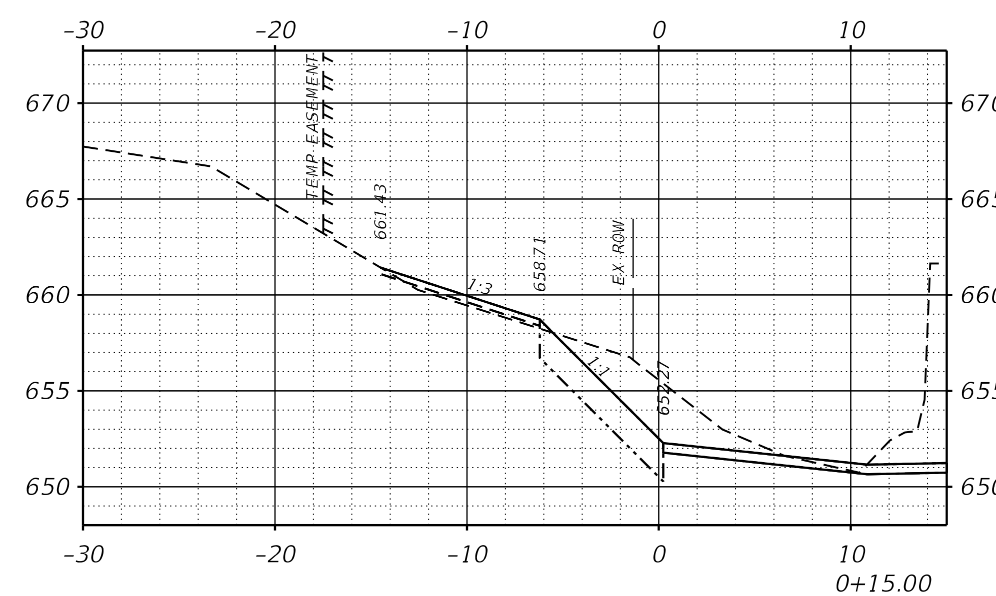












NOTE:

BEGIN STATION 0+00.00
AT NORTHWEST END OF THE CULVERT

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	DRAWN -	REVISED -	
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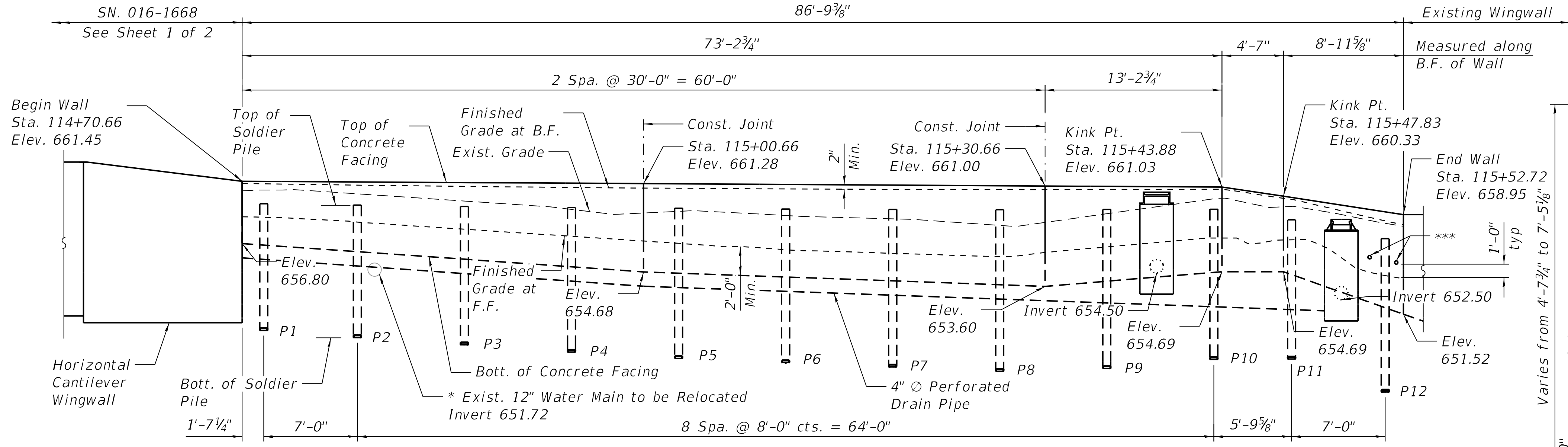
PLOT DATE = 10/16/2023	DATE -	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

####
####

SCALE: #### SHEET #### OF 1 SHEETS STA. TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
####	####	####	1	####
		CONTRACT NO. ####		
		ILLINOIS	FED. AID PROJECT	



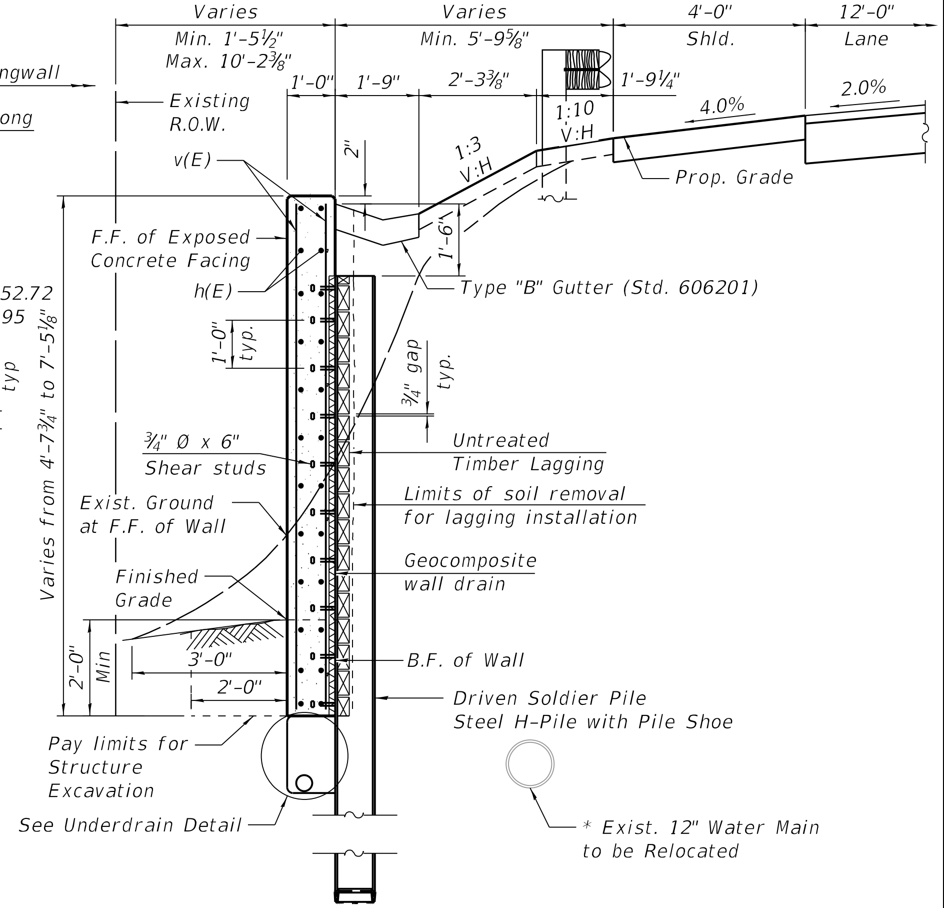
UNFOLDED ELEVATION

(Looking North at Back Face of Wall)

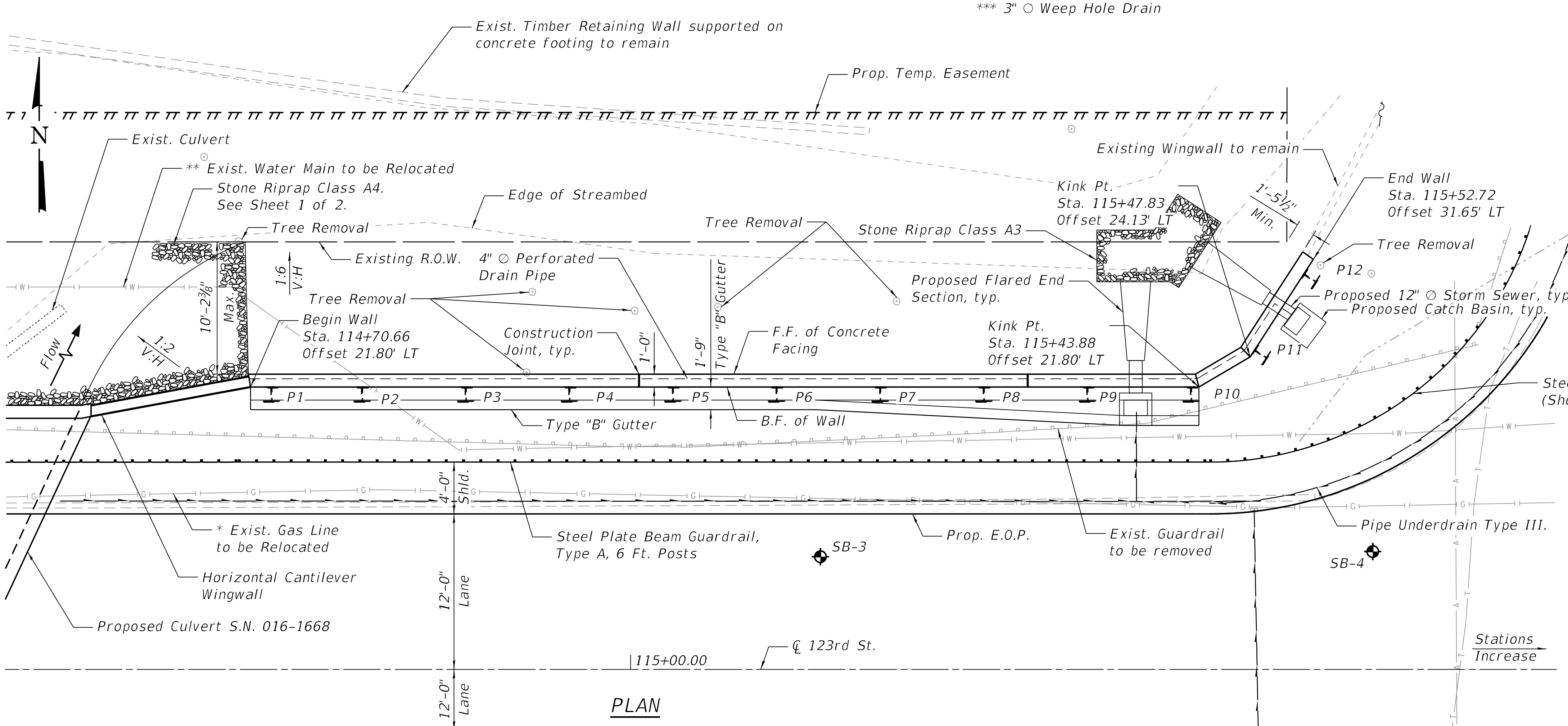
* Depth assumption provided by SUE Electronic Depth Data.

** Depth assumption provided by Palos Pothole Elevation Data.

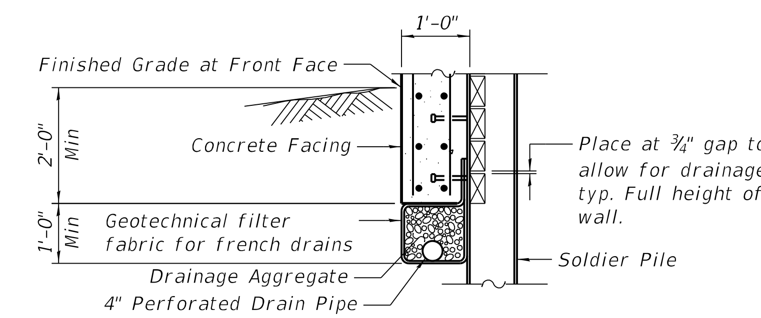
*** 3" ○ Weep Hole Drain



SECTION THRU SOLDIER PILE WALL



PLAN



UNDERDRAIN DETAIL

NOTE

Retaining wall stations and offsets are measured from the ℄ of 123rd St. to Back Face of the retaining wall.

GENERAL PLAN AND ELEVATION
RETAINING WALL ALONG F.A.U. 1587 (W. 123rd STREET)
SECTION F.A.U. 1587 22 CR
COOK COUNTY
STATION 114+70.66 TO 115+52.72
STRUCTURE NO. 016-W2508

ATLAS ENGINEERING GROUP, LTD.	USER NAME =	DESIGNED - SPB	REVISED -
		CHECKED - JKL	REVISED -
	PLOT SCALE =	DRAWN - SPB	REVISED -
	PLOT DATE =	CHECKED - 12/8/2023	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

RETAINING WALL PLAN AND ELEVATION
STRUCTURE NO. 016–W2508

SHEET 2 OF 2 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1587	FAU 1587 22 CR	COOK	2	2
		CONTRACT NO. 62T94		
		ILLINOIS FED. AID PROJECT		

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12/13/2023 12:50:52 PM

Bench Mark: Set X on east curb return at 123rd and 93rd Street, Northing 1821627.928, Easting 1117075.114, Elev. 662.609.

Existing Structure: S.N. 016-1359 Original construction year of R.C. double box (4'x4' and 5'x4') is unknown; in 1954 extended 6 ft north and headwalls extended upward by approx. 2.5 ft. Total barrel length is approx. 46'-2".

Traffic to be maintained by a detour.

No salvage.

Precast alternate is not allowed.

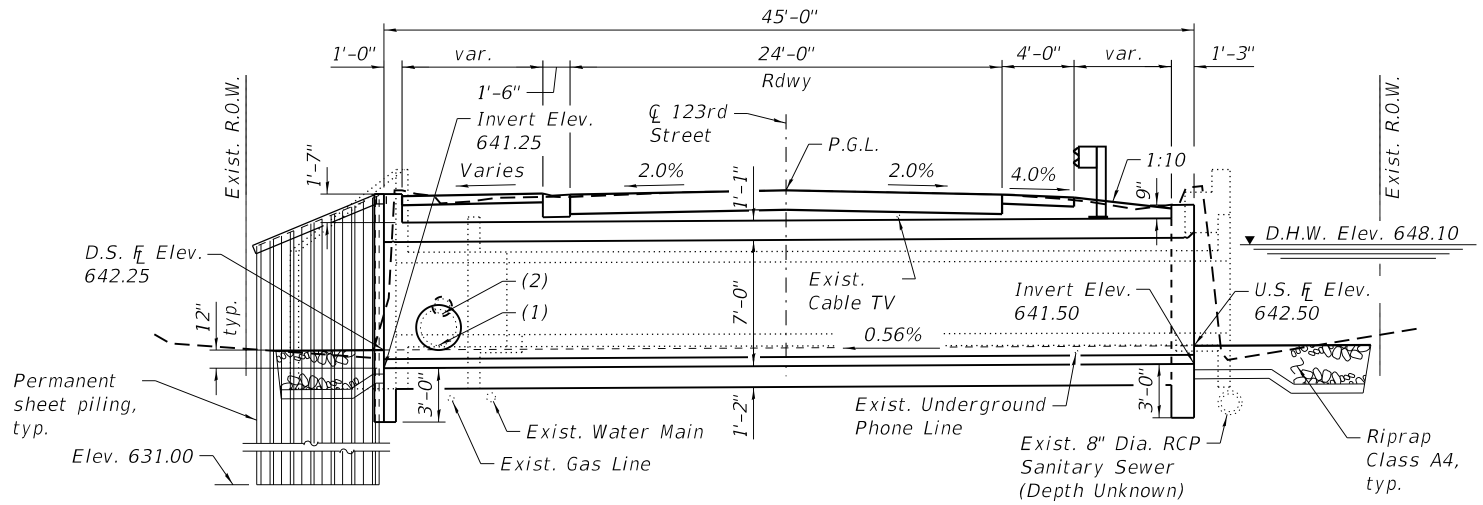
(1) Exist. 24" Dia. RCP Storm Sewer Inv. Elev. 642.51 (E. Wall)
(2) Exist. 10" Dia. RCP Storm Sewer Inv. Elev. 644.26 (W. Wall)

WATERWAY INFORMATION

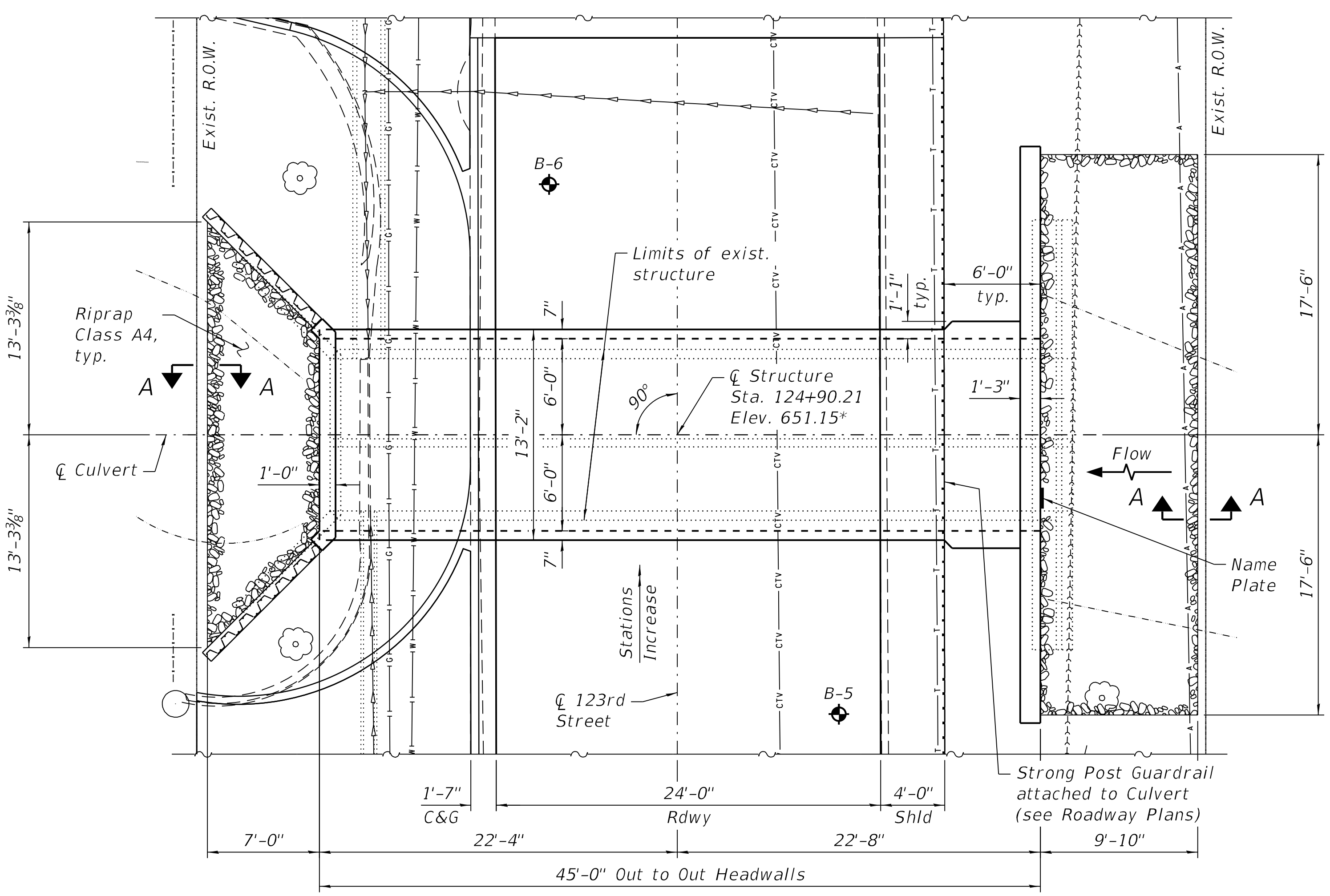
Drainage Area= 6.5 square miles
Existing Overtopping Elev. = 651.11 at Sta 125+15
Proposed Overtopping Elev. = 651.11 at Sta 125+15

Flood Event	Freq. Yr.	Discharge ft^3/s	Waterway Opening-ft^2 Existing	Waterway Opening-ft^2 Proposed	Natural H.W.E.- ft	Head -ft Existing	Head -ft Proposed	Headwater Elevation-ft Existing	Headwater Elevation-ft Proposed
	10	166	36.0	49.2	646.60	0.42	0.16	647.02	646.76
Design	50	380	36.0	67.2	648.10	2.59	0.51	650.69	648.61
Base	100	468	36.0	71.5	648.46	3.01	0.72	651.47	649.18
Overtop Existing	74	413	36.0	69.0	-	-	-	651.11	-
Overtop Proposed	247	782	36.0	72.0	-	-	-	-	651.11
Max. Calc.	500	1321	36.0	72.0	650.96	1.99	1.62	652.95	652.58

10 year velocity through Existing Structure = 4.6 ft/s
10 year velocity through Proposed Structure = 3.4 ft/s

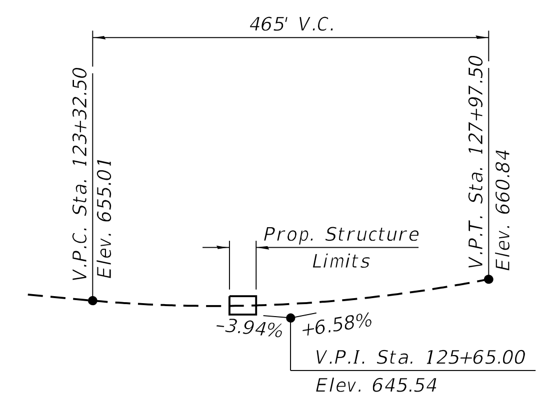


LONGITUDINAL SECTION

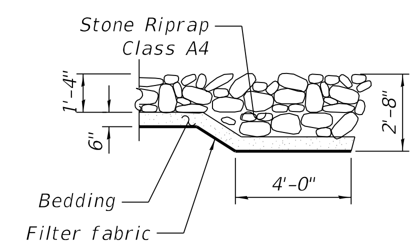


PLAN

* Approximated from survey



EXIST. PROFILE GRADE
(123rd Street)
(Approximated from survey)



SECTION A-A

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition.

LOADING HL-93

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

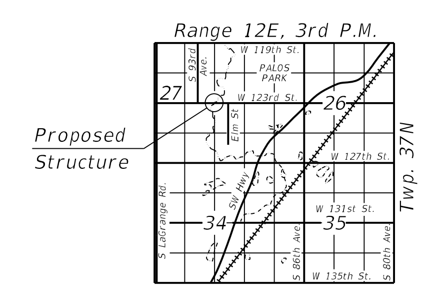
DESIGN STRESSES

FIELD UNITS:

f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (Permanent Sheet Piling)

LEGEND

BSB (Bridge Soil Boring)
Existing Aerial Lines
Existing Underground Gas Line
Existing Underground Water Line
Existing Underground Cable TV
Existing Sanitary Sewer
Existing Storm Sewer
Existing Underground Phone Line
Existing Fence



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
123RD STREET/McCARTHY ROAD
OVER MILL CREEK
F.A.U. RTE. 1587
SEC. FAU 1587 22 CR
COOK COUNTY
STATION 124+90.21
STRUCTURE NO. 016-8300

HDR
9450 W. BRYN MAWR AVE.
ROSEMONT, IL 60018

USER NAME =	DESIGNED - RGB	REVISED -	
	CHECKED - MBQ	REVISED -	
PLOT SCALE =	DRAWN - JM	REVISED -	
PLOT DATE = 2/14/2023	CHECKED - RGB	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN & ELEVATION
STRUCTURE NO. 016-8300

SHEET 1 OF 6 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
1587	FAU 1587 22 CR	COOK	58	40

CONTRACT NO. 62T94
ILLINOIS FED. AID PROJECT PROT-J5P0(118)

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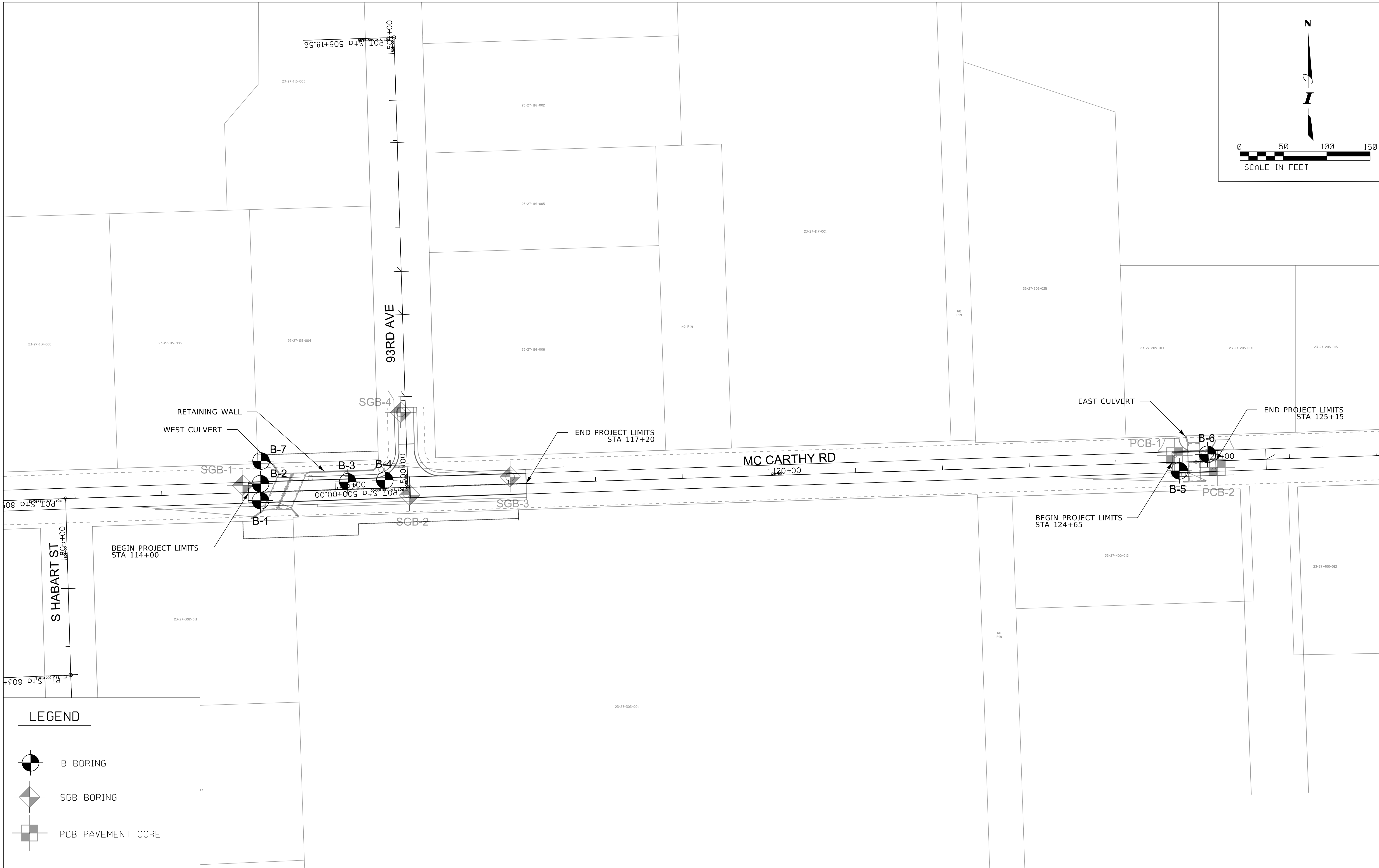
2/14/2023 3:05:56 PM

APPENDIX B

SOIL BORING LOCATION PLAN

AND SUBSURFACE PROFILES



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PLOT SCALE = $SCALE$
USER NAME = $USER$

GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1.630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME	= $USER$	DESIGNED	- ES
SHEET SIZE	= $SHEETSIZE$	DRAWN	- NN
PLOT SCALE	= $SCALE$	CHECKED	- DE
PLOT DATE	= $DATE$	DATE	- 08/04/2022

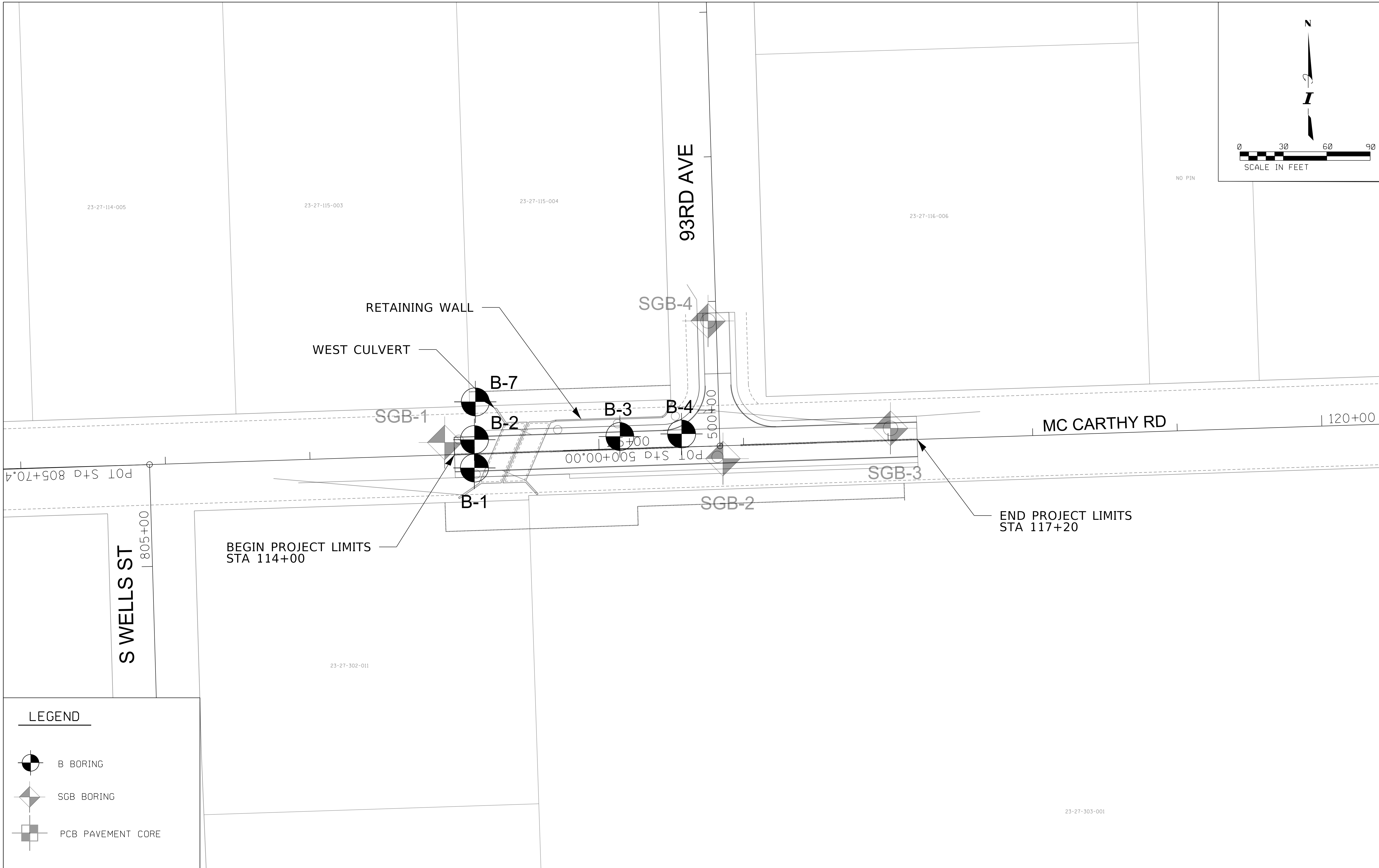
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. PTB-200-004
SOIL BORING LOCATION PLAN
PALOS PARK, ILLINOIS

SCALE: 1:50 | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	4	1

CONTRACT NO. PTB-200-004
ILLINOIS | FED. AID PROJECT



GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME	= $USER$	DESIGNED	- ES
SHEET SIZE	= $SHEETSIZE$	DRAWN	- NN
PLOT SCALE	= 60.0000 ' / in.	CHECKED	- DE
PLOT DATE	= 10/17/2023	DATE	- 08/04/2022

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. PTB-200-004
SOIL BORING LOCATION PLAN
PALOS PARK, ILLINOIS
SCALE: 1:30 | SHEET 1 OF 2 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	6	1
		CONTRACT NO. PTB-200-004		
ILLINOIS	FED. AID PROJECT			

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PEN TABLE = $PENTBL$
PLOT DATE = $DATE$
TIME = $TIME$
SHEET SIZE = $SHEETSIZE$
PLOT SCALE = $SCALE$
USER NAME = $USER$

GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME	= $USER$	DESIGNED	- ES
SHEET SIZE	= $SHEETSIZE$	DRAWN	- NN
PLOT SCALE	= $SCALE$	CHECKED	- DE
PLOT DATE	= $DATE$	DATE	- 08/04/2022

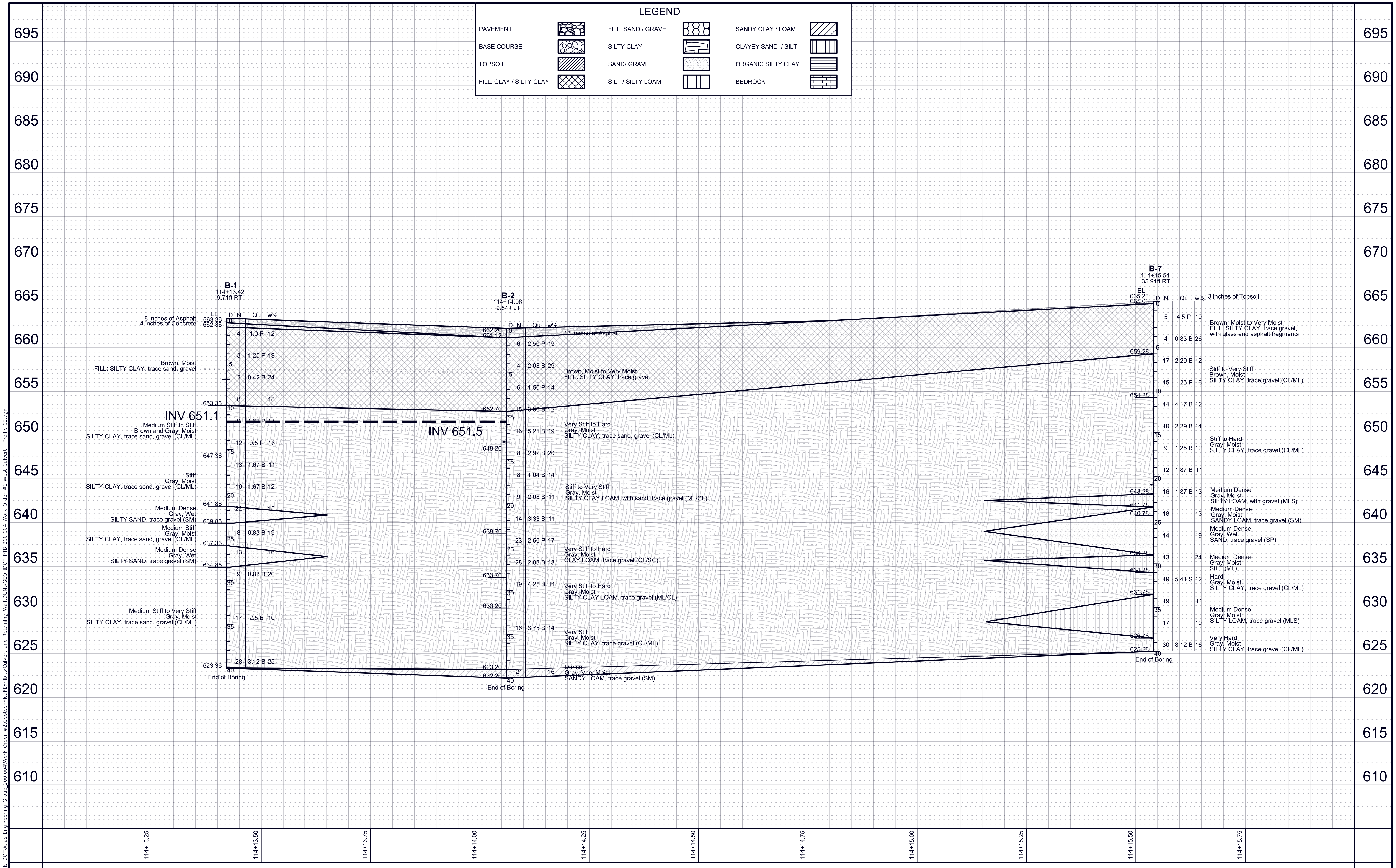
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. PTB-200-004
SOIL BORING LOCATION PLAN
PALOS PARK, ILLINOIS

SCALE: 1:30 | SHEET 2 OF 2 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	6	2

CONTRACT NO. PTB-200-004
ILLINOIS | FED. AID PROJECT



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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT STV PTB 200–004 – WEST CULVERT
PALOS PARK, ILLINOIS
BORING PROFILE

SCALE: AS NOTED | SHEET 2 OF 2 SHEETS | STA. 114+13.25 TO STA. 114+15.75

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	6	5
CONTRACT NO. PTB-200-004				
ILLINOIS	FED. AID PROJECT			

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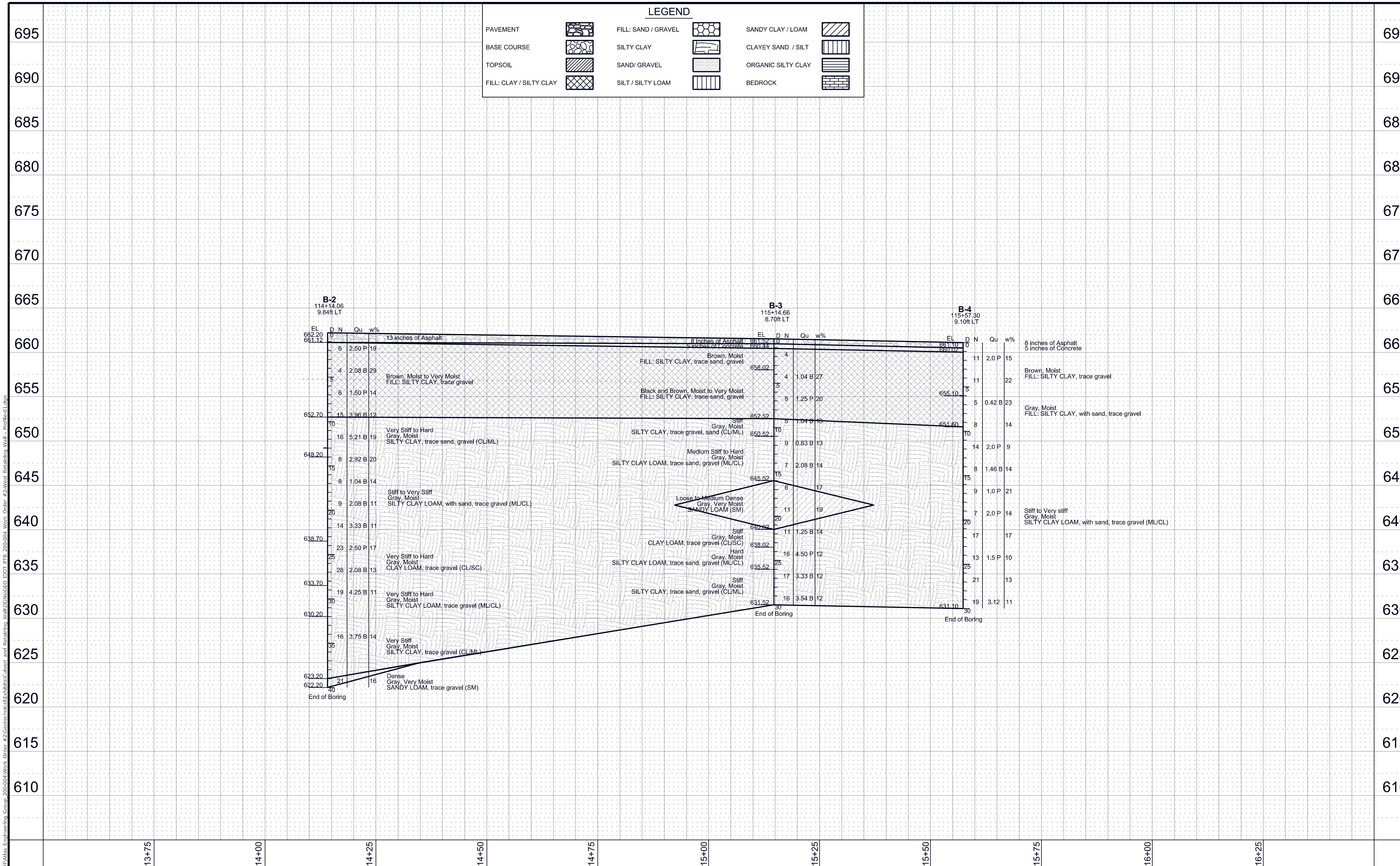

GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

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	DRAWN - NN	REVISED -	
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PLOT DATE = 8/12/2022	DATE - 08/04/2022	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT STV PTB 200-004 – WEST RETAINING WALL
PALOS PARK, ILLINOIS
BORING PROFILE

SCALE: AS NOTED | SHEET 1 OF 1 SHEETS | STA. 113+50 TO STA. 116+50

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	6	4
		CONTRACT NO. PTB-200-004		
	ILLINOIS	FED. AID PROJECT		

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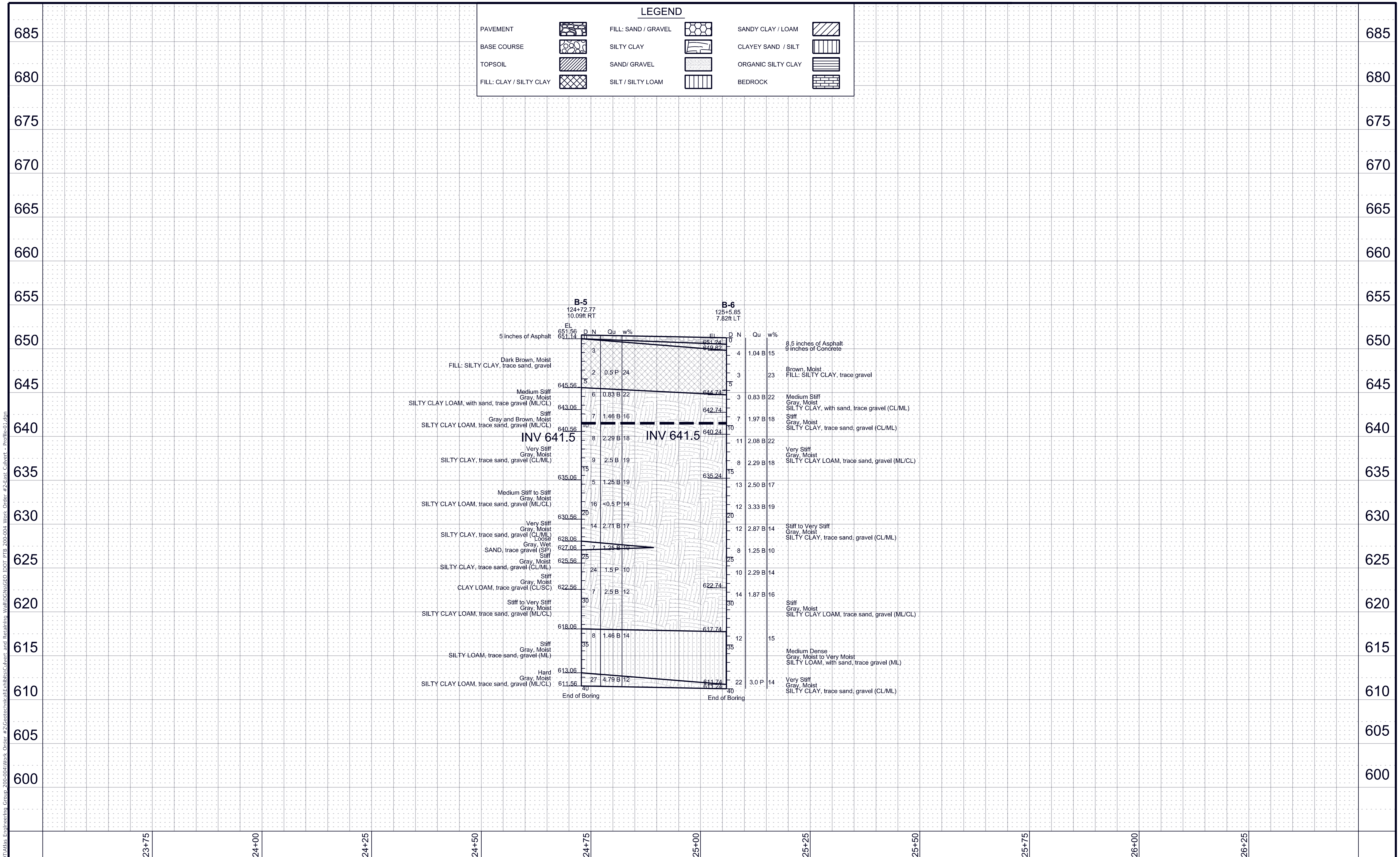

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GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME = nnano	DESIGNED - ES	REVISED -
	DRAWN - NN	REVISED -
PLOT SCALE = 240.0000 ' / ft.	CHECKED - DE	REVISED -
PLOT DATE = 8/12/2022	DATE - 08/04/2022	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT STV PTB 200–004 – EAST CULVERT
PALOS PARK, ILLINOIS
BORING PROFILE

SCALE: AS NOTED | SHEET 1 OF 1 SHEETS | STA. 123+50 TO STA. 126+50

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	6	6

CONTRACT NO. PTB-200-004

ILLINOIS | FED. AID PROJECT

APPENDIX C

SOIL BORING LOGS

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

SOIL BORING LOG

Date 7/20/22

ROUTE 123rd Street **DESCRIPTION** West Culvert **LOGGED BY** AA

SECTION 123rd Street **LOCATION** Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** ,
Latitude , **Longitude**

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 91

STRUCT. NO. SN 016-1668
Station 114+40

BORING NO. B-1
Station 114+13.42
Offset 9.71ft RT
Ground Surface Elev. 663.36 ft

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

Groundwater Elev.:
First Encounter 656.4 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
8 inches of Asphalt 4 inches of Concrete	662.36				
Brown, Moist FILL: SILTY CLAY, trace sand, gravel			2		
			2	1.0	12
			2	P	
			1		
			1	1.3	19
		-5	2	P	
			1		
		▼	1	0.4	24
			1	B	
Sand seam at 7.5 feet					
Cobble at 8.5 feet			4		
			4		18
	653.36	-10	4		
Medium Stiff to Stiff Brown and Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)			2		
			3	1.9	13
			6	P	
Cobble at 13.5 feet			6		
			6	0.5	16
		-15	6	P	
	647.36				
Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)			3		
			6	1.7	11
			7	B	
			2		
			3	1.7	12
		-20	7	B	
			11		
	641.86				
Medium Dense Gray, Wet SILTY SAND, trace gravel (SM)			12		15
			10		
	639.86				
Medium Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)			2		
			4	0.8	19
		-25	4	B	
	637.36				
Medium Dense Gray, Wet SILTY SAND, trace gravel (SM)			12		
			7		16
			6		
	634.86				
Medium Stiff to Very Stiff Gray, Moist SILTY CLAY, with sand, gravel (CL/ML)			2		
			4	0.8	20
		-30	5	B	
			8		
			8	2.5	10
		-35	9	B	
			9		
			12	3.1	25
	623.36	-40	16	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 7/18/22

ROUTE 123rd Street **DESCRIPTION** West Culvert/ Retaining Wall **LOGGED BY** DD

SECTION 123rd Street **LOCATION** Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** , **Latitude** , **Longitude**

COUNTY COOK **DRILLING RIG** CME 75 **DRILLING METHOD** HSA **HAMMER TYPE** AUTO **HAMMER EFF (%)** 91

STRUCT. NO. SN 016-1668
Station 114+40

BORING NO. B-2
Station 114+14.06
Offset 9.84ft LT
Ground Surface Elev. 662.20 ft

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

Groundwater Elev.:
First Encounter 649.2 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
13 inches of Asphalt				
661.12		2		
Brown, Moist to Very Moist FILL: SILTY CLAY, trace gravel		3	2.5	19
		3	P	
		2		
		2	2.1	29
	-5	2	B	
		2		
		2	1.5	14
		4	P	
		4		
652.70		6	4.0	12
Very Stiff to Hard Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)	-10	9	B	
		4		
		7	5.2	19
		9	B	
▼				
648.20		3		
Stiff to Very Stiff Gray, Moist SILTY CLAY LOAM, with sand, trace gravel (ML/CL)		3	2.9	20
	-15	5	B	
		1		
		3	1.0	14
		5	B	
		2		
		4	2.1	11
	-20	5	B	

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Very Stiff Gray, Moist SILTY CLAY LOAM, with sand, trace gravel (ML/CL) *(continued)*		3		
		5	3.3	11
		9	B	
638.70				
Very Stiff to Hard Gray, Moist CLAY LOAM, trace gravel (CL/SC)		5		
		10	2.5	17
	-25	13	P	
		8		
		15	2.1	13
Cobble at 27.0 feet		13	B	
633.70				
Very Stiff to Hard Gray, Moist SILTY CLAY LOAM, trace gravel (ML/CL)		18		
		7	4.3	11
	-30	12	B	
630.20				
Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)		15		
		6	3.8	14
	-35	10	B	
623.20		9		
Dense Gray, Very Moist		5		16
622.20	-40	16		

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 7/18/22

ROUTE 123rd Street **DESCRIPTION** West Culvert/ Retaining Wall **LOGGED BY** DD

SECTION 123rd Street **LOCATION** Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** ,
Latitude , **Longitude**

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 91

STRUCT. NO. SN 016-1668
Station 114+40

BORING NO. B-2
Station 114+14.06
Offset 9.84ft LT
Ground Surface Elev. 662.20 ft

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

Groundwater Elev.:
First Encounter 649.2 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SANDY LOAM, trace gravel (SM)				
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 7/18/22

ROUTE 123rd Street **DESCRIPTION** Retaining Wall **LOGGED BY** DD

SECTION 123rd Street **LOCATION** Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** , **Latitude** , **Longitude**

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 91

STRUCT. NO. SN 016- W2508
Station 115+00

BORING NO. B-3
Station 115+14.66
Offset 8.70ft LT
Ground Surface Elev. 661.52 ft

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

Groundwater Elev.:
First Encounter 650.5 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
8 inches of Asphalt 5 inches of Concrete	660.44				
Brown, Moist FILL: SILTY CLAY, trace sand, gravel			3 2 2		
	658.02				
Black and Brown, Moist to Very Moist FILL: SILTY CLAY, trace sand, gravel		-5	1 2 2	1.0 B	27
			2 2 6	1.3 P	20
	652.52		2		
Stiff Gray, Moist SILTY CLAY, trace gravel, sand (CL/ML)		-10	3 2	1.0 B	13
	650.52 ▼				
Medium Stiff to Hard Gray, Moist SILTY CLAY LOAM, trace sand, gravel (ML/CL) 3 inch Sand Seam at 11.5 feet			2 4 5	0.8 B	13
		-15	1 3 4	2.1 B	14
	645.52				
Loose to Medium Dense Gray, Very Moist SANDY LOAM (SM)			WH 3 3		17
		-20	3 6 5		19
Loose to Medium Dense Gray, Very Moist SANDY LOAM (SM) *(continued)*	640.02		3		
Stiff Gray, Moist CLAY LOAM, trace gravel (CL/SC)			4 7	1.3 B	14
	638.02				
Hard Gray, Moist SILTY CLAY LOAM, trace sand, gravel (ML/CL)		-25	4 7 9	4.5 P	12
	635.52				
Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)			4 7 10	3.3 B	12
	631.52	-30	4 7 9	3.5 B	12
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 7/18/22

ROUTE 123rd Street **DESCRIPTION** Retaining Wall **LOGGED BY** DD

SECTION 123rd Street **LOCATION** Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** ,
Latitude , **Longitude**

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 91

STRUCT. NO. SN 016- W2508
Station 115+00

BORING NO. B-4
Station 115+57.30
Offset 9.10ft LT
Ground Surface Elev. 661.10 ft

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

Groundwater Elev.:
First Encounter 655.1 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
8 inches of Asphalt 5 inches of Concrete	660.02				
Brown, Moist FILL: SILTY CLAY, trace gravel			3 3 8	2.0 P	15
		-5	5 6 5		22
	655.10 ▼				
Gray, Moist FILL: SILTY CLAY, with sand, trace gravel			1 1 4	0.4 B	23
	651.60	-10	4 3 5		14
Stiff to Very Stiff Gray, Moist SILTY CLAY LOAM, with sand, trace gravel (ML/CL)			3 7 7	2.0 P	9
		-15	3 2 6	1.5 B	14
			2 3 6	1.0 P	21
		-20	1 3 4	2.0 P	14
Stiff to Very Stiff Gray, Moist SILTY CLAY LOAM, with sand, trace gravel (ML/CL) *(continued)*			6 10 7		17
		-25	8 6 7	1.5 P	10
			7 11 10		13
	631.10	-30	4 8 11	3.1 B	11
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 7/19/22

ROUTE 123rd Street **DESCRIPTION** East Culvert **LOGGED BY** AA

SECTION 123rd Street **LOCATION** Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** ,
Latitude , **Longitude**

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 91

STRUCT. NO. SN 016-8300
Station 124+90

BORING NO. B-5
Station 124+72.77
Offset 10.09ft RT
Ground Surface Elev. 651.56 ft

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

Groundwater Elev.:
First Encounter 645.6 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
5 inches of Asphalt	651.14				
Dark Brown, Moist FILL: SILTY CLAY, trace sand, gravel			2 1 2		
		-5	1 1 1	0.5 P	24
	645.56 ▼				
Medium Stiff Gray, Moist SILTY CLAY LOAM, with sand, trace gravel (ML/CL)			WH 1 5	0.8 B	22
	643.06				
Stiff Gray and Brown, Moist SILTY CLAY LOAM, trace sand, gravel (ML/CL)		-10	1 3 4	1.5 B	16
	640.56				
Very Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)			4 3 5	2.3 B	18
		-15	2 4 5	2.5 B	19
	635.06				
Medium Stiff to Stiff Gray, Moist SILTY CLAY LOAM, trace sand, gravel (ML/CL) 2 inch Sand seam at 17.5 feet			2 2 3	1.3 B	19
		-20	4 8 8	<0.5 P	14

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	630.56				
Very Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)			2 4 10	2.7 B	17
	628.06				
Loose Gray, Wet SAND, trace gravel (SP)	627.06	-25	3 3 4	1.3 B	19
Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)	625.56				
Stiff Gray, Moist CLAY LOAM, trace gravel (CL/SC)			4 17 7	1.5 P	10
	622.56				
Stiff to Very Stiff Gray, Moist SILTY CLAY LOAM, trace sand, gravel (ML/CL)		-30	4 3 4	2.5 B	12
	618.06				
Loose Gray, Moist SILTY LOAM, trace sand, gravel (ML)		-35	2 3 5	1.5 B	14
	613.06				
Hard Gray, Moist SILTY CLAY LOAM, trace sand,	611.56	-40	5 11 16	4.8 B	12

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 7/19/22

ROUTE 123rd Street DESCRIPTION East Culvert LOGGED BY AA

SECTION 123rd Street LOCATION Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** ,
Latitude , Longitude

COUNTY COOK DRILLING RIG CME 75 HAMMER TYPE AUTO
DRILLING METHOD HSA HAMMER EFF (%) 91

STRUCT. NO. SN 016-8300
Station 124+90

BORING NO. B-5
Station 124+72.77
Offset 10.09ft RT
Ground Surface Elev. 651.56 ft

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

Groundwater Elev.:
First Encounter 645.6 ft ▼
Upon Completion N/A ft
After N/A Hrs. N/A ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
gravel (ML/CL)				
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 7/19/22

ROUTE 123rd Street **DESCRIPTION** East Culvert **LOGGED BY** AA

SECTION 123rd Street **LOCATION** Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** ,
Latitude , **Longitude**

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 91

STRUCT. NO. SN 016-8300
Station 124+90

BORING NO. B-6
Station 125+5.85
Offset 7.82ft LT
Ground Surface Elev. 651.24 ft

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

Groundwater Elev.:
First Encounter 645.2 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
8.5 inches of Asphalt 9 inches of Concrete	649.82				
Brown, Moist FILL: SILTY CLAY, trace gravel			5 2 2	1.0 B	15
		-5	1 2 1		23
	644.74	▼	WH 1 2	0.8 B	22
Medium Stiff Gray, Moist SILTY CLAY, with sand, trace gravel (CL/ML)	642.74				
Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)	640.24	-10	1 3 4	2.0 B	18
Very Stiff Gray, Moist SILTY CLAY LOAM, trace sand, gravel (ML/CL)			2 3 8	2.1 B	22
	635.24	-15	1 3 5	2.3 B	18
Stiff to Very Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)			3 4 9	2.5 B	17
		-20	1 5 7	3.3 B	19

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Very Stiff Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML) *(continued)* 3 inch Sand seam at 21.0 feet			4 6 6	2.9 B	14
		-25	4 4 4	1.3 B	10
	622.74		2 4 6	2.3 B	14
Stiff Gray, Moist SILTY CLAY LOAM, trace sand, gravel (ML/CL)	617.74	-30	3 7 7	1.9 B	16
Medium Dense Gray, Moist to Very Moist SILTY LOAM, with sand, trace gravel (ML)	611.74	-35	3 6 6		15
			5 10 12	3.0 P	14
Very Stiff	611.24	-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 7/19/22

ROUTE	123rd Street	**DESCRIPTION**	East Culvert	**LOGGED BY**	AA
SECTION	123rd Street	**LOCATION**	Palos Park, IL, **SEC.** , **TWP.** Palos, **RNG.** , **Latitude** , **Longitude**		
COUNTY	COOK	**DRILLING RIG**	CME 75	**HAMMER TYPE**	AUTO
		DRILLING METHOD	HSA	**HAMMER EFF (%)**	91

STRUCT. NO. SN 016-8300
Station 124+90

BORING NO. B-6
Station 125+5.85
Offset 7.82ft LT
Ground Surface Elev. 651.24 ft

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

Groundwater Elev.:
First Encounter 645.2 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray, Moist SILTY CLAY, trace sand, gravel (CL/ML)				
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 8/29/23

ROUTE 123rd Street **DESCRIPTION** Slope Boring **LOGGED BY**

SECTION 123rd Street **LOCATION** , SEC. , TWP. , RNG. ,
Latitude 41.667063, **Longitude** -87.847989

COUNTY COOK **DRILLING RIG** Geoprobe **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 92.2

STRUCT. NO.
Station

BORING NO. B-7
Station 114+15.54
Offset 35.91ft RT
Ground Surface Elev. 665.28 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 644.3 ft ▼
Upon Completion NA ft
After Hrs. NA ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
3 inches of Topsoil	665.03				
Brown, Moist to Very Moist FILL: SILTY CLAY, trace gravel, with glass and asphalt fragments			4 2 3	4.5 P	19
		-5	4 2 2	0.8 B	26
	659.28				
Stiff to Very Stiff Brown, Moist SILTY CLAY, trace gravel (CL/ML)			2 6 11	2.3 B	12
		-10	5 7 8	1.3 P	16
	654.28				
Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML)			5 6 8	4.2 B	12
		-15	2 4 6	2.3 B	14
			3 3 6	1.3 B	12
		-20	3 4 8	1.9 B	11

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)* ▼	643.28		7 10 6	1.9 B	13
Medium Dense Gray, Moist SILTY LOAM, with gravel (MLS)	641.78				
Medium Dense Gray, Moist SANDY LOAM, trace gravel (SM)	640.78	-25	7 10 8		13
Medium Dense Gray, Wet SAND, trace gravel (SP)			5 7 7		19
	636.28		4		
Medium Dense Gray, Moist SILT (ML)		-30	6 7		24
	634.28				
Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML)			7 9 10	5.4 S	12
	631.78				
Medium Dense Gray, Moist SILTY LOAM, trace gravel (MLS)		-35	5 9 10		11
			5 7 10		10
	626.78				
Very Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML)	625.28	-40	6 13 17	8.1 B	16

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 8/29/23

ROUTE 123rd Street **DESCRIPTION** Slope Boring **LOGGED BY**

SECTION 123rd Street **LOCATION** , SEC. , TWP. , RNG. ,
Latitude 41.667063, **Longitude** -87.847989

COUNTY COOK **DRILLING RIG** Geoprobe **HAMMER TYPE** AUTO
DRILLING METHOD HSA **HAMMER EFF (%)** 92.2

STRUCT. NO.
Station

BORING NO. B-7
Station 114+15.54
Offset 35.91ft RT
Ground Surface Elev. 665.28 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 644.3 ft ▼
Upon Completion NA ft
After Hrs. NA ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Occasional silt seams at 39.0 feet				
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)

APPENDIX D

LABORATORY TEST RESULTS

GSG CONSULTANTS, INC.

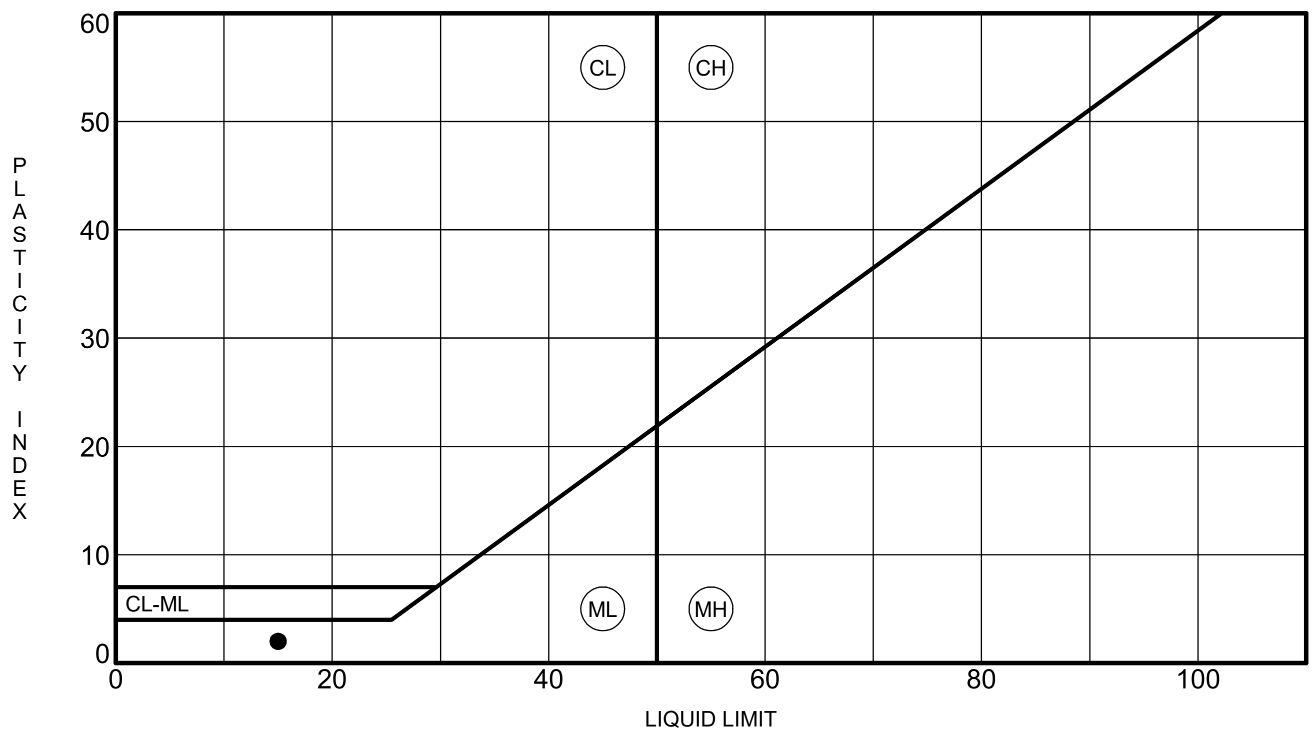
735 Remington Road
Schaumburg, IL 60173
Tel: 630.994.2600
www.gsg-consultants.com

Table 1 – Atterberg Limits

Boring ID	Sample Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Classification
B-5	33.5-35	15.0	13.0	2.0	ML

Table 2 – Dry Unit Weight

Boring ID	Sample Depth (ft)	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
B-2	18.5-20	127.3	142.8
B-6	8.5-10	110.4	134.2



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-5**	**33.50**	**15.0**	**13.0**	**2.0**		

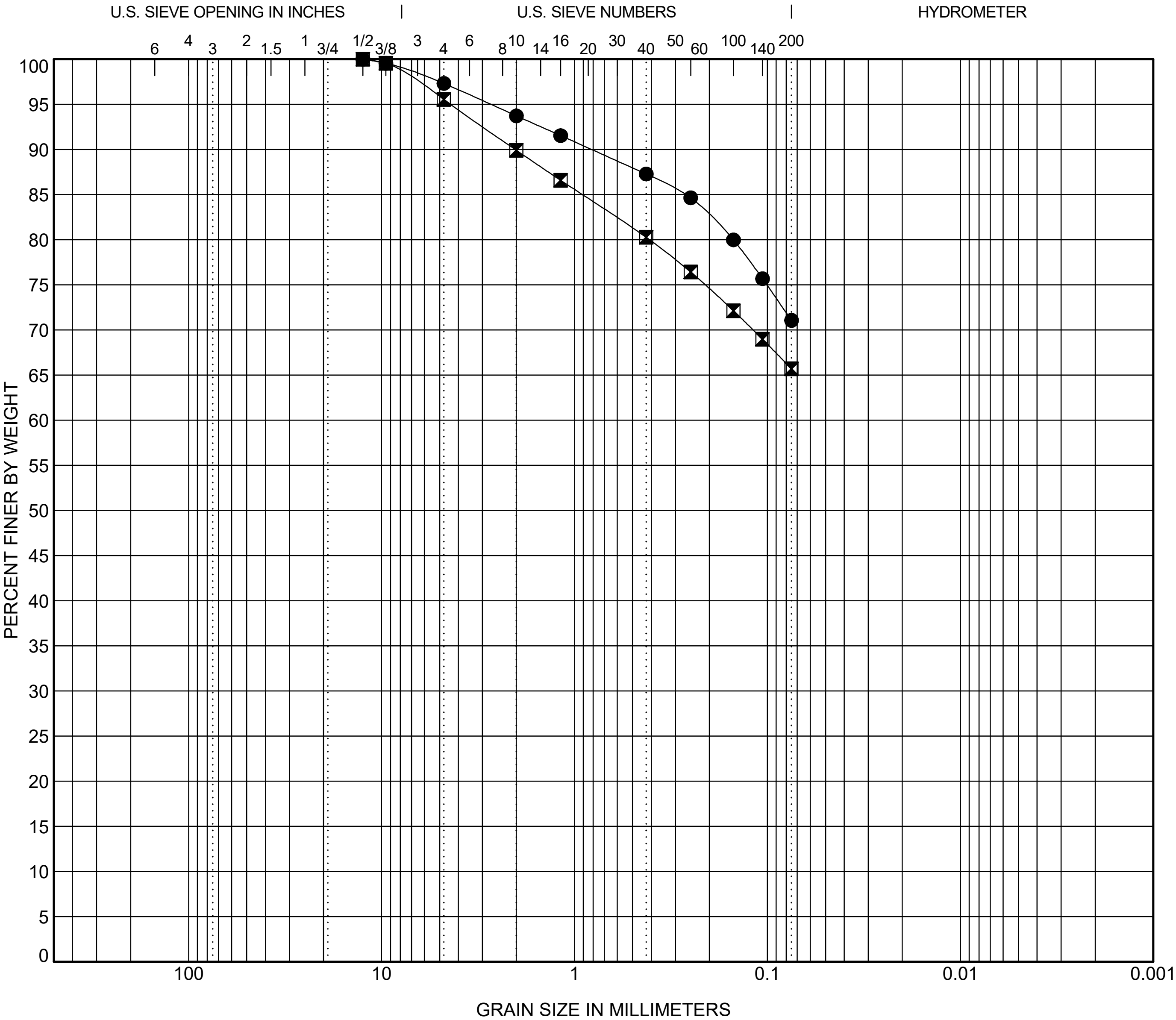
GSG CONSULTANTS, INC.
735 Remington Road, Schaumburg, IL 60173
Tel: 630.994.2600, www.gsg-consultants.com

ATTERBERG LIMITS RESULTS

Route: 123rd St

Section: 123rd St Culverts Over the West Branch of Mill Creek

County: COOK



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**33.50**						
⧗	**B-2**	**18.50**						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**33.50**	**12.5**				**2.7**	**26.3**	**71.1**	
⧗	**B-2**	**18.50**	**12.5**				**4.5**	**29.8**	**65.7**	

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

GRAIN SIZE DISTRIBUTION

Route: 123rd St

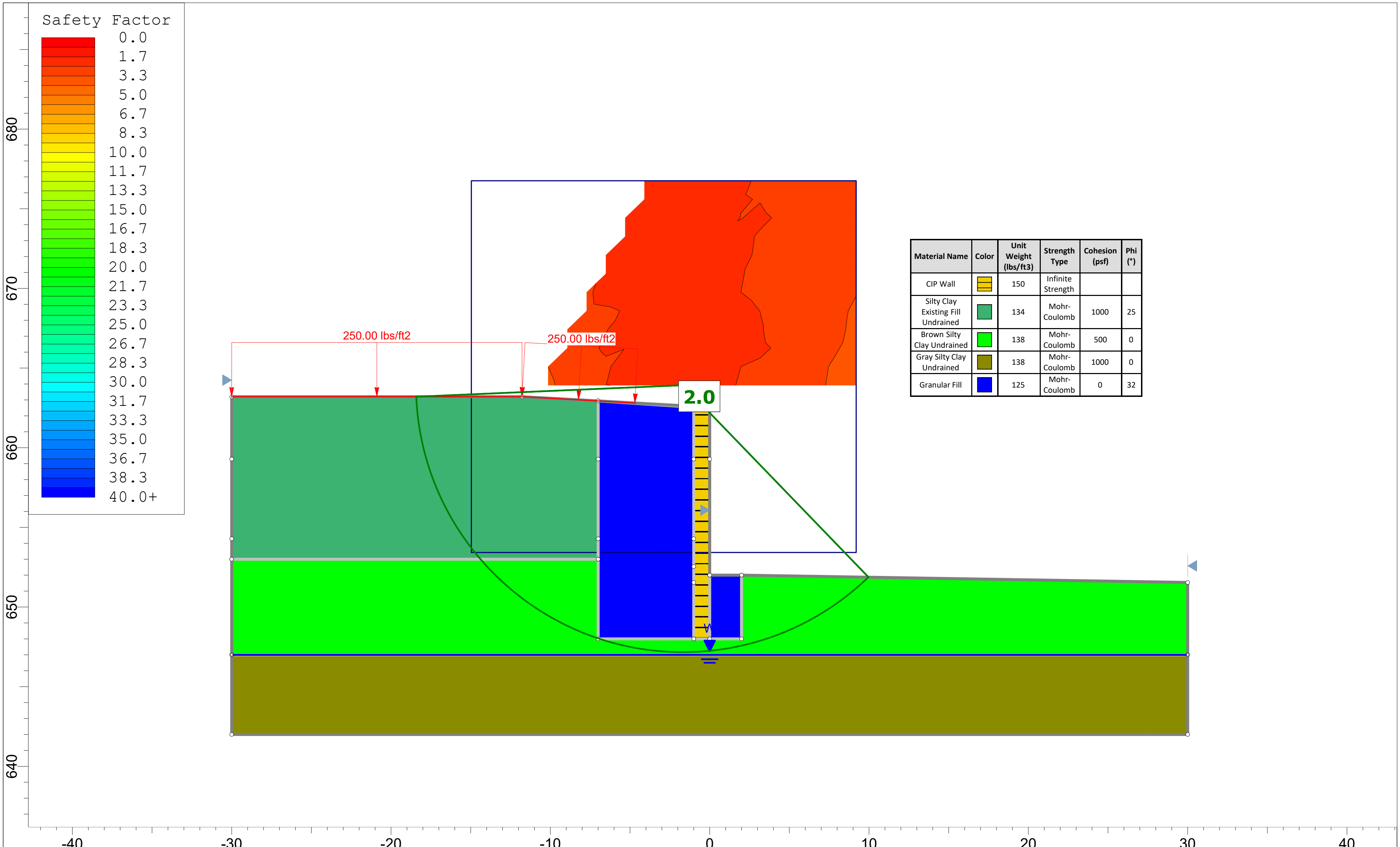
Section: 123rd St Culverts Over the West Branch of Mill Creek

County: COOK

GRAIN SIZE PTB 200-004 WO2 MILL.GPJ IL DOT.GDT 8/8/22

APPENDIX E

SLOPE STABILITY ANALYSIS EXHIBITS



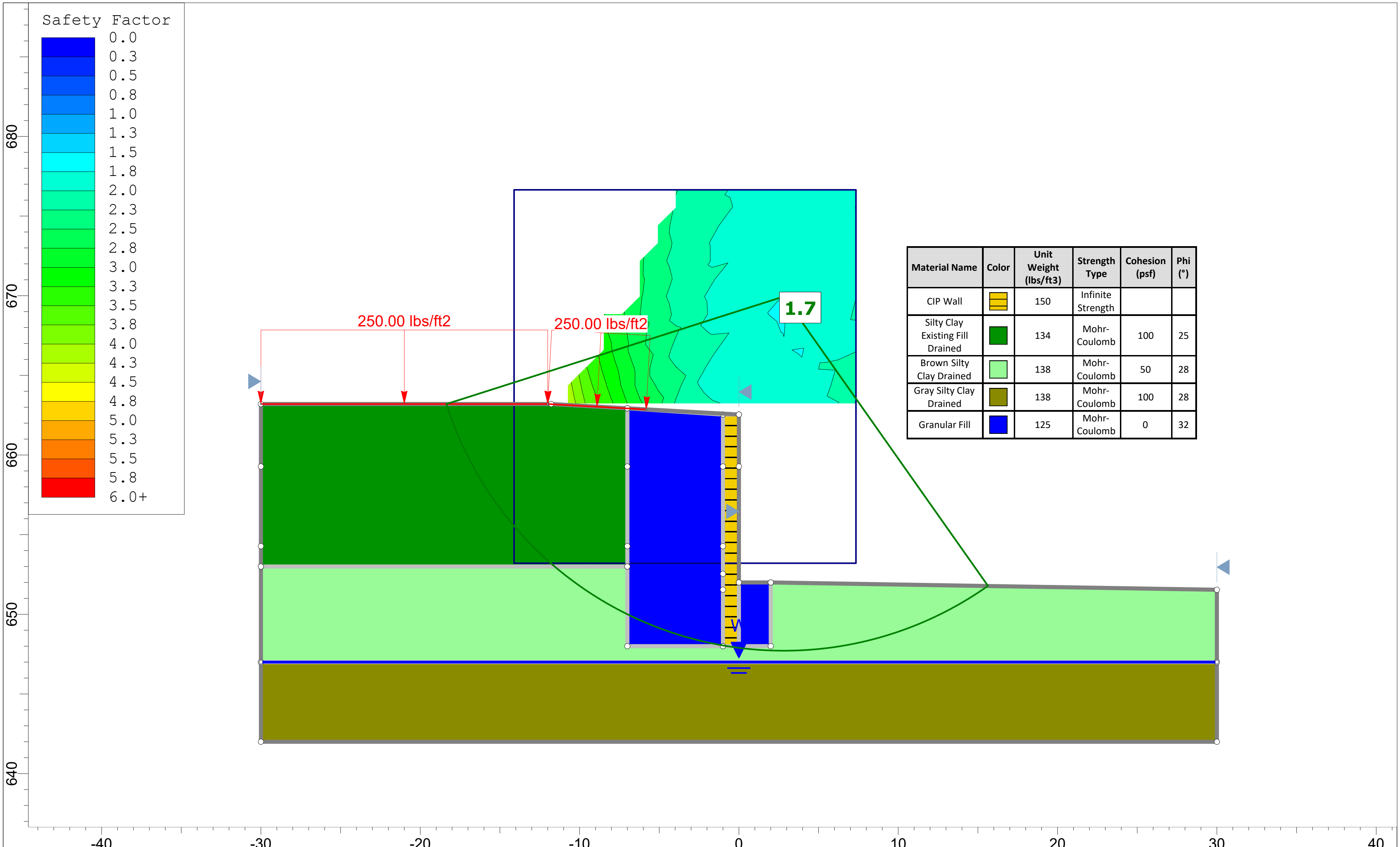
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
CIP Wall		150	Infinite Strength		
Silty Clay Existing Fill Undrained		134	Mohr-Coulomb	1000	25
Brown Silty Clay Undrained		138	Mohr-Coulomb	500	0
Gray Silty Clay Undrained		138	Mohr-Coulomb	1000	0
Granular Fill		125	Mohr-Coulomb	0	32

GSG

GSG CONSULTANTS, INC.
735 Remington Road, Schaumburg, IL 60173
Tel: 630.994.2600, www.gsg-consultants.com

SLIDEINTERPRET 9.028

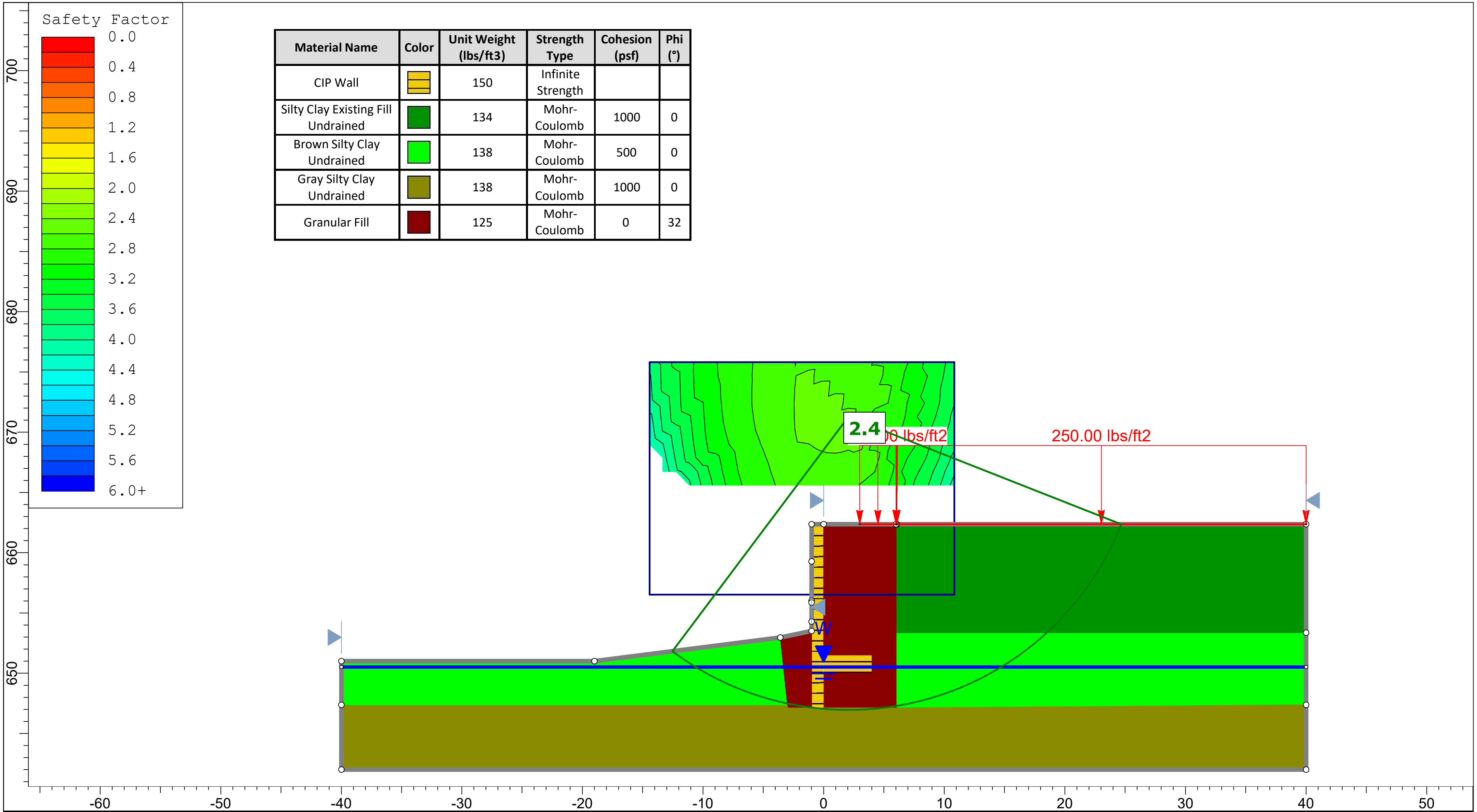
Project	123rd Street over the West Branch of Mill Creek and Mill Creek		
	Exhibit 1 - Circular -Short Term - North Wingwall - West Culvert		
Drawn By BG	1:100	*Company*	GSG Consultants, Inc.
Date	10/17/2023, 4:07:24 PM	*File Name*	Slope 0+05.00 - Copy.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
CIP Wall		150	Infinite Strength		
Silty Clay Existing Fill Drained		134	Mohr-Coulomb	100	25
Brown Silty Clay Drained		138	Mohr-Coulomb	50	28
Gray Silty Clay Drained		138	Mohr-Coulomb	100	28
Granular Fill		125	Mohr-Coulomb	0	32

GSG CONSULTANTS, INC.
735 Remington Road, Schaumburg, IL 60173
Tel: 630.994.2600, www.gsg-consultants.com
SLIDEINTERPRET 9.028

Project	123rd Street over the West Branch of Mill Creek and Mill Creek		
	Exhibit 2 - Circular - Long Term - North Wingwall - West Culvert		
Drawn By BG	1:100	*Company*	GSG Consultants, Inc.
Date 10/17/2023, 4:07:24 PM		*File Name*	Slope 0+05.00 - Copy.slmd

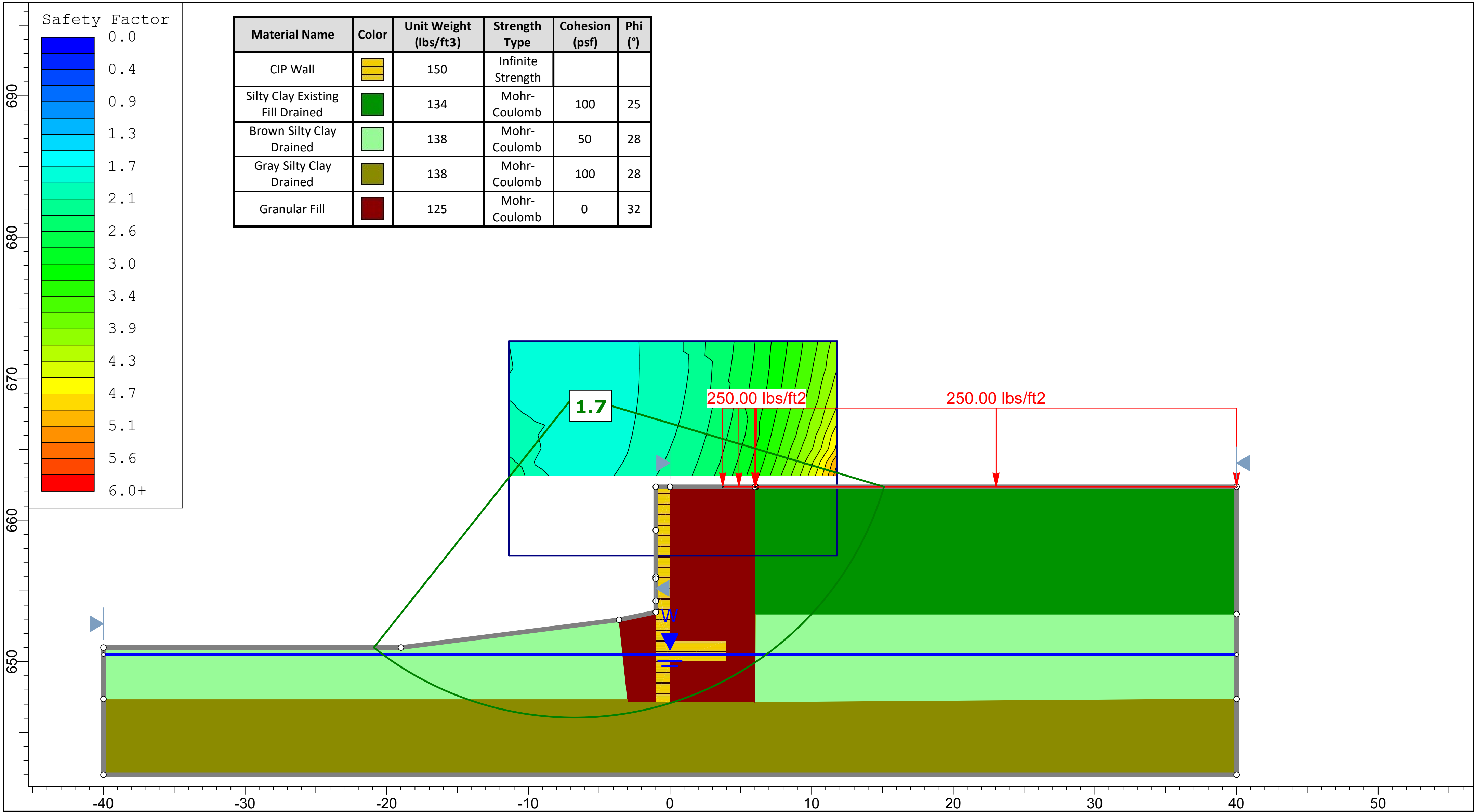


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
CIP Wall		150	Infinite Strength		
Silty Clay Existing Fill Undrained		134	Mohr-Coulomb	1000	0
Brown Silty Clay Undrained		138	Mohr-Coulomb	500	0
Gray Silty Clay Undrained		138	Mohr-Coulomb	1000	0
Granular Fill		125	Mohr-Coulomb	0	32

GSG CONSULTANTS, INC.
735 Remington Road, Schaumburg, IL 60173
Tel: 630.994.2600, www.gsg-consultants.com

Project	IDOT PTB 200-004 Work Order # 9 - West Culvert CIP Wing Wall
Analysis Description	Exhibit 3 - CIP Wall - Circular Failure Short Term
Drawn By	BG
Company	GSG Consultants, Inc.
Date	10/17/2023, 1:19:48 PM
File Name	CIP 0+05.00.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
CIP Wall		150	Infinite Strength		
Silty Clay Existing Fill Drained		134	Mohr-Coulomb	100	25
Brown Silty Clay Drained		138	Mohr-Coulomb	50	28
Gray Silty Clay Drained		138	Mohr-Coulomb	100	28
Granular Fill		125	Mohr-Coulomb	0	32



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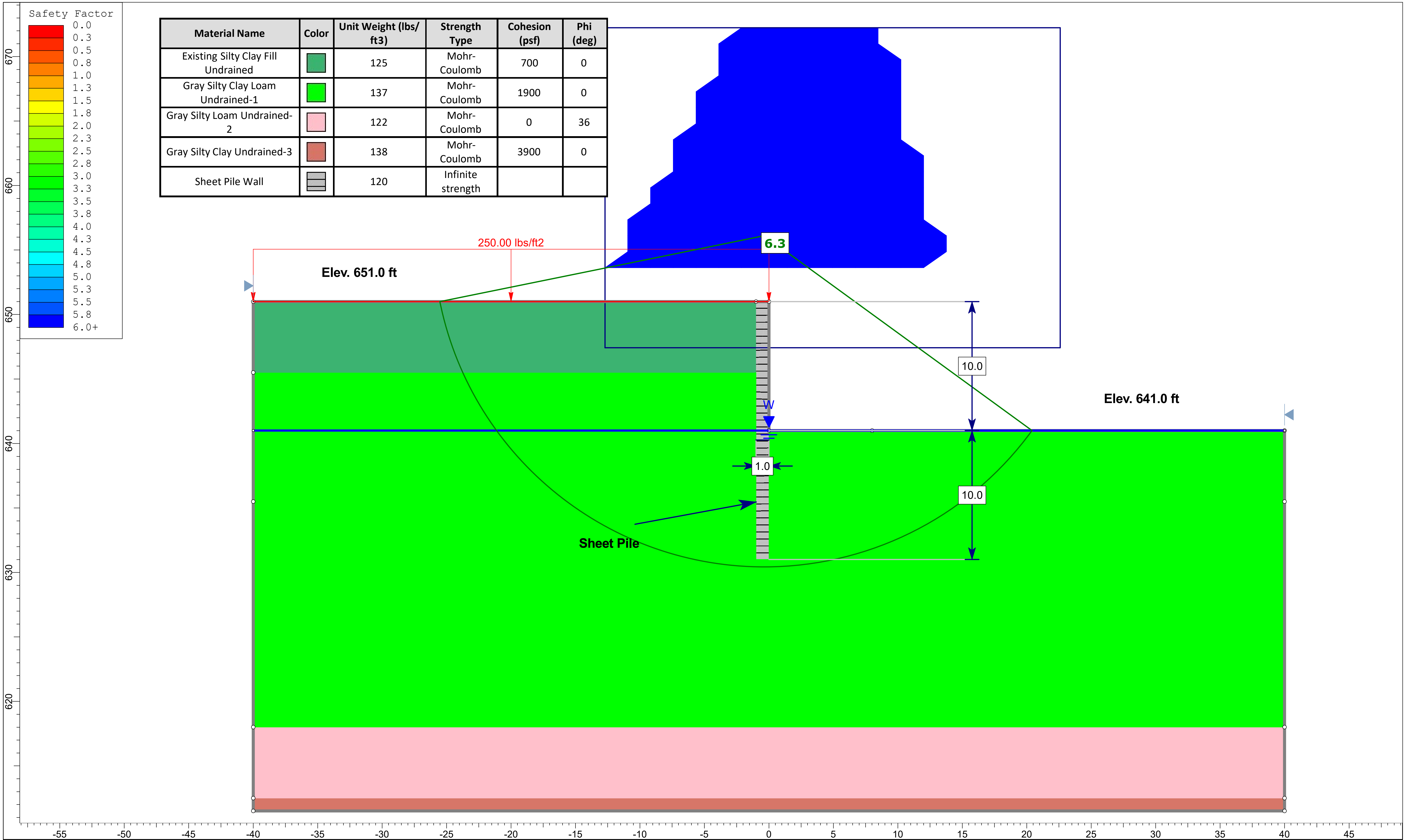
Project	IDOT PTB 200-004 Work Order # 9 - West Culvert CIP Wing Wall
Analysis Description	Exhibit 4 - CIP Wall - Circular Failure Long Term
Drawn By	BG
Company	GSG Consultants, Inc.
Date	10/17/2023, 1:19:48 PM
File Name	CIP 0+05.00.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Existing Silty Clay Fill Undrained		125	Mohr-Coulomb	700	0
Gray Silty Clay Loam Undrained-1		137	Mohr-Coulomb	1900	0
Gray Silty Loam Undrained-2		122	Mohr-Coulomb	0	36
Gray Silty Clay Undrained-3		138	Mohr-Coulomb	3900	0
Sheet Pile Wall		120	Infinite strength		



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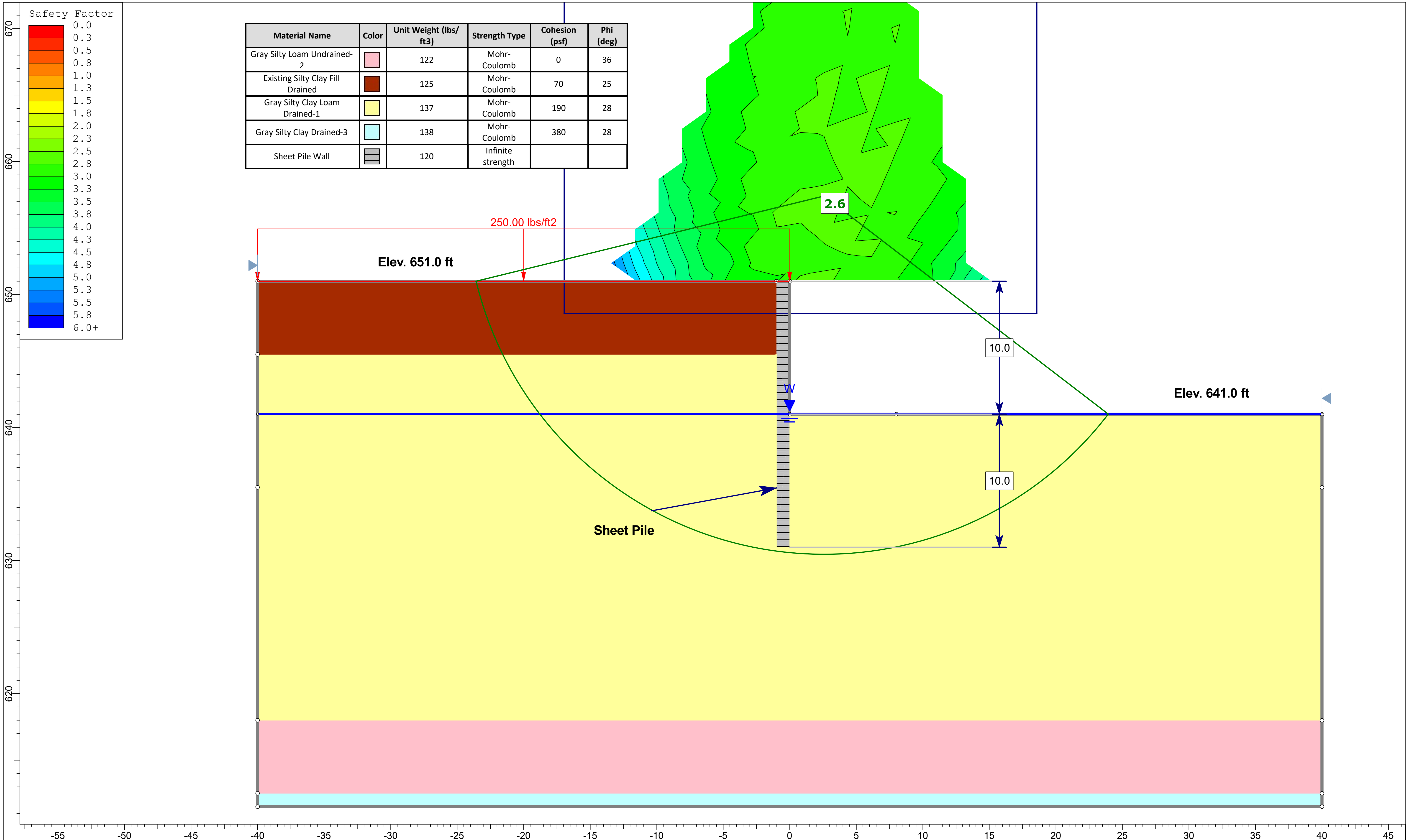
Project	IDOT PTB 200-004 Work Order #2 - East Culvert Sheet Pile Wingwall
Analysis Description	Exhibit 5 - Circular Failure Short Term
Drawn By	ES
Company	GSG Consultants, Inc.
Date	2/16/2023
File Name	Sheet Pile Wingwall (East) 124+90_v0.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Gray Silty Loam Undrained-2		122	Mohr-Coulomb	0	36
Existing Silty Clay Fill Drained		125	Mohr-Coulomb	70	25
Gray Silty Clay Loam Drained-1		137	Mohr-Coulomb	190	28
Gray Silty Clay Drained-3		138	Mohr-Coulomb	380	28
Sheet Pile Wall		120	Infinite strength		

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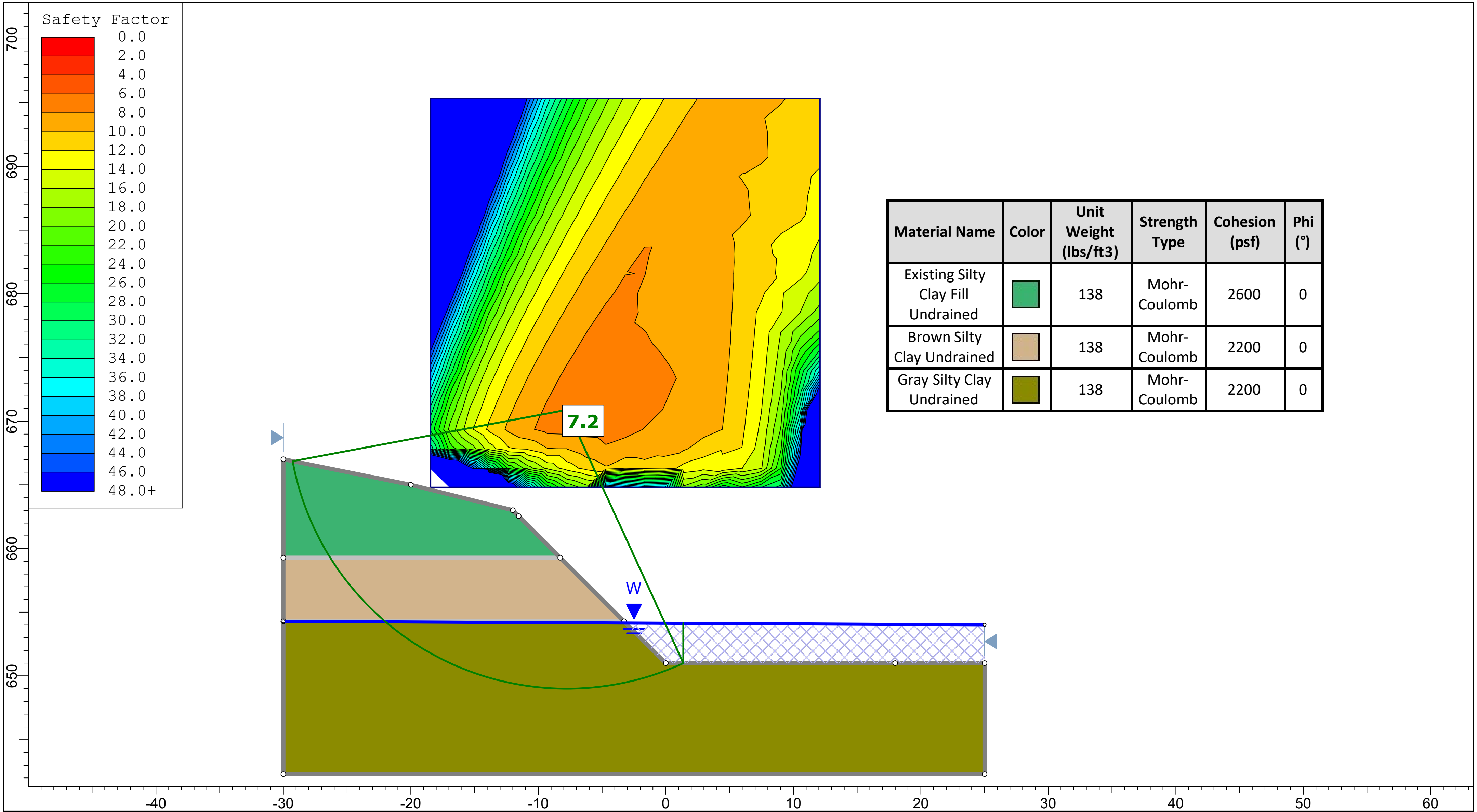
Project	IDOT PTB 200-004 Work Order #2 - East Culvert Sheet Pile Wingwall
Analysis Description	Exhibit 6 - Circular Failure Long Term
Drawn By	ES
Company	GSG Consultants, Inc.
Date	2/16/2023
File Name	Sheet Pile Wingwall (East) 124+90_v0.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Existing Silty Clay Fill Undrained		138	Mohr-Coulomb	2600	0
Brown Silty Clay Undrained		138	Mohr-Coulomb	2200	0
Gray Silty Clay Undrained		138	Mohr-Coulomb	2200	0

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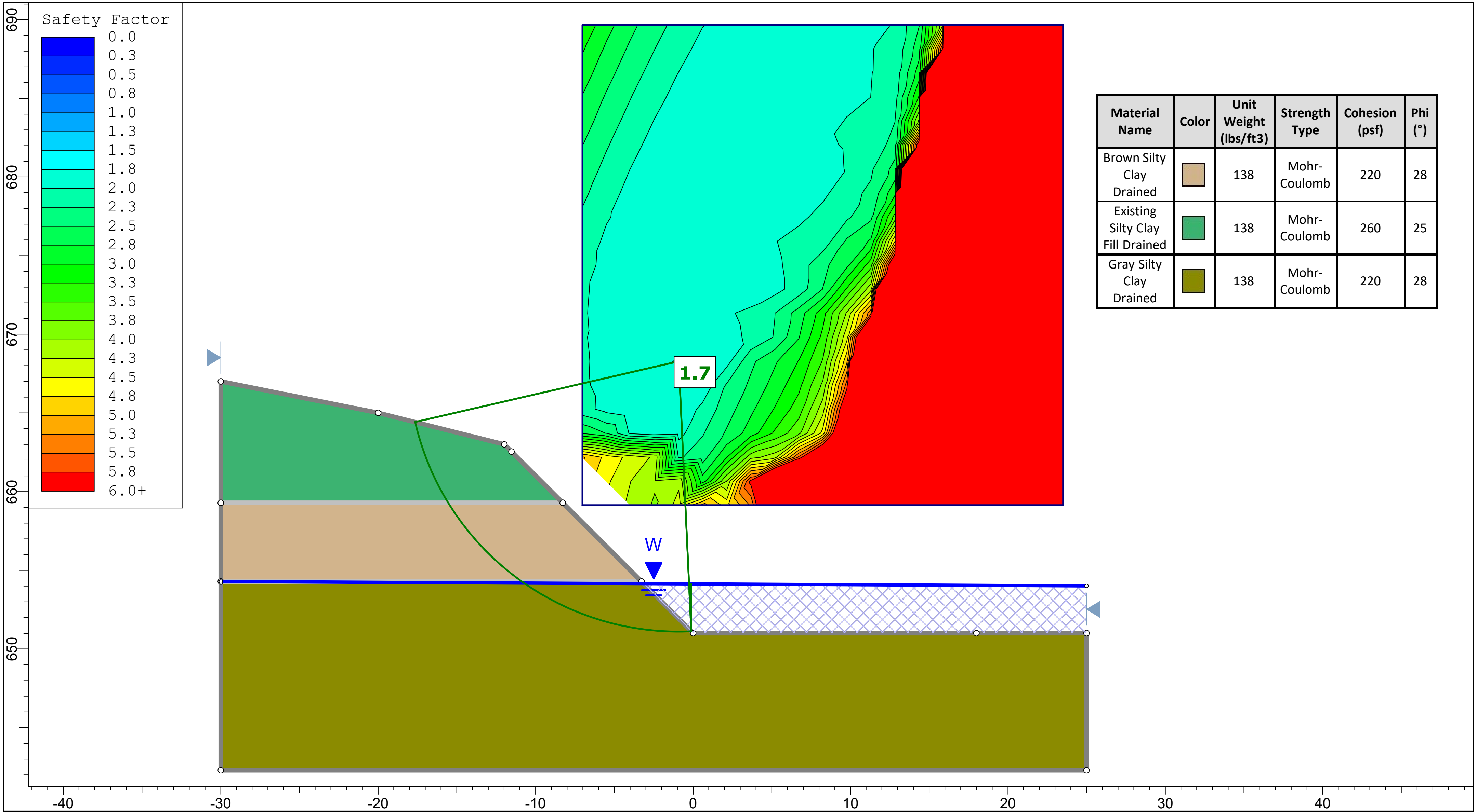
Project
IDOT PTB 200-004 Work Order # 9 - West Culvert Slope Analysis

Analysis Description
Exhibit 7 - Slope Analysis - Circular Failure Short Term

Drawn By BG | *Company* GSG Consultants, Inc.

Date 10/16/2023, 3:13:03 PM | *File Name* CIP 0+05.00 - slope.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)
Brown Silty Clay Drained		138	Mohr-Coulomb	220	28
Existing Silty Clay Fill Drained		138	Mohr-Coulomb	260	25
Gray Silty Clay Drained		138	Mohr-Coulomb	220	28

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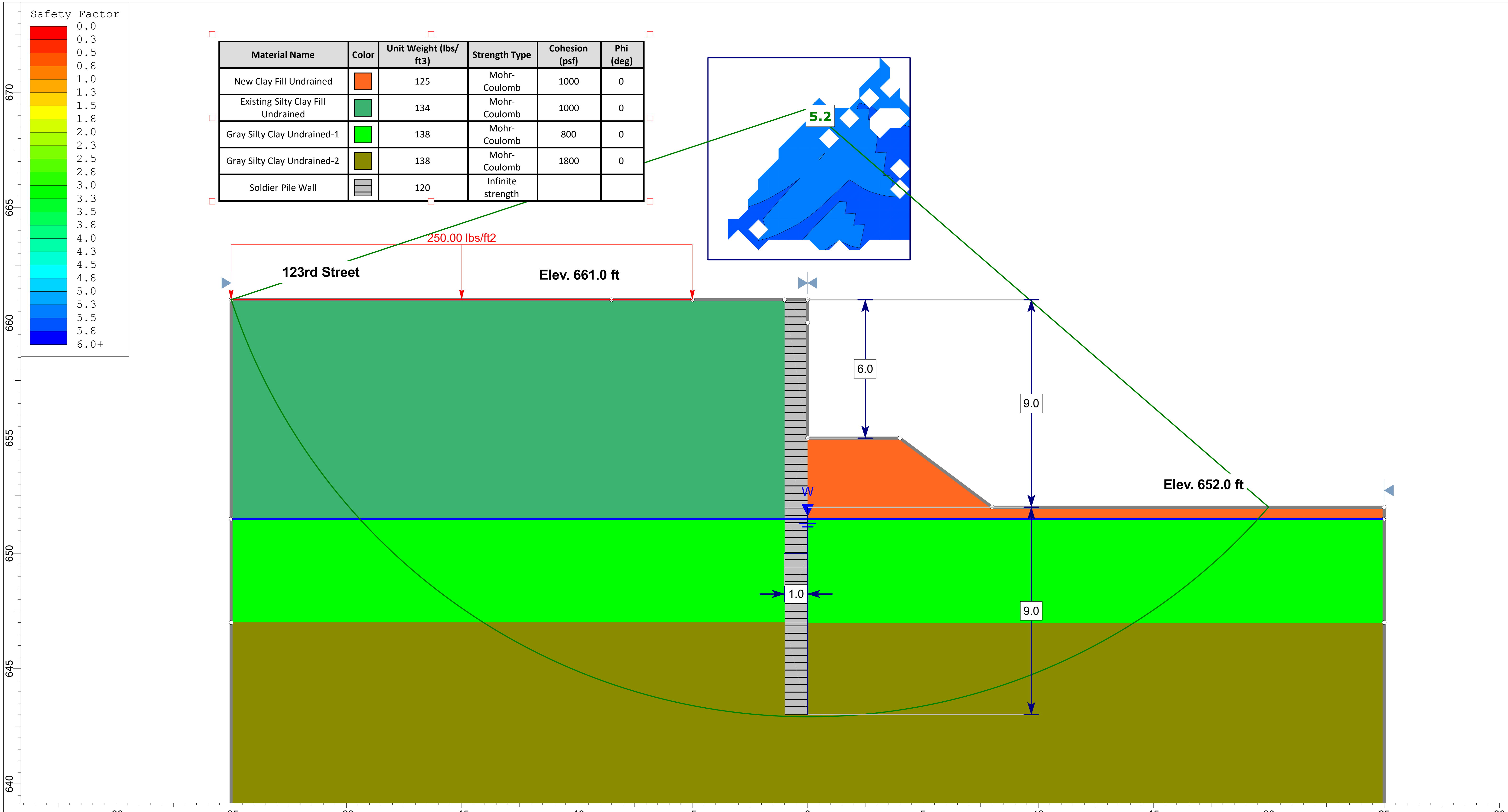
Project	IDOT PTB 200-004 Work Order # 9 - West Culvert Slope Analysis
Analysis Description	Exhibit 8 - Slope Analysis - Circular Failure Long Term
Drawn By	BG
Company	GSG Consultants, Inc.
Date	10/16/2023, 3:13:03 PM
File Name	CIP 0+05.00 - slope.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
New Clay Fill Undrained		125	Mohr-Coulomb	1000	0
Existing Silty Clay Fill Undrained		134	Mohr-Coulomb	1000	0
Gray Silty Clay Undrained-1		138	Mohr-Coulomb	800	0
Gray Silty Clay Undrained-2		138	Mohr-Coulomb	1800	0
Soldier Pile Wall		120	Infinite strength		

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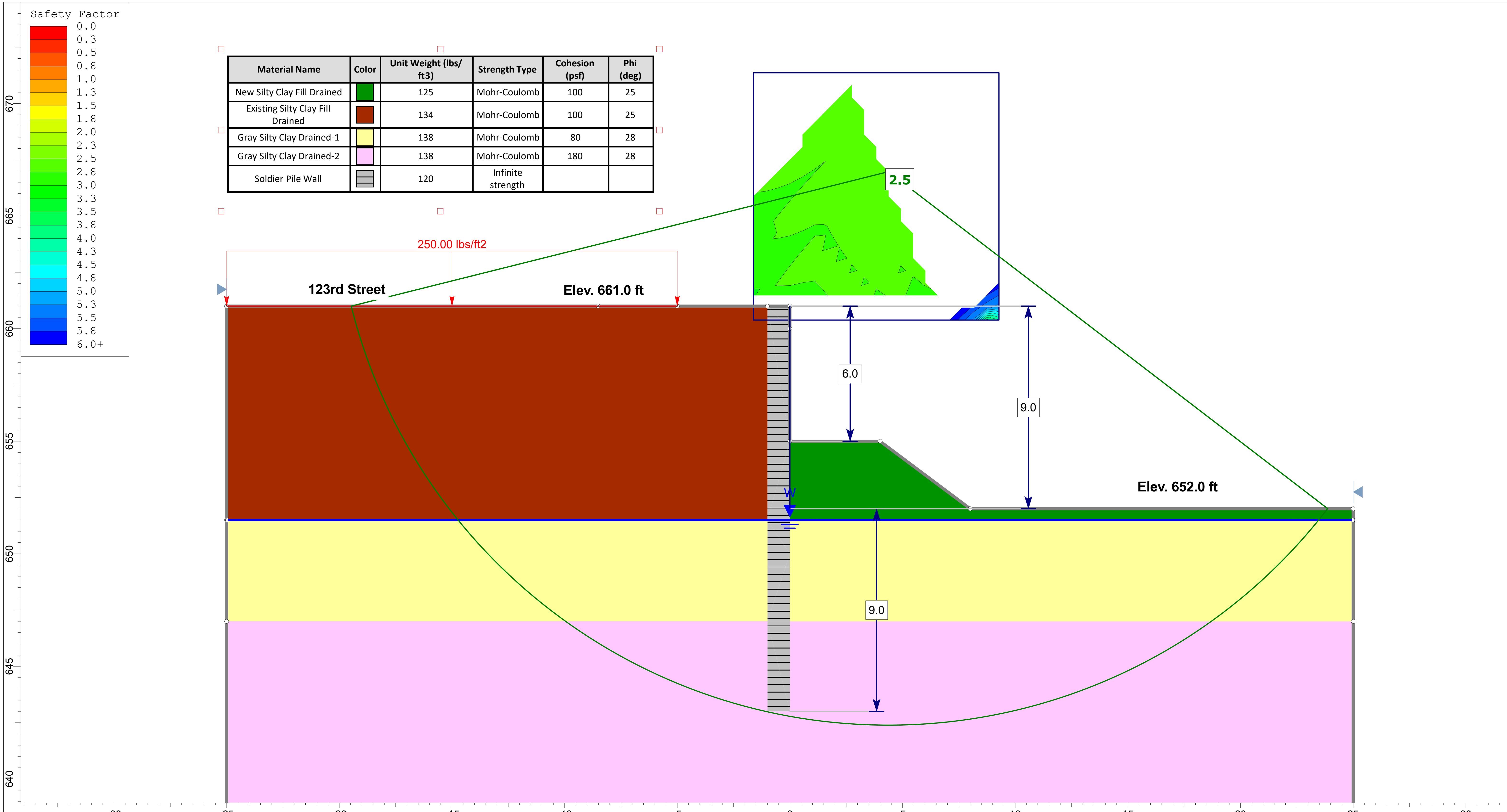
Project	IDOT PTB 200-004 Work Order #2 - Soldier Pile Retaining Wall		
Analysis Description	Exhibit 9 - Circular Failure Short Term		
Drawn By	ES	*Company*	GSG Consultants, Inc.
Date	2/6/2023	*File Name*	Soldier Pile 115+45_v3.slmd



Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
New Silty Clay Fill Drained		125	Mohr-Coulomb	100	25
Existing Silty Clay Fill Drained		134	Mohr-Coulomb	100	25
Gray Silty Clay Drained-1		138	Mohr-Coulomb	80	28
Gray Silty Clay Drained-2		138	Mohr-Coulomb	180	28
Soldier Pile Wall		120	Infinite strength		

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Project	IDOT PTB 200-004 Work Order #2 - Soldier Pile Retaining Wall		
Analysis Description	Exhibit 10 - Circular Failure Long Term		
Drawn By	ES	*Company*	GSG Consultants, Inc.
Date	2/6/2023	*File Name*	Soldier Pile 115+45_v3.slmd