# Structural Geotechnical Report

Proposed Center Street Bridge over I-80
SN: 099-8332
IDOT PTB 198-003
Will County, Illinois

Prepared for

Illinois Department of Transportation
Contract Number: D-91-204-19

Project Design Engineer Team
WSP USA

Geotechnical Consultant
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Structural Geotechnical Report
Proposed Bridge Center Street Bridge over I-80
Will County, IL
PTB 198-003

Dear Mr. Skaleski:

Attached is a copy of the Structural Geotechnical Report for the above referenced project. The report provides a description of the site investigation, site conditions, and foundation and construction recommendations. The site investigation for the proposed bridge construction included advancing seven (7) soil borings to depths ranging from 8.0 to 28.5 feet.

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

Sincerely,

Matthew J Heron, P.E.
Project Engineer

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

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# 1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the proposed bridge carrying Center Street over I-80 in the City of Joliet in Will County, Illinois. The purpose of the investigation was to explore the subsurface conditions, to determine engineering properties of the subsurface soil, and develop design and construction recommendations for the proposed bridge. **Exhibit 1** shows the general project location.

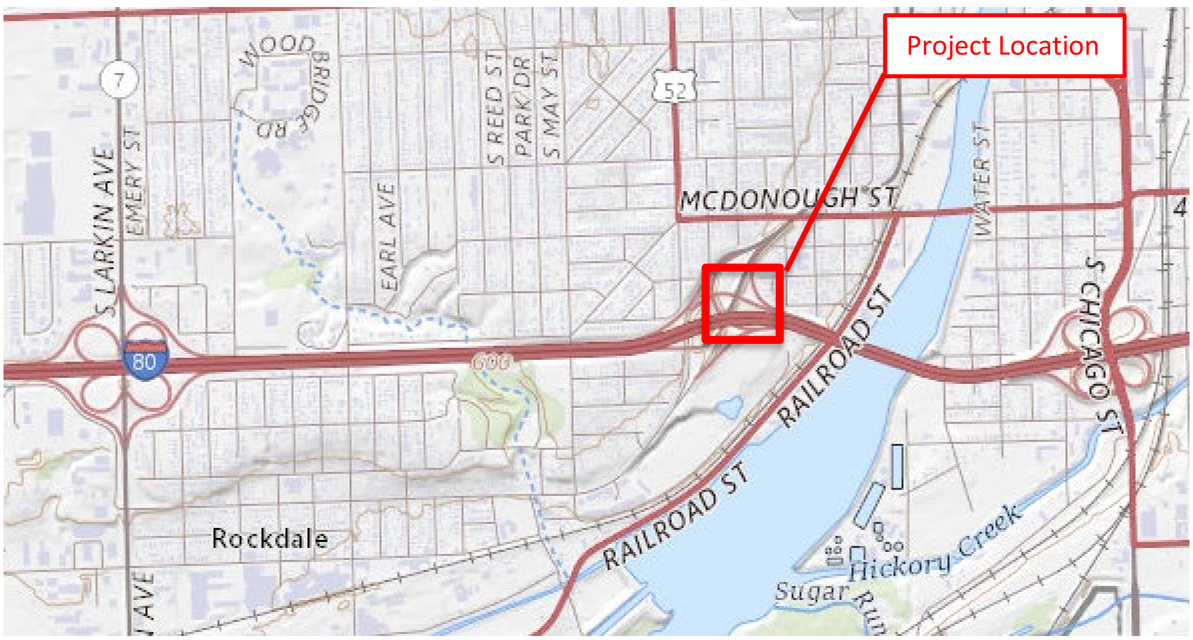



**Exhibit 1 – Project Location Map**
**(Source: USGS Topographic Maps, usgs.gov)**

## 1.1 Existing Bridge Information

The existing Center Street bridge is located west of the proposed new bridge location and carries Center Street (Raynor Avenue) over I-80 and the I-80 eastbound ramp. **Exhibits 2a and 2b** show the existing conditions of the bridge to be replaced.

**Exhibit 2a – Existing Bridge Looking Northwest**


**Exhibit 2b –Existing Bridge Looking West**

## 1.2 Proposed Bridge Information

Based on the proposed TSL dated 02/02/2024, a new bridge will be constructed to carry Center Street over I-80 and I-80 eastbound Ramp B. The new structure will be located approximately 100 feet east of the existing structure due to the realignment of Center Street and the entrance/exit ramps for I-80. The new bridge is anticipated to be a 2-span bridge with a center pier between I-80 WB and EB. The total length of the new bridge structure is anticipated to be approximately 291 feet back-to-back and a varying deck width between 72'-0" and 79'-9 $\frac{5}{8}$". New embankments will be constructed for both the north and south abutments with side slopes of 1V:2H anticipated below the new bridge abutments. Based on the proposed plans, the existing structure will be completely removed, and traffic will be detoured during construction. An existing 36-inch sewer is noted beneath the proposed south abutment and is anticipated to be abandoned.

## 2.0 SITE SUBSURFACE CONDITIONS

This section describes the subsurface exploration program and laboratory testing program completed as part of this project. The proposed locations and depths of the soil borings were selected in accordance with IDOT requirements and reviewed with WSP. The borings were completed in the field based on field conditions and accessibility.

### 2.1 Subsurface Exploration and Laboratory Testing

The subsurface exploration for the proposed bridge structure was conducted between April 20 and April 26, 2022. The investigation included advancing four (4) borings to depths between 8.0 and 28.5 feet. A second investigation was completed between June 18 and 22, 2023 to collect additional information on the bedrock at the bridge location. The locations of these soil borings were reviewed and approved by WSP and adjusted in the field as necessary based on utilities and access. Elevations and as-drilled locations for the borings were gathered by GSG's field crew using GPS surveying equipment. The approximate as-drilled locations of the soil borings are shown on the Soil Boring Location Plan & Subsurface Profiles **(Appendix B)**. **Table 1** presents a summary of the borings used for the proposed bridge analyses.

**Table 1 – Summary of Subsurface Exploration Borings**

| Abutment/Pier Location | Boring ID | Station * | Offset (ft)/ Direction | Depth (ft) | Surface Elevation (ft) |
|---|---|---|---|---|---|
| North Abutment | BSB-65 | 28+35.56 | 126.55 LT | 23.5 | 595.18 |
| Center Pier | BSB-66 | 27+10.92 | 15.07 RT | 8.0 | 593.57 |
| Center Pier | BSB-67 | 28+03.84 | 46.47 RT | 19.5 | 593.60 |
| South Abutment | BSB-68 | 27+05.60 | 174.55 RT | 28.5 | 575.39 |
| North Abutment | BSB-301 | 27+64.99 | 162.09 LT | 25.5 | 599.00 |
| South Abutment | BSB-302 | 26+94.09 | 132.49 RT | 18.5 | 573.14 |
| South Abutment | BSB-303 | 25+96.54 | 150.34 RT | 17.0 | 593.14 |

* Based on proposed I-80 Stationing

Copies of the Soil Boring Logs are provided in **Appendix C**.

The soil borings were drilled using truck mounted Diedrich D-50 (hammer efficiency 98%), and CME-75 (hammer efficiency 91%) drill rigs, each equipped with 3¼-inch I.D. hollow stem augers and an automatic hammer. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained at 2.5-foot intervals to the boring termination depths or upon encountering auger refusal on apparent bedrock. 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 where necessary to match the existing pavement.

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

GSG also collected rock core runs from six of the soil boring locations with the use of a ten-foot or and/or a five-foot, diamond bit, NX-5 split core barrel during the investigation. The bedrock cores were evaluated in the field for texture, physical condition, recovery percentage, and Rock Quality Designation (RQD). The extracted samples were visually inspected and classified, and the Rock Quality Designation (RQD) was determined according to ASTM D 6032, "Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core" by totaling all sections with a length in excess of four (4) inches and dividing it by the total length of the core run. The RQD is given a classification based upon the numeric value as indicated in **Table 2**.

**Table 2 – Rock Quality Designation Summary**

| Rock Quality Designation | Descriptions |
|---|---|
| < 25% | Very Poor |
| 25 – 50% | Poor |
| 51 – 75% | Fair |
| 76 – 90% | Good |
| 91 – 100% | Excellent |

### 2.2 Laboratory Testing Program

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area.

The following laboratory tests were performed on representative soil and rock samples:

- Moisture content ASTM D2216 / AASHTO T-265
- Unconfined Compression Strength on Rock – ASTM D2938

The laboratory tests were performed in accordance with test procedures outlined in the most current IDOT Geotechnical Manual, 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 Laboratory Test Results **(Appendix D)** and are also shown along with the field test results in the Soil Boring Logs **(Appendix C)**.

### 2.3 Subsurface Soil Conditions

This section provides a brief description of the soils encountered in the borings performed in the vicinity of the proposed bridge. Variations in the general subsurface soil profile were noted during the drilling activities. Detailed descriptions of the subsurface soils are provided in the soil boring logs and are shown graphically in the Boring Location Plan & Subsurface Profiles. The soil boring logs provide specific conditions encountered at each boring location and include soil descriptions, stratifications, penetration resistance, elevations, location of the samples, and laboratory test data. Unless otherwise noted, soil descriptions indicated on boring logs are visual identifications. The stratifications shown on the boring logs represent the conditions only at the actual boring locations and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

The surface elevations of the borings ranged between 573.0 and 599.0 feet. The borings generally noted 10 to 16 inches of asphalt. Boring BSB-301 noted 3 inches of asphalt followed by 8 inches concrete and 5 inches of aggregate subbase materials, while boring BSB-303 was drilled off the shoulder and initially encountered 4 inches of topsoil. Below the surficial layers, borings BSB-65 to BSB-67, BSB-302 and BSB-303 encountered 1.0 to 2.0 feet of silty clay fill; Boring BSB-68 noted sand fill below the asphalt to a depth of 11.0 feet, which was likely utility backfill. Stiff to very stiff silty clay and silty clay loam was encountered in borings BSB-65, BSB-66 and BSB-301, with average unconfined compressive strength value of 3.0 tsf. Very dense sand was encountered below the fill material in borings BSB-67 and BSB-68, with SPT blow counts ‘N’ value of 50 blows per 5 inches. Bedrock was encountered upon encountering auger refusal in the majority of borings at depths ranging from 2.0 and 10.5 feet; bedrock was encountered in boring BSB-68 at a depth of 13.5 feet.

Rock core samples were collected in six (6) of the boring locations. The bedrock cores generally consisted of light gray limestone, with slight to moderate weathering and slight to high levels of fracturing. Unconfined compressive strength tests were completed on representative samples of the rock cores in three (3) of the borings. **Table 3** provides the RQD values and unconfined compression strength values of the rock cores extracted during the site investigation. Photographs of the cores are included with each boring log in **Appendix C**.

**Table 3 – Rock Core Summary and Classification**

| Boring Number | Core Run / Length (ft) | Core Depth (feet) | Type of Rock | RQD (%) | RQD Description | Depth (ft)/ Compressive Strength (psi) |
|---|---|---|---|---|---|---|
| BSB-65 | 1 / 10 | 7.5 – 17.5 | Limestone | 19.2 | Very Poor | 23.0/9,784 |
| | 2 / 6 | 17.5 – 23.5 | Limestone | 40.3 | Poor | |
| BSB-67 | 1 / 10 | 4.5 – 14.5 | Limestone | 25.8 | Poor | 25.0/8,380 |
| | 2 / 5 | 14.5 – 19.5 | Limestone | 29.2 | Poor | |
| BSB-68 | 1 / 10 | 13.5 – 23.5 | Limestone | 76.7 | Good | 27.5/14,412 |
| | 2 / 5 | 23.5 – 28.5 | Limestone | 92.5 | Excellent | |
| BSB-301 | 1 / 10 | 10.5 – 20.5 | Limestone | 16.7 | Very Poor | n/a |
| | 2 / 5 | 20.5 – 25.5 | Limestone | 38.3 | Poor | |
| BSB-302 | 1 / 10 | 3.5 – 13.5 | Limestone | 83.0 | Good | n/a |
| | 2 / 5 | 13.5 – 18.5 | Limestone | 100 | Excellent | |
| BSB-303 | 1 / 5 | 2.0 – 7.0 | Limestone | 20.0 | Very Poor | n/a |
| | 2 / 5 | 7.0 – 12.0 | Limestone | 6.7 | Very Poor | |
| | 3 / 5 | 12.0 – 17.0 | Limestone | 20.0 | Very Poor | |

## 2.4 Groundwater Conditions

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed. Groundwater was not encountered during or immediately after drilling at any of the borings. None of the borings were left open after leaving the site due to safety concerns.

Based on the general lack of water levels and color change from brown to gray observed in the soil borings, it is anticipated that the long-term groundwater level may be near the bedrock interface due to the proximity of the Des Plaines River. Perched water may also be present within the fill materials observed in the borings. The elevation of the water level in the Des Plaines River is near 539 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 the rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported herein.

# 3.0 GEOTECHNICAL ANALYSES

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

## 3.1 Scour

The proposed bridge structure will carry Center Street over I-80 and have no waterways in the vicinity; therefore, scour will not be a concern for this project.

## 3.2 Settlement

It is understood that the new bridge for Center Street will be moved approximately 100 feet to the east as part of the realignment of Center Street. Based on the observed site grades it is assumed that between 13.6 and 31.4 feet of new engineered fill will be necessary to create the new north and south abutments, respectively.

An analysis was performed to evaluate the anticipated total settlement due to the new embankment construction for the alignment. Immediate settlement for cohesionless soils can typically occur during the filling operations, while the consolidation settlement for cohesive soils generally occurs over a longer period of time. The maximum estimated total settlements within the existing fill soils and native soils were calculated as shown in **Table 4** where 90% of the total settlement is estimated to be completed within 12 months. The settlement values provided in **Table 4** do not include any potential settlement of the newly constructed embankment materials as it is assumed the new embankment will be compacted and constructed per the IDOT specifications. Settlement estimates were calculated for the northern-most and southern-most soil boring locations that were completed along the ramps of I-80, in the area of the proposed fill.

**Table 4 – Anticipated Abutment Fill Settlement – Preliminary Calculations**

| Location | Nearest Boring | Roadway Fill Area | | Assumed New Fill Height (feet) | Anticipated Total Settlement (inches) |
|---|---|---|---|---|---|
| | | Assumed Width (feet) | Assumed Length (feet) | | |
| North Abutment / North Approach Bent | BSB-65 | 85 | 150 | 13.6 | 0.79 |
| South Abutment / South Approach Bent | BSB-68 | 95 | 150 | 31.4 | 0.17 |

Based on the general nature of the cohesive soils, underlain by sand and gravel, encountered in the area of the proposed north abutment, the estimated settlement of the existing soils from the new fill could be approximately 0.79 inches. Accordingly, downdrag should be anticipated to be an issue in areas where pile foundations are constructed in the north embankment. The granular soils in the area of the proposed south abutment will experience approximately 0.17 inches of settlement due to the proposed new fill.

### 3.3 Roadway Fill Settlement Treatment and Recommendations

If the anticipated settlement is excessive for the proposed improvement, special design recommendations may be considered to mitigate the impact to the bridge construction. Some areas of the subgrade soil beneath the new roadway fill may require in-situ ground improvement in order to mitigate the anticipated settlement after the anticipated filling operations. The recommended ground improvement technique and the impact on the estimated time rate of settlement are discussed below. The treatment alternative that is selected must also consider the proposed bridge foundation construction schedule.

In the area of the existing Center Street alignment that will be filled in for construction of the new I-80 mainline, evaluation of the subgrade and settlement will be completed in a separate report.

#### 3.3.1 Embankment Construction

For construction of the embankment, the proposed alignment of Center Street may be partially constructed, allowing for consolidation settlement of the new constructed embankment materials to occur and dissipate the excess pore water pressure prior to completion of the full fill placement. For the initial construction, allowing the partially filled embankment to remain in place for varying amounts of time, prior to the final stage construction will result in different amounts of settlement after construction. The longer the initial stage construction remains in place as a surcharge over the underlying soils, the less settlement is anticipated to occur post-construction.

Proper instrumentation, as outlined in IDOT Geotechnical Manual in Section 6.4.4.6-Instrumentation and Control of Embankment Construction, will be required to monitor the state of stress in the soil during the loading period, to ensure that loading does not proceed so rapidly as to cause a shear failure.

### 3.3.2 Maintenance

A maintenance program will likely be necessary throughout the construction stage to account for settlement of the new fill. This will require additional quantities of fill materials to be placed during construction, which should be accounted for when estimating earthwork quantities.

## 3.4 Slope Stability

The bridge abutments will be supported on a deep foundation system that will be designed to support the substructure against lateral and slope failure. Therefore, there are no slope stability concerns anticipated for the bridge structure. The proposed abutment slopes are anticipated to be at 2H:1V slopes. The overall stability of the proposed slopes were evaluated, considering a short-term and a long-term (potential five year) construction period.

Slide 2018 is a comprehensive slope stability analysis software used to evaluate the proposed abutment slopes for the project based on the limit equilibrium method. The slopes were analyzed based on the geometry shown on the preliminary TSL and the soils encountered at the site. Circular failure analyses were evaluated using the simplified Bishops analyses methods for the proposed slope geometries.

A circular failure analyses was evaluated for both a short term (undrained) and long term (drained) condition based on the proposed geometry for the proposed abutment slopes. The results of the analyses are shown in **Table 5**.

**Table 5 – Global Slope Stability Analyses Results**

| Analysis Exhibit | Excavation Slope 2H:1V | Analysis Type | Factor of Safety | Minimum Factor of Safety |
|---|---|---|---|---|
| Exhibit 1 | North Abutment | Circular – Short Term | 4.2 | 1.5 |
| Exhibit 2 | | Circular – Long Term | 1.8 | 1.5 |
| Exhibit 3 | South Abutment | Circular – Short Term | 1.9 | 1.5 |
| Exhibit 4 | | Circular – Long Term | 1.5 | 1.5 |

Based on general soils profiles for the side slopes below each abutment, the north and south slope can maintain a stable slope of 2H:1V. Copies of the slope stability analyses exhibits are included in **Appendix E**.

### 3.5 Seismic Parameters

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

The AASHTO Seismic Design Parameters program was used to determine the peak ground acceleration coefficient (PGA), and the short ($S_{DS}$) and long ($S_{D1}$) period design spectral acceleration coefficients for each of the proposed structures. For this section of the project, the $S_{DS}$ and the $S_{D1}$ were determined using 2020 AASHTO Guide Specifications as shown in **Table 6**. Given the site location and materials encountered, the potential for liquefaction is minimal.

**Table 6 – Seismic Parameters**

| Building Code Reference | PGA | $S_{DS}$ | $S_{D1}$ |
|---|---|---|---|
| 2020 AASHTO Guide for LRFD Seismic Bridge Design | 0.049g | 0.126g | 0.068g |

## 4.0 GEOTECHNICAL BRIDGE DESIGN RECOMMENDATIONS

The foundations for the proposed bridge must provide sufficient support to resist the dead and live loads, as well as seismic loading. The foundation design recommendations presented within this section were completed per the AASHTO LRFD 9$^{th}$ Edition (2020). The anticipated loads provided by WSP are in **Table 7**.

**Table 7 – Summary of Substructure Loads**

| Substructure ID | Service Dead Load (Kips) | Service Dead Live (Kips) | Combined Service Load (Kips) | Total Factored Load (Kips) |
|---|---|---|---|---|
| **N. Abutment** | 1,843 | 403 | 2,246 | 3,092 |
| **Central Pier** | 3,941 | 854 | 4,795 | 6,588 |
| **S Abutment** | 1,987 | 475 | 2,462 | 3,399 |

### 4.1 Bridge Foundation Recommendations

GSG evaluated potential foundation systems for the proposed bridge. GSG's evaluation included shallow spread footings, drilled shafts, and driven piles. The results of the evaluation are presented below.

#### 4.1.1 Shallow Foundations

Based on the shallow bedrock encountered in the site, the new anticipated span length and the anticipated loads, shallow foundations are anticipated to be feasible and a cost-effective option for the proposed bridge pier. Based on preliminary design information, shallow foundations for the center pier would bear at elevation 580.5 feet, approximately 13.1 feet below existing grade on bedrock. Design recommendations for shallow foundations are provided in *Section 4.2*.

#### 4.1.2 Drilled Shaft Foundations

Drilled shafts are generally not recommended for integral abutments because they do not have the lateral flexibility necessary to accommodate the thermal movements for integral abutments. Therefore, drilled shafts will not be further discussed in this report.

#### 4.1.3 Driven Pile Foundations

Driven piles could be considered to support the bridge abutments and approach bents. H-piles are a feasible option for the construction of the abutments and approach bents for the proposed bridge structures. Concrete piles are not recommended for this site because the pile lengths cannot be readily adjusted to accommodate variability in soil conditions. Metal shell piles are not recommended due to the shallow proximity of bedrock. Design recommendations for driven piles are provided in *Section 4.3* of this report.

Driving shoes for the piles, in accordance with Section 1006.05 of the IDOT Standard Specifications for Road and Bridge Construction (SSRBC), should be considered to guard against the very dense granular soils and relatively shallow bedrock.

### 4.2 Shallow Foundations Recommendations

Based on the preliminary design information available and the soil conditions at the site, it is anticipated that the center pier of the bridge will be supported on shallow spread footings bearing on the underlying bedrock. The results of the evaluation are presented below.

#### 4.2.1 Shallow Foundations Bearing Resistance

Bearing resistance for the center pier spread footings shall be evaluated at the strength limit state using load factors, and factored bearing resistance. The bearing resistance factor, $\phi_b$, for shallow bedrock is 0.45 per AASHTO Table 10.5.5.2.2-1. Bearing on the underlying bedrock, the spread footings could be designed using nominal bearing resistance of 67 ksf and factored resistance of 30 ksf. The nominal bearing resistance of the footings should not be greater than the compressive resistance of the footing concrete. The shallow footings should be designed such that the eccentricity of loading at the strength limit state should not exceed 1/3 of the corresponding footing dimensions (0.45 of footing width or length) AASHTO 10.6.3.3, Eccentric Load Limitations. No differential settlement is anticipated for footings bearing on bedrock. The footing bearing elevation for the center pier is anticipated to be 580.5 feet.

#### 4.2.2 Shallow Foundation Lateral Resistance

The shallow foundations should be designed to resist sliding and overturning lateral and/or eccentric bridge loading. Resistance to lateral loads can be developed by sliding friction between the bearing bedrock and the bottom of the footings. A nominal coefficient of sliding friction of 0.45 may be assumed between the bottom of the concrete footing and the bedrock and a resistance factor of 0.80 is recommended. Sliding resistance due to passive pressure in front of the footing can be applied given that the lower portion of the footing is keyed into bedrock. If the footing sliding resistance required embedment in rock, the bottom of the footing elevation should be adjusted to ensure the required minimum embedment. The top 2 feet of the rock should be neglected from the passive resistance due to disturbance during construction. A nominal passive resistance equivalent fluid pressure of 420 pounds per cubic foot (pcf) acting against the embedded portion of the footing may be used with a resistance factor of 0.50.

### 4.3 Driven Pile Foundation Design Recommendation

Depending on the construction sequences, driven piles for the abutments and approach bents, within the newly constructed embankments, may be subjected to downdrag effects. If the new Center Street embankment is constructed and preloaded to allow settlement to occur before the pile installations, there will be no downward movement of the soil relative to piles and downdrag influence is eliminated. Pile design recommendations with no downdrag are provided in *Section 4.3.1*. If the piles are installed before the filling operations, downdrag effects should be considered in the pile design or should be mitigated. Pile design recommendations with downdrag mitigation (precoring) for the abutment and approach bent locations are provided in *Section 4.3.2*.

#### 4.3.1 Pile Design with No Downdrag

The Modified IDOT static method-excel spreadsheet was used to estimate the pile lengths at various axial geotechnical resistances for driven piles per IDOT AGMU Memo 10.2. The factored resistance includes a reduction of 0.55 for the geotechnical resistance for the pile installation. No geotechnical losses due to scour or liquefaction were included in the axial pile resistance calculations.

Based on the presence of shallow bedrock, GSG recommends using HP piles to support the bridge foundation if the pile option is selected. **Tables 8a through 8d** summarize the estimated maximum pile lengths for representative pile sections along with the factored resistance available for several pile types that could be feasible for the proposed substructures. The complete IDOT Pile Design Tables for each substructure, including factored resistance available ($R_F$) and nominal required bearing ($R_N$), are included in **Appendix F**.

The estimated pile lengths shown in **Tables 8a through 8d** and in **Appendix F** are based on the pile cut off estimated elevations noted below each table. The actual pile length and resistance should be evaluated based on test piles installed in accordance with the specifications provided in Section 512.15 of IDOT Standard Specifications for Road and Bridge Construction. Per section 3.10.1.11 of the IDOT Bridge Manual, the minimum pile spacing should be 3 pile diameters.

**Table 8a – North Abutment Pile Design (BSB-65)**

| Pile Section | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (FT)* |
|---|---|---|---|
| HP12x53 (Max. $R_N$ = 418 Kips) | 418 | 230 | 21.0 |
| HP12x74 (Max. $R_N$ = 589 Kips) | 589 | 324 | 23.0 |
| HP14x73 (Max. $R_N$ = 578 Kips) | 578 | 318 | 22.0 |
| HP14x89 (Max. $R_N$ = 705 Kips) | 705 | 388 | 23.0 |
| HP14x102 (Max. $R_N$ = 810 Kips) | 810 | 445 | 23.0 |
| HP14x117 (Max. $R_N$ = 929 Kips) | 929 | 511 | 24.0 |

* Estimated pile length is based on assuming the pile cut off elevation: 606.9 ft., and ground elevation at beginning of pile driving: 604.9 ft.

** All HP piles extend into the limestone bedrock.

**Table 8b – North Approach Bent Pile Design (BSB-65)**

| Pile Section | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (FT)* |
|---|---|---|---|
| HP12x53 (Max. $R_N$ = 418 Kips) | 418 | 230 | 25.0 |
| HP12x74 (Max. $R_N$ = 589 Kips) | 589 | 324 | 26.0 |
| HP14x73 (Max. $R_N$ = 578 Kips) | 578 | 318 | 26.0 |
| HP14x89 (Max. $R_N$ = 705 Kips) | 705 | 388 | 26.0 |

* Estimated pile length is based on assuming the pile cut off elevation: 611.2 ft., and ground elevation at beginning of pile driving: 610.2 ft.

** All HP piles extend into the limestone bedrock.

**Table 8c – South Abutment & South Approach Bent Pile Design (BSB-302)**

| Pile Section | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (FT)* |
|---|---|---|---|
| HP12x53 (Max. $R_N$ = 418 Kips) | 418 | 230 | 36.0 |
| HP12x74 (Max. $R_N$ = 589 Kips) | 589 | 324 | 37.0 |
| HP14x73 (Max. $R_N$ = 578 Kips) | 578 | 318 | 36.0 |
| HP14x89 (Max. $R_N$ = 705 Kips) | 705 | 388 | 37.0 |
| HP14x102 (Max. $R_N$ = 810 Kips) | 810 | 445 | 37.0 |
| HP14x117 (Max. $R_N$ = 929 Kips) | 929 | 511 | 38.0 |

* Estimated pile length is based on assuming the pile cut off elevation: 603.2 ft., and ground elevation at beginning of pile driving: 601.2 ft.

** All HP piles extend into the limestone bedrock.

**Table 8d – South Abutment & South Approach Bent Pile Design (BSB-303)**

| Pile Section | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (FT)* |
|---|---|---|---|
| HP12x53 (Max. $R_N$ = 418 Kips) | 418 | 230 | 19.0 |
| HP12x74 (Max. $R_N$ = 589 Kips) | 589 | 324 | 20.0 |
| HP14x73 (Max. $R_N$ = 578 Kips) | 578 | 318 | 19.0 |
| HP14x89 (Max. $R_N$ = 705 Kips) | 705 | 388 | 20.0 |

* Estimated pile length is based on assuming the pile cut off elevation: 607.4 ft., and ground elevation at beginning of pile driving: 606.4 ft.

** All HP piles extend into the limestone bedrock.

It is recommended that all HP piles extend into the limestone bedrock.

### 4.3.2 Pile Design with Downdrag

This section presents pile design recommendations including the effect of downdrag induced due to the downward movement of the soil relative to the piles for the abutment and approach bent foundations. According to AASHTO Section 3.11.8-Downdrag, the pile should be designed to resist the downdrag if the ground settlement is 0.4 inches or greater. Based on *Section 3.2 Settlement*, 0.79 inches of ground settlement is anticipated at the north abutment, therefore downdrag needs to be considered. Based on the construction sequencing, excessive settlement of the southern embankment may also cause downdrag and should be evaluated once construction staging is evaluated. The nominal geotechnical resistance available to resist the structure load plus the downdrag load is estimated by considering only the positive side resistance and tip resistance below the lowest layer contributing to the downdrag.

GSG utilized the Modified IDOT static method-excel spreadsheet to estimate the pile lengths at various axial geotechnical resistances for driven piles.

**Table 9a and 9b** summarize the estimated maximum pile lengths for representative pile sections along with the factored resistance available for H-piles that are feasible for the proposed substructures. The complete IDOT Pile Design Table including factored resistance available (RF) and nominal required bearing (RN), is included in **Appendix G**.

The estimated pile lengths shown in **Table 9a and 9b** and in **Appendix G** are based on the estimated pile cut off elevations noted below the table. The actual pile length and resistance should be evaluated based on test piles installed in accordance with the specifications provided in Section 512.15 of IDOT Standard Specifications for Road and Bridge Construction. Per section 3.10.1.11 of the IDOT Bridge Manual, the minimum pile spacing should be 3 pile diameters, and the maximum pile spacing should not be more than 3.5 times the effective footing thickness plus one foot, not to exceed a total of 8 feet.

**Table 9a – North Abutment Pile Design (BSB-65) with Downdrag to 593.0 ft**

| Pile Section | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (FT)* |
|---|---|---|---|
| HP12x53 (Max. $R_N$ = 418 Kips) | 418 | 185 | 21.0 |
| HP12x74 (Max. $R_N$ = 589 Kips) | 589 | 278 | 23.0 |
| HP14x73 (Max. $R_N$ = 578 Kips) | 578 | 264 | 22.0 |
| HP14x89 (Max. $R_N$ = 705 Kips) | 705 | 334 | 23.0 |
| HP14x102 (Max. $R_N$ = 810 Kips) | 810 | 391 | 23.0 |
| HP14x117 (Max. $R_N$ = 929 Kips) | 929 | 456 | 24.0 |

* Estimated pile length is based on assuming the pile cut off elevation: 606.9 ft., ground elevation at beginning of pile driving: 604.9 and downdrag to 593.0 ft.

** All HP piles extend into the limestone bedrock.

**Table 9b – North Approach Bent Pile Design (BSB-65) with Downdrag to 596.0 ft**

| Pile Section | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (FT)* |
|---|---|---|---|
| HP12x53 (Max. $R_N$ = 418 Kips) | 418 | 134 | 25.0 |
| HP12x74 (Max. $R_N$ = 589 Kips) | 589 | 253 | 26.0 |
| HP14x73 (Max. $R_N$ = 578 Kips) | 578 | 235 | 26.0 |
| HP14x89 (Max. $R_N$ = 705 Kips) | 705 | 304 | 26.0 |

* Estimated pile length is based on assuming the pile cut off elevation: 611.2 ft., ground elevation at beginning of pile driving: 610.2 and downdrag to 596.0 ft.

** All HP piles extend into the limestone bedrock.

### 4.4 Lateral Load Resistance

Lateral loadings applied to deep foundations are typically resisted by the soil/structure interaction, pile flexure, or a combination of these factors. Section 3.10.1.10 of the 2012 IDOT Bridge Manual requires performing detailed structure interaction analysis if the factored lateral loading per pile exceeds 3 kips. The analysis shall determine actual pile moment and deflection to determine the selected pile adequacy for the existing loadings. **Tables H-1 and H-2** in **Appendix H** provide generalized soil parameters for the abutments and approach bents, and includes recommended lateral soil modulus and soil strain parameters that can be used for deep foundation analysis via the p-y curve method based on the encountered subsurface conditions.

## 5.0 CONSTRUCTION CONSIDERATIONS

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

### 5.1 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.

### 5.2 Site Excavation

If borrow material is to be used for onsite construction, it should conform to Section 204 "Borrow and Furnished Excavation" of the IDOT Construction Manual (2021). The fill material should be free of organic matter and debris. Earth-moving operations should be avoided during excessively cold or wet weather to avoid freezing of softening subgrade soils.

Structural fill shall consist of crushed limestone or recycled concrete consistent with IDOT CA-6 gradation or medium plasticity silty clays. Structural fill should be placed in lifts not to exceed 8 inches in loose thickness and compacted to a minimum of 95% of the material's standard proctor maximum dry density obtained according to the ASTM D698/AASHTO T 99 method.

Materials unsatisfactory for use as structural fill include soils classified as silt or organic silt (ML, MH, PT, OL, and OH) in the Unified Classification System (ASTM D2487). Soils with these classifications may be used for general purpose landscaping and in areas where uncontrolled settlement is acceptable.

Should fill be placed during cool, wet seasons, the use of granular fill may be necessary since weather conditions will make compaction of cohesive soils more difficult. If water seepage while excavating and backfilling procedures, or where wet conditions are encountered such that the water cannot be removed with conventional sump and pump procedures, GSG recommends placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation. The CA-7 stone should be placed to 12 inches above the water level, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation should be backfilled using approved engineered fill.

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

### 5.3 Pile Installation

Based on the variance in top-of-rock elevations (between about El. 569.5 feet and 589.1 feet) it is recommended test piles be utilized at the site. One test pile is recommended at each abutment. The test-piles are installed based on the preliminary driving criteria in order to evaluate site conditions and are inspected in accordance with the IDOT Standard for Road and Bridge Construction. All test pile installation should be completed in accordance with the IDOT SSRBC Section 512.15. Pile shoes should be used for the H-piles to facilitate driving into the bedrock and protect piles from damage during installation. Due to conflict with the reinforced mass of a nearby retaining wall, some of the approach slab piles will require pile sleeves. The pile sleeves should be backfilled with bentonite, per IDOT Bridge Manual (2023).

### 5.4 Temporary Earth Structure Lateral Earth Pressures

Based on the anticipated excavation depths for the shallow foundations for the piers, a temporary soil retention system (TSRS) will likely be required. Based on the soil profile, a cantilevered sheet pile system is likely not feasible due to the presence of layers of dense granular soils and bedrock. The Temporary Soil Retention System shall be designed by an Illinois licensed structural engineer in accordance with the IDOT Bridge Design Manual. The design of the Temporary Soil Retention System 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.

## 5.5 Groundwater Management

Long term groundwater is anticipated to be beneath the bottom of the borings. GSG does not anticipate that groundwater related issues occur during construction activity, however perched water may be encountered within the existing fill materials. 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 the removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

## 6.0 LIMITATIONS

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

**Appendix A**

**Preliminary TS&L**

Benchmark: Chiseled "X" on top of SE bolt of Fire Hydrant at South ROW of Jasper St. (in front of 640 Jasper St. address), Elev. 585.86.

Existing Structure: S.N. 099-0188 was originally constructed in 1961 as a four (4) span structure with a skew carrying northbound Center Street Route 61 over eastbound and westbound I-80 (F.A.I. Route 80; Section 10 (Str. 5)). The bridge has an overall length of approximately 259'-6" (back-to back-abutments), an overall width that varies from 39'-5½" to 47'-10¼" (out-to-out superstructure), and consists of a 7"-thick reinforced concrete deck with 2" microsilica concrete overlay. The existing deck is supported by seven (7) steel beams spaced from 3'-7¼" to 8'-5¾" center-to-center spacing. The substructure consists of reinforced concrete abutments on battered steel piles and creosoted timber piles and reinforced concrete piers with spread footings on rock.

This structure will be removed in a separate Contract 62R22 and replaced at location to the east. Traffic will be detoured during construction.

Salvage: None.

## HIGHWAY CLASSIFICATION

| Center Street | Center Street Ramp B | F.A.I. Rte. 80 - I-80 |
|---|---|---|
| Functional Class: Minor Arterial | Functional Class: Interstate | Functional Class: Interstate |
| ADT: 18,900 (2019); 29,100 (2040) | ADT: 4,650(2017); 2,930 (2040) | ADT: 91,100 (2017); 133,500 (2040) |
| ADTT: 1,266 (2019); 1,950 (2040) | ADTT: 400 (2017); 252 (2040) | ADTT: 19,240 (2017); 28,195 (2040) |
| DHV: 3,201 (2040) | DHV: 512 (2040) | DHV: 14,685 (2032) |
| Design Speed: 35 m.p.h. | Design Speed: 40 m.p.h. | Design Speed: 70 m.p.h. |
| Posted Speed: 35 m.p.h. | Posted Speed: 40 m.p.h. | Posted Speed: 70 m.p.h. |
| 2-Way Traffic | 1-Way Traffic | 2-Way Traffic |
| Directional Distribution: 50-50 | | Directional Distribution: 50-50 |

## DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

## DESIGN STRESSES

FIELD UNITS

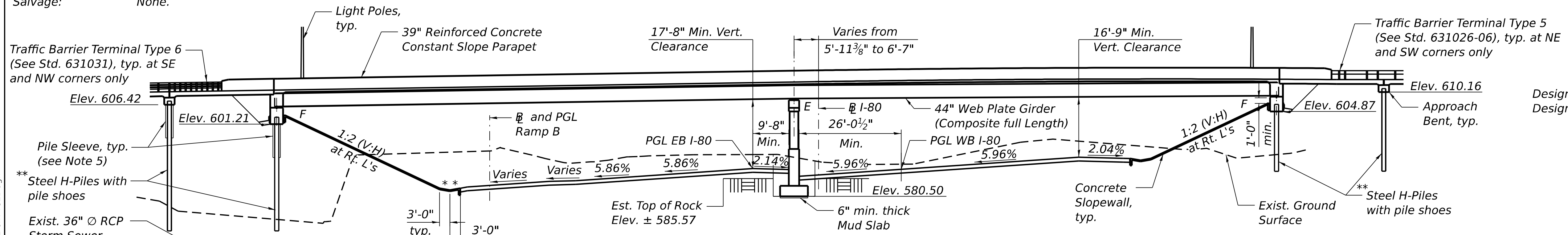
f'c = 4,000 psi (Superstructure)
f'c = 3,500 psi (Substructure)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)

## LOADING HL-93

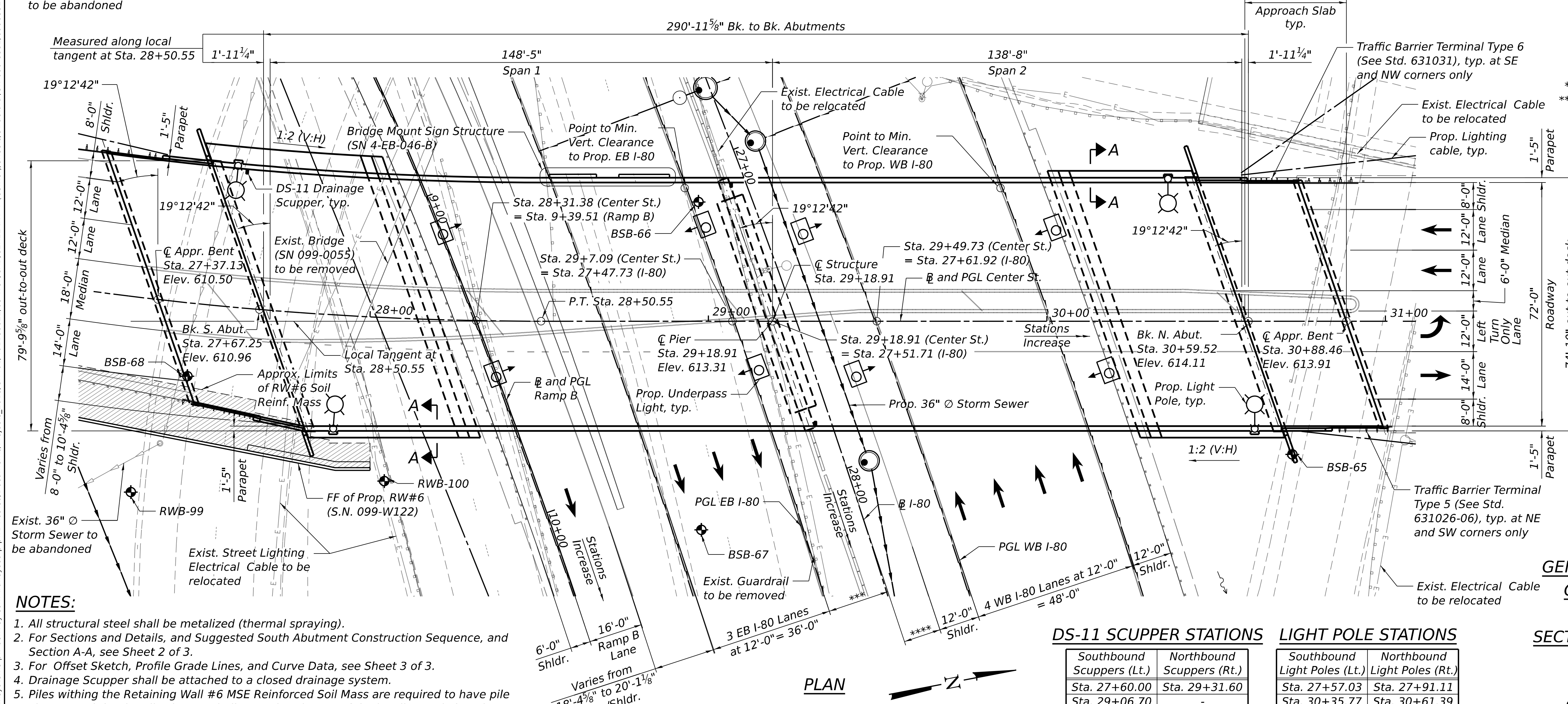
Allow 50#/sq.ft. for future wearing surface

## SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.068 g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.126 g
Soil Site Class = C



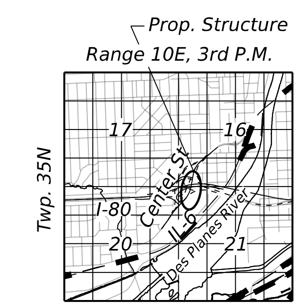

ELEVATION




* 1:6 (V:H)
** Spacing, tip elevation and steel pile size to be determined during final design
*** Varies from 17'-5" to 18'-0⅝"
**** Varies from 9'-7⅞" to 10'-10"

## LEGEND

- Exist. Electrical Cable
- Exist. Storm Sewer
- Prop. Storm Sewer
- Prop. Pipe Underdrain
- Exist. Guardrail
- Exist. Light Pole
- Prop. Light Pole
- Prop. Underpass Light
- Soil Boring




LOCATION SKETCH

PLAN

## NOTES:

1. All structural steel shall be metalized (thermal spraying).
2. For Sections and Details, and Suggested South Abutment Construction Sequence, and Section A-A, see Sheet 2 of 3.
3. For Offset Sketch, Profile Grade Lines, and Curve Data, see Sheet 3 of 3.
4. Drainage Scupper shall be attached to a closed drainage system.
5. Piles withing the Retaining Wall #6 MSE Reinforced Soil Mass are required to have pile sleeves and the the pile sleeves shall extend to the top of the leveling pad elevation.

## DS-11 SCUPPER STATIONS

| Southbound Scuppers (Lt.) | Northbound Scuppers (Rt.) |
|---|---|
| Sta. 27+60.00 | Sta. 29+31.60 |
| Sta. 29+06.70 | - |

## LIGHT POLE STATIONS

| Southbound Light Poles (Lt.) | Northbound Light Poles (Rt.) |
|---|---|
| Sta. 27+57.03 | Sta. 27+91.11 |
| Sta. 30+35.77 | Sta. 30+61.39 |

GENERAL PLAN AND ELEVATION
CENTER STREET OVER I-80
F.A.I. ROUTE 80
SECTION- FAI 80 21 INTERCHANGE
WILL COUNTY
STA. 29+18.91
STRUCTURE NO. 099-8332

HBM ENGINEERING GROUP, LLC

| USER NAME = | DESIGNED - PG | REVISED - |
|---|---|---|
| | CHECKED - MI | REVISED - |
| PLOT SCALE = | DRAWN - PG | REVISED - |
| PLOT DATE = | CHECKED - MI | REVISED - |

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 3 SHEETS

| F.A.I. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
| 80 | FAI 80 21 INTERCHANGE | WILL | 3 | 1 |

CONTRACT NO. 62R22
ILLINOIS FED. AID PROJECT

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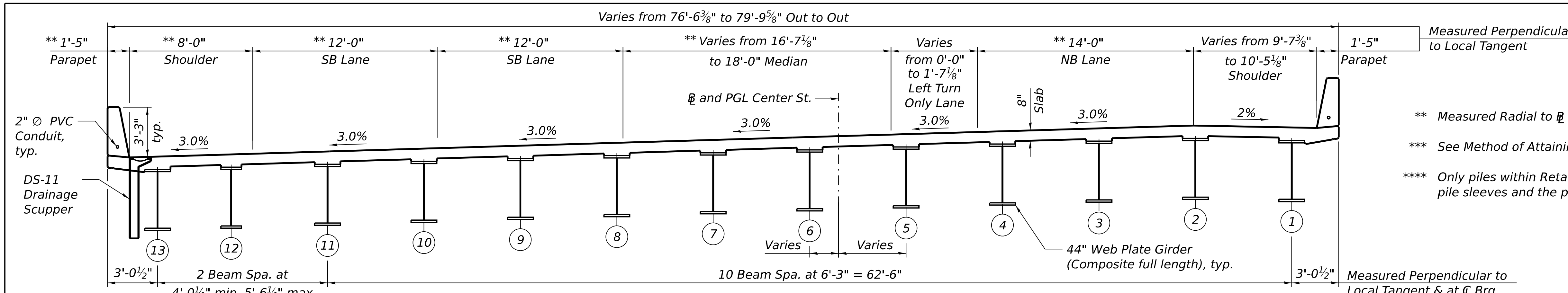



## TYPICAL CROSS SECTION

(Looking North)
(Sta. 27+68.34 to Sta. 27+91.49)

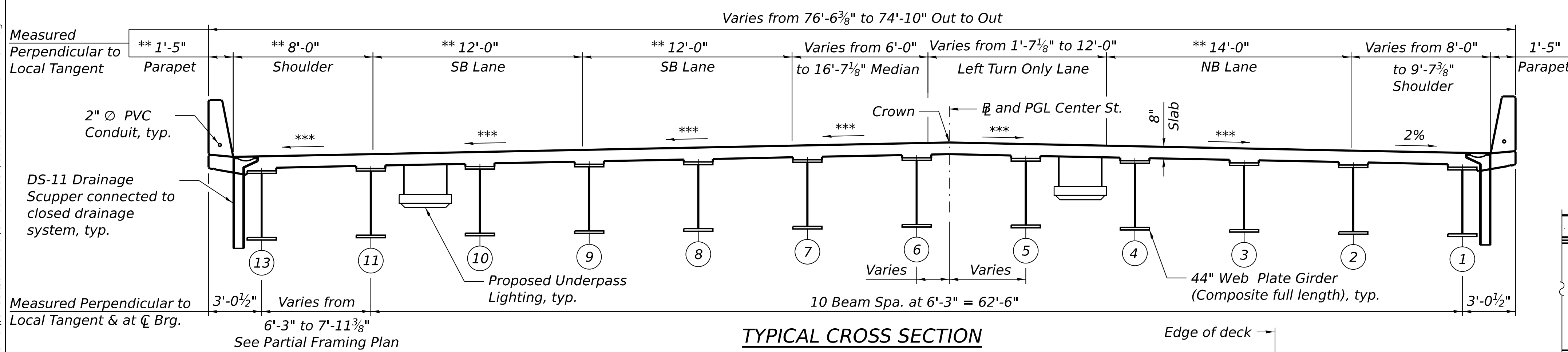
** Measured Radial to ℗ Center Street.

*** See Method of Attaining Superelevation for Deck Cross Slopes.

**** Only piles within Retaining Wall #6 MSE reinforced soil mass are required to have pile sleeves and the pile sleeves shall extend to the top of leveling pad elevation.

## SUGGESTED SOUTH ABUTMENT CONSTRUCTION SEQUENCE:

1. Backfill to the theoretical top of leveling pad elevation of Retaining Wall #6.
2. Drive South Abutment and South Approach Bent piles which lay within the Retaining Wall #6 MSE Reinforced Soil Mass.
3. Place Pile Sleeve around piles of the South Abutment and South Approach Slab Bent which lay within the Retaining Wall #6 MSE Reinforced Soil Mass.
4. Construct Retaining Wall #6 MSE Wall and backfill embankment up to the bottom of the South Abutment and South Approach Bent.
5. Fill the Pile Sleeve with bentonite up to the bottom of the South Abutment and South Approach Slab Bent.
6. Drive rest of the South Abutment and South Approach Bent piles.




## TYPICAL CROSS SECTION

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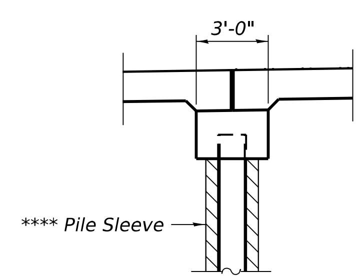
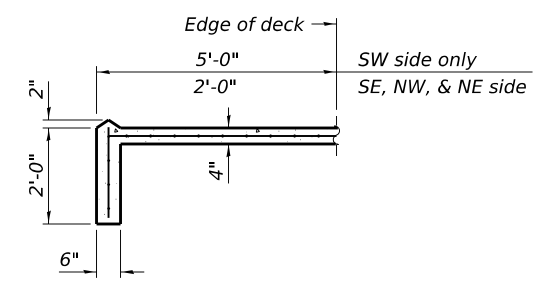



## SECTION THRU APPROACH BENT

(Horiz. dim. at Rt. ∠'s)

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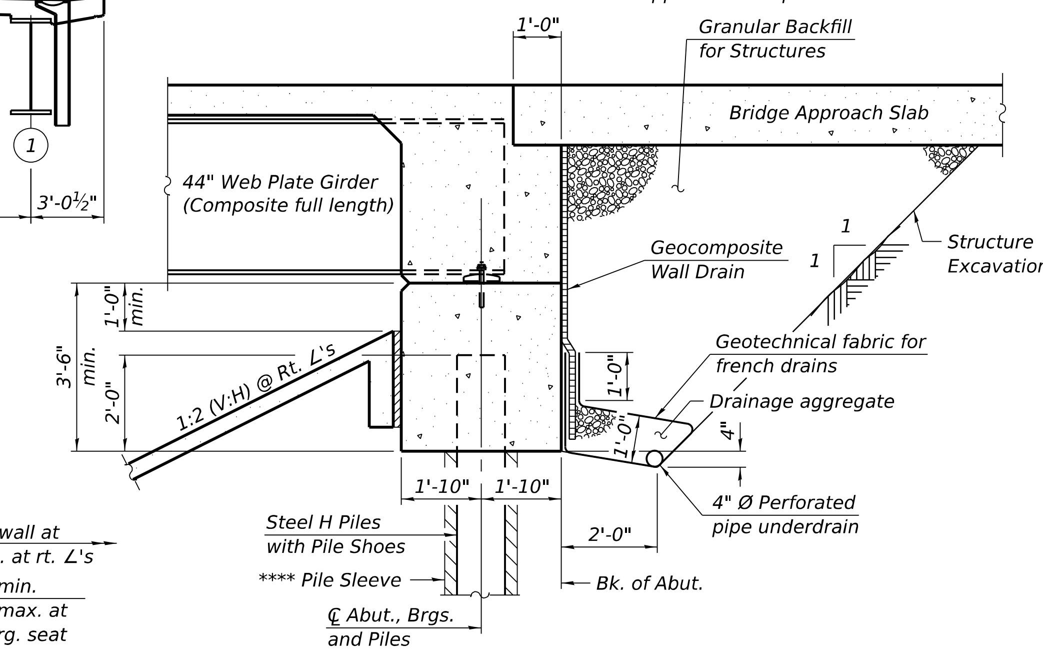


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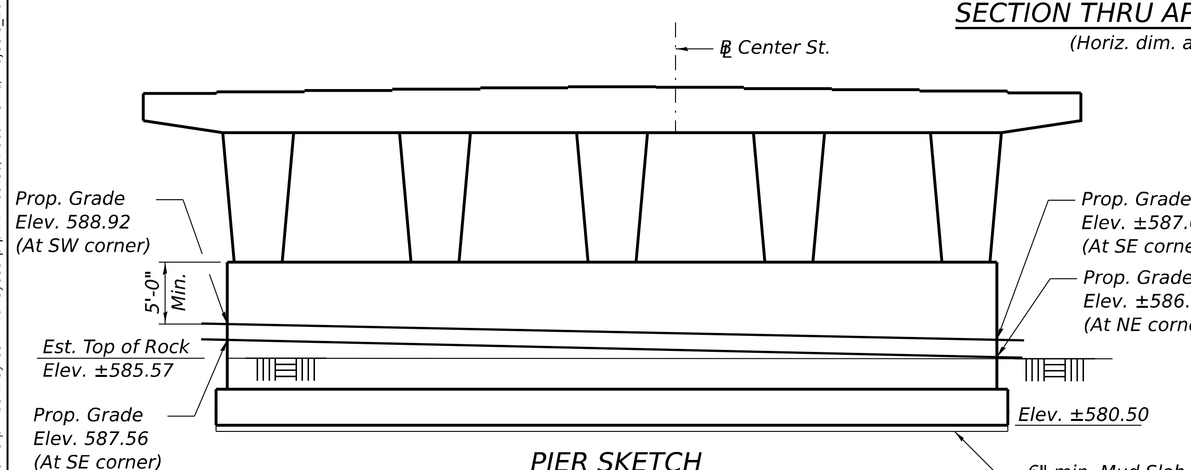
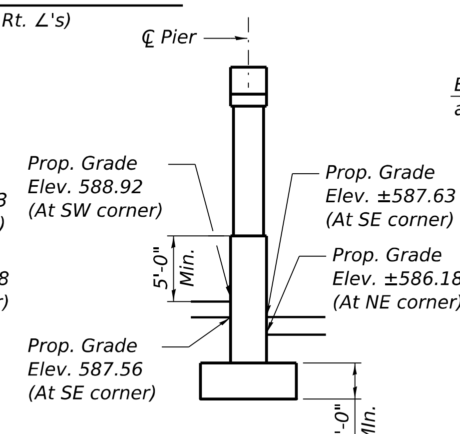



## PIER SKETCH

(Looking Upstation)
(Footing elevation, width, and other proportions to be finalized in design.)

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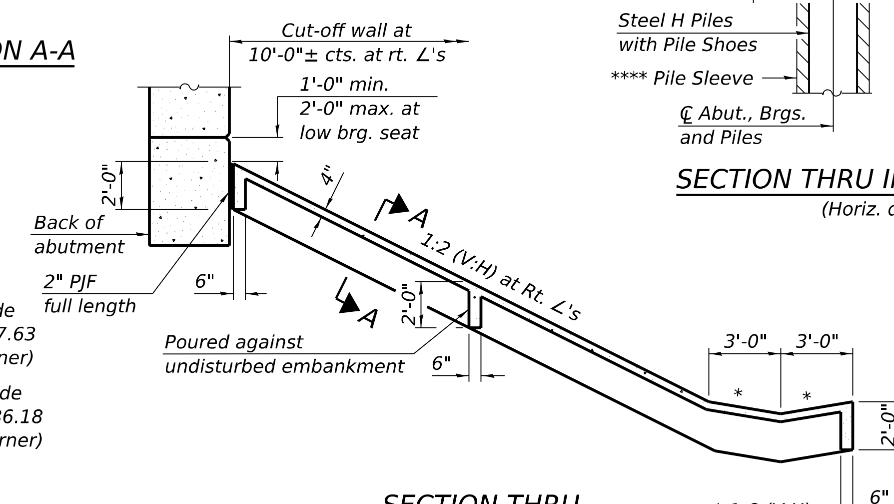


## SECTION THRU CONCRETE SLOPEWALL

## SECTIONS AND DETAILS
## CENTER STREET OVER I-80
## F.A.I. ROUTE 80
## SECTION- FAI 80 21 INTERCHANGE
## WILL COUNTY
## STA. 29+18.91
## STRUCTURE NO. 099-8332

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HBM ENGINEERING GROUP, LLC

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**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

SHEET 2 OF 3 SHEETS

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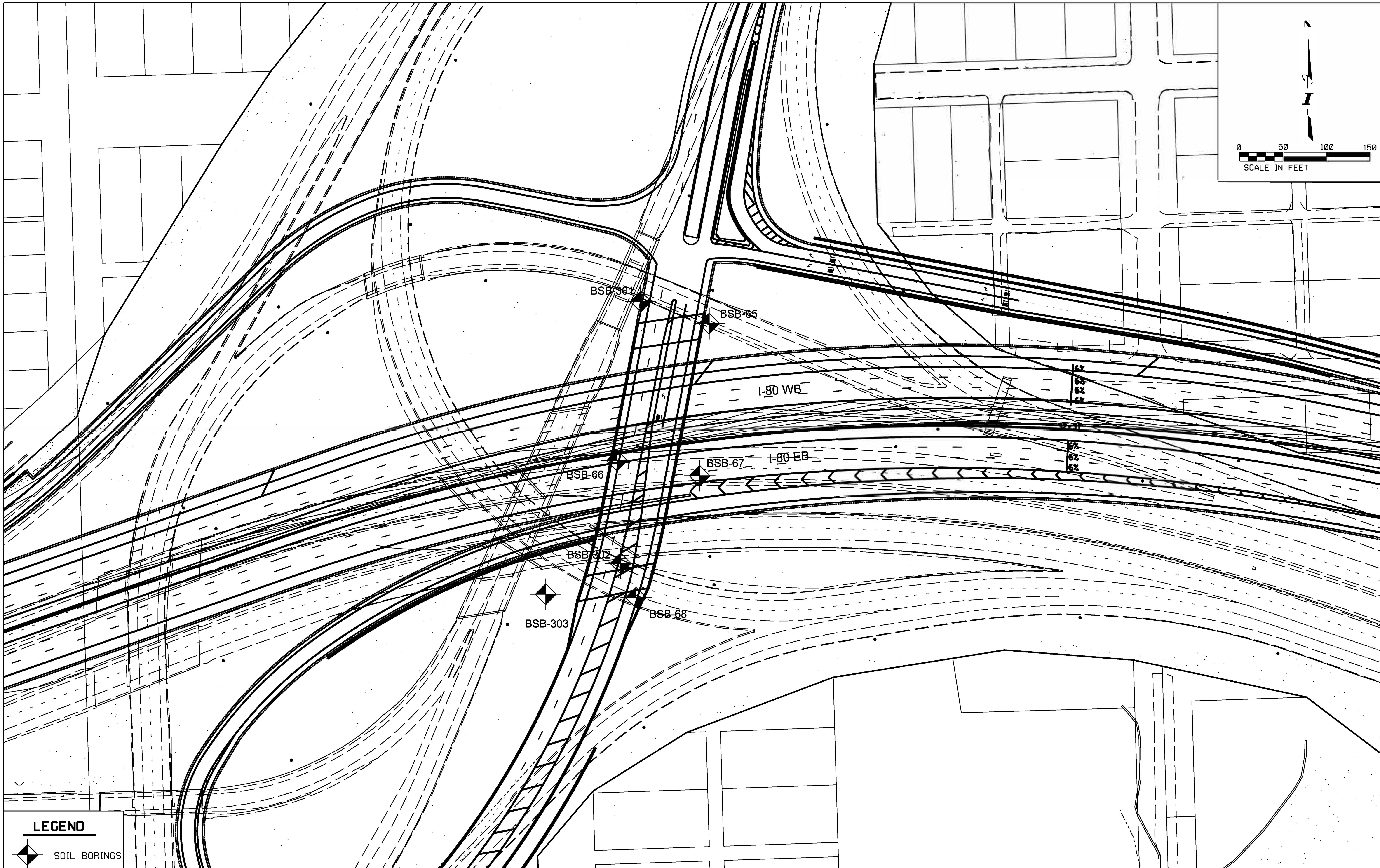
| | ILLINOIS | FED. AID PROJECT | | |

**Appendix B**

**Soil Boring Location Plan and Subsurface Profile**




## LEGEND

SOIL BORINGS

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

| | | | |
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**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

CENTER STREET BRIDGE, SN: 099-8337

SOIL BORING LOCATION PLAN
JOLIET, ILLINOIS

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

| F.A. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
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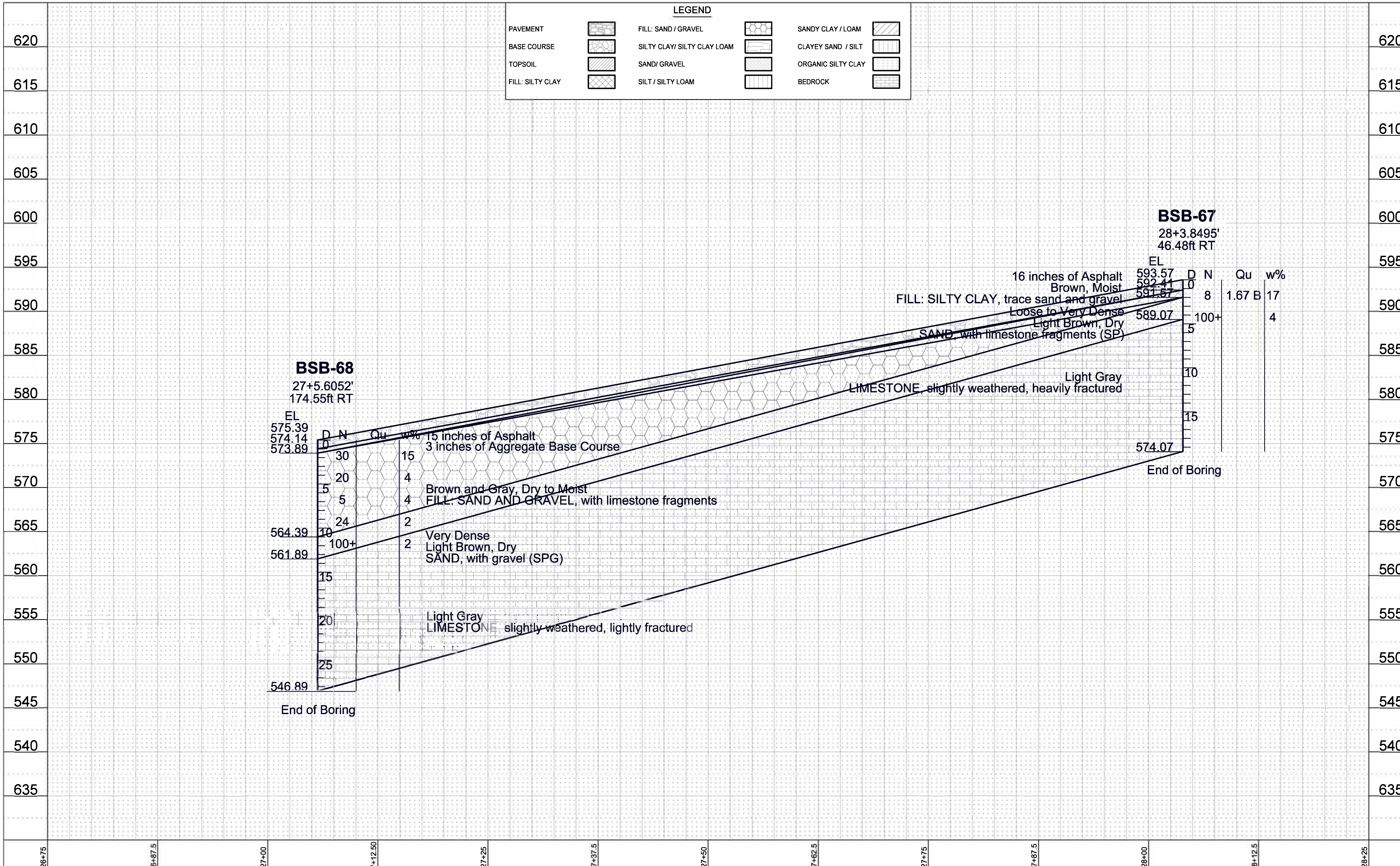
CONTRACT NO. PTB 198-003

ILLINOIS | FED. AID PROJECT




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

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**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

CENTER STREET BRIDGE
SOIL BORING LOCATION PROFILE
JOLIET, ILLINOIS

SCALE: AS NOTED | SHEET 1 OF 3 SHEETS | STA. 27+75 TO STA. 28+25

| F.A. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
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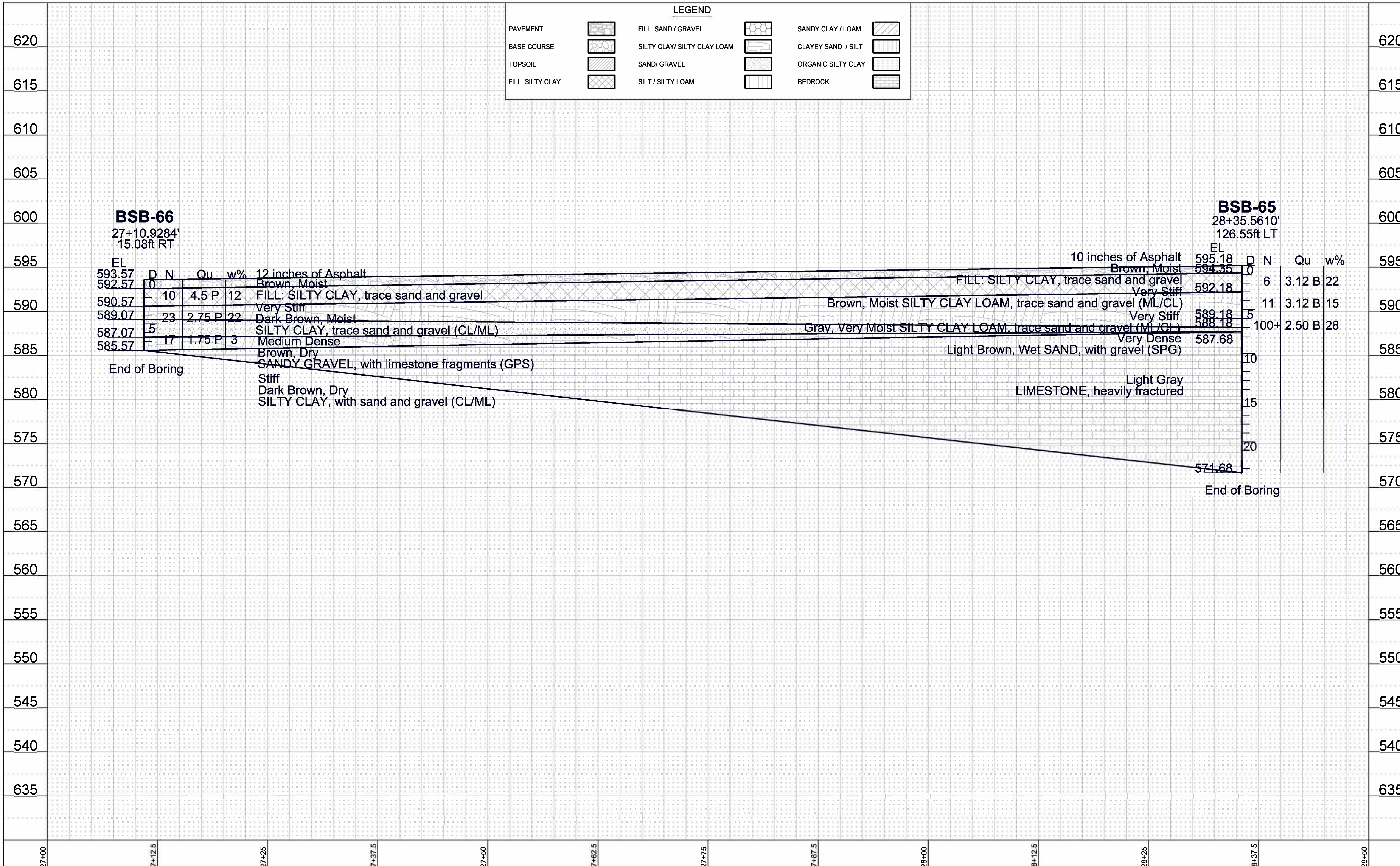
CONTRACT NO. PTB 198-003
ILLINOIS | FED. AID PROJECT




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

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**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

CENTER STREET BRIDGE
SOIL BORING LOCATION PROFILE
JOLIET, ILLINOIS

SCALE: AS NOTED | SHEET 2 OF 3 SHEETS | STA. 27+00 TO STA. 28+50

| F.A. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
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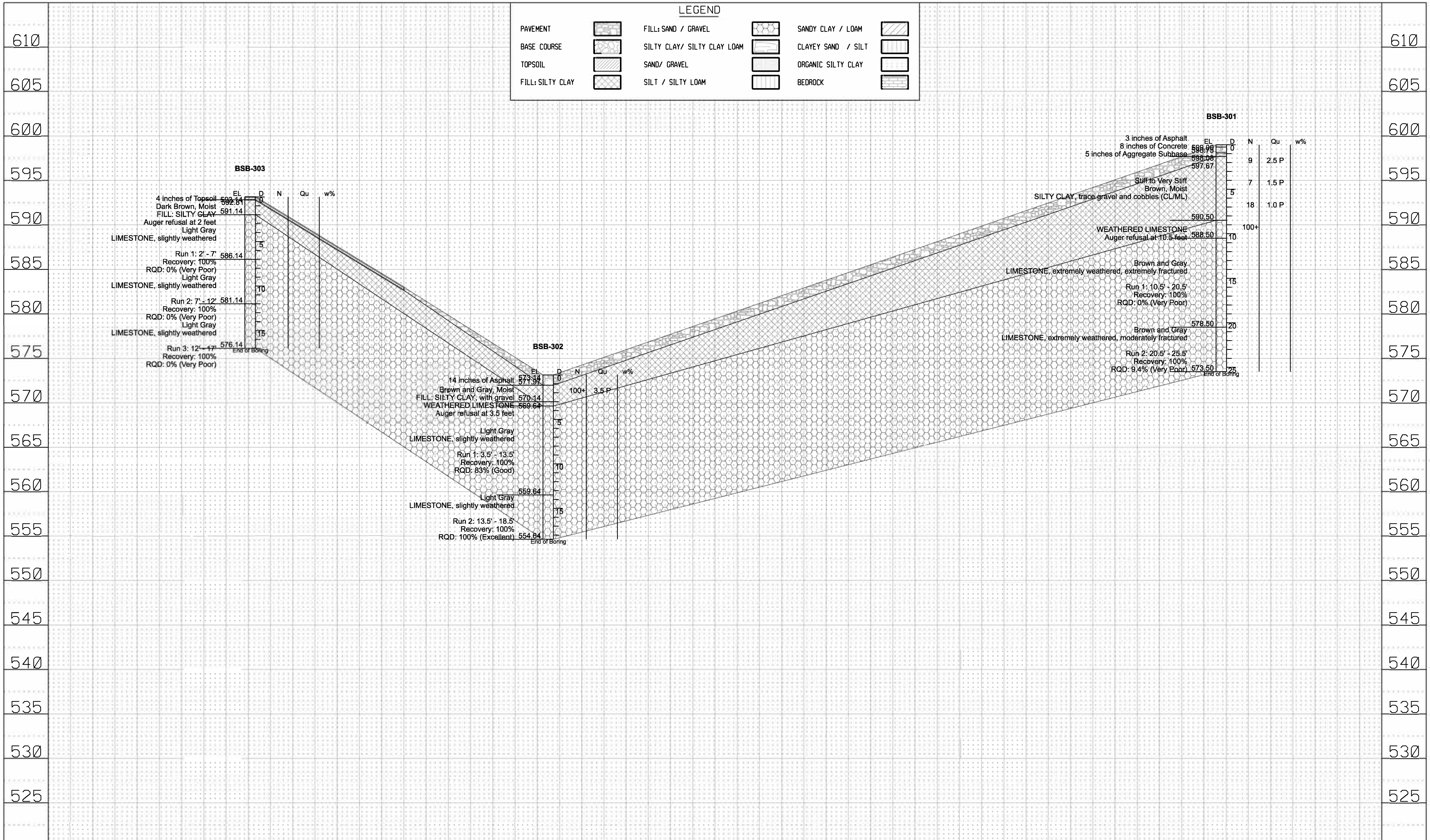
CONTRACT NO. PTB 198-003
ILLINOIS | FED. AID PROJECT




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

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CENTER STREET BRIDGE
SOIL BORING LOCATION PROFILE
JOLIET, ILLINOIS

SCALE: AS NOTED | SHEET 3 OF 3 SHEETS | STA. 27+00 | TO STA. 28+50

| F.A. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
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| | | CONTRACT NO. PTB 198-003 | | |

ILLINOIS | FED. AID PROJECT

**Appendix C**

**Soil Boring Logs**

# Illinois Department of Transportation
Division of Highways
GSG

# SOIL BORING LOG



Date 4/20/22

**ROUTE** I-80 **DESCRIPTION** I-80 at Center Street **LOGGED BY** DD

**SECTION** I-80 over Des Plaines River **LOCATION** , **SEC.** 16, **TWP.** 35 N, **RNG.** 10 E, Latitude , Longitude

**COUNTY** Will **DRILLING METHOD** HSA

**DRILLING RIG** CME-75
**HAMMER TYPE** AUTO
**HAMMER EFF (%)** 91

**STRUCT. NO.** 099-8332
**Station**

**BORING NO.** BSB-65
**Station** 28+35.56'
**Offset** 126.55ft LT
**Ground Surface Elev.** 595.18 ft

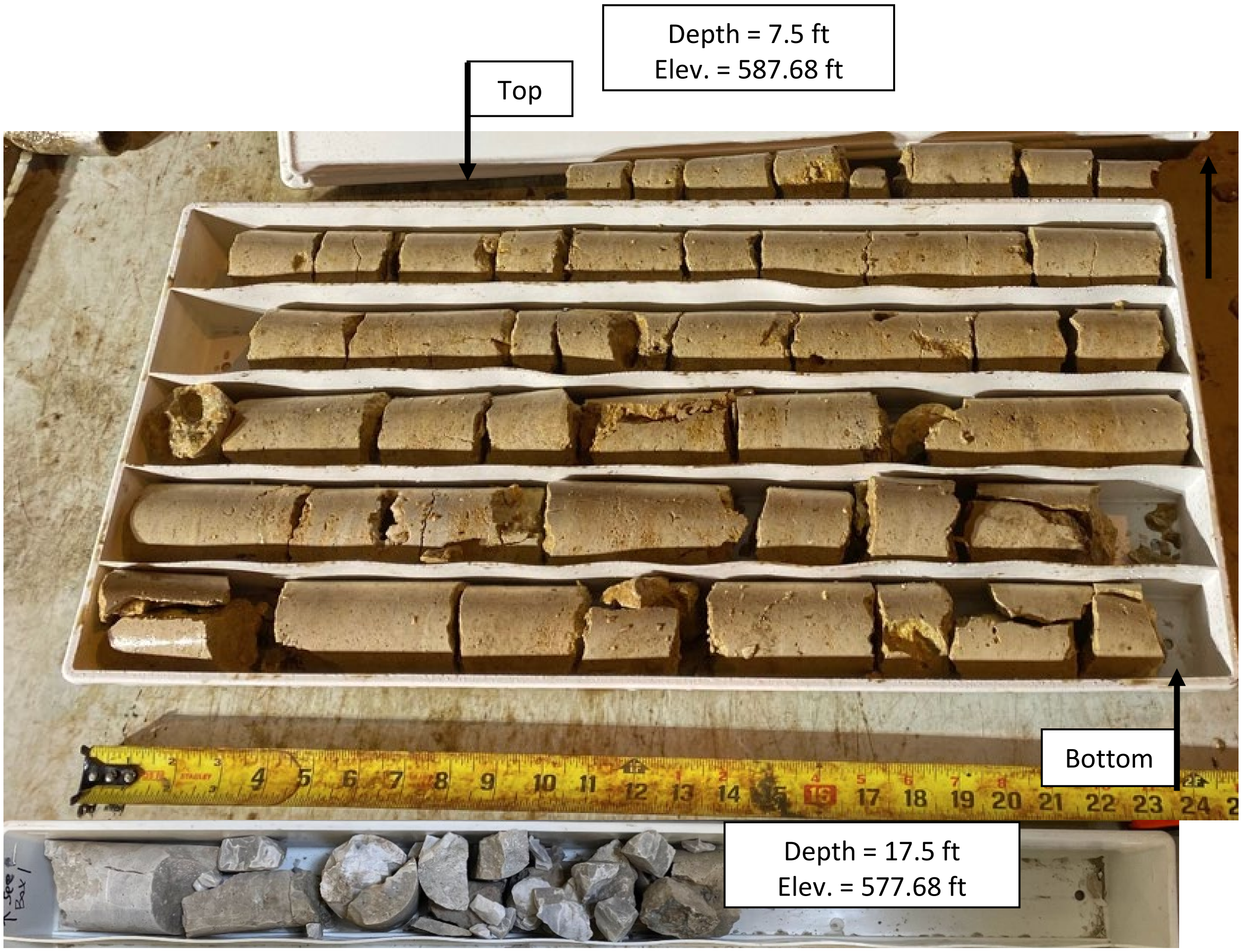
**Surface Water Elev.** N/A ft
**Stream Bed Elev.** N/A ft

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

| Description | Elev. (ft) | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 10 inches of Asphalt | 594.35 | | | | |
| Brown, Moist<br>FILL: SILTY CLAY, trace sand and gravel | 592.18 | | 3<br>3<br>3 | 3.1<br>B | 22 |
| Very Stiff<br>Brown, Moist<br>SILTY CLAY LOAM, trace sand and gravel (ML/CL) | 589.18 | -5 | 4<br>5<br>6 | 3.1<br>B | 15 |
| Very Stiff<br>Gray, Very Moist<br>SILTY CLAY LOAM, trace sand and gravel (ML/CL) | 588.18 | | 3<br>5<br>50/2" | 2.5<br>B | 28 |
| Very Dense<br>Light Brown, Wet<br>SAND, with gravel (SPG) | 587.68 | | | | |
| Auger refusal at 7.5 feet<br>Light Gray<br>LIMESTONE, slightly weathered, heavily fractured<br>Run 1: 7.5' - 17.5'<br>Recovery: 100%<br>RQD: 19.2% (Very Poor) | | -10 | | | |
| | | -15 | | | |
| Run 2: 17.5' - 23.5'<br>Recovery: 100%<br>RQD: 40.3% (Poor) | | -20 | | | |
| Light Gray<br>LIMESTONE, slightly weathered, heavily fractured *(continued)* | 571.68 | | | | |
| End of Boring | | -25 | | | |
| | | -30 | | | |
| | | -35 | | | |
| | | -40 | | | |

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

Center Street Bridge
Boring Number: BSB-65, Run 1




| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Description |
|---|---|---|---|---|---|---|
| BSB-65 | 1 | 7.5' – 17.5' | 100.0 | 19.2 | Very Poor | Light Gray Limestone<br>Slightly Weathered, Heavily Fractured |

Center Street Bridge
Boring Number: BSB-65, Run 2

Top

Depth = 17.5 ft
Elev. = 577.68 ft

Depth = 23.5 ft
Elev. = 571.68 ft

Bottom

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-65 | 2 | 17.5' – 23.5' | 100 | 40.3 | Poor | 9,784 | Light Gray Limestone, Slightly Weathered, Fractured |

Illinois Department of Transportation
Division of Highways
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# SOIL BORING LOG

Date 4/26/22

**ROUTE** I-80 **DESCRIPTION** I-80 at Center Street **LOGGED BY** DM

**SECTION** I-80 over Des Plaines River **LOCATION** , **SEC.** 16, **TWP.** 35 N, **RNG.** 10 E,
Latitude , Longitude

**COUNTY** Will **DRILLING METHOD** HSA

**DRILLING RIG** CME-75
**HAMMER TYPE** AUTO
**HAMMER EFF (%)** 91

**STRUCT. NO.** 099-8332
**Station**

**BORING NO.** BSB-66
**Station** 27+10.93'
**Offset** 15.08ft RT
**Ground Surface Elev.** 593.57 ft

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

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

| Description | Elev. | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 12 inches of Asphalt | 592.57 | | | | |
| Brown, Moist<br>FILL: SILTY CLAY, trace sand and gravel | 590.57 | | 14<br>4<br>6 | 4.5<br>P | 12 |
| Very Stiff<br>Dark Brown, Moist<br>SILTY CLAY, trace sand and gravel (CL/ML) | 589.07 | | 5<br>11<br>12 | 2.8<br>P | 22 |
| Medium Dense<br>Brown, Dry<br>SANDY GRAVEL, with limestone fragments (GPS) | 587.07 | -5 | 6 | | |
| Stiff<br>Dark Brown, Dry<br>SILTY CLAY, with sand and gravel (CL/ML) | 585.57 | | 8<br>9 | 1.8<br>P | 3 |
| Auger refusal at 8.0 feet<br>End of Boring | | -10<br>-15<br>-20 | | | |

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

**BBS, form 137 (Rev. 8-99)**

Illinois Department of Transportation
Division of Highways
GSG

# SOIL BORING LOG

Date 4/21/22

**ROUTE** I-80 **DESCRIPTION** I-80 at Center Street **LOGGED BY** DD

**SECTION** I-80 over Des Plaines River **LOCATION** , **SEC.** 16, **TWP.** 35 N, **RNG.** 10 E, **Latitude** , **Longitude**

**COUNTY** Will **DRILLING METHOD** HSA

**DRILLING RIG** CME-75
**HAMMER TYPE** AUTO
**HAMMER EFF (%)** 91

**STRUCT. NO.** 099-8332
**Station**

**BORING NO.** BSB-67
**Station** 28+3.85'
**Offset** 46.48ft RT
**Ground Surface Elev.** 593.57 ft

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

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

| Description | Elev. | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 16 inches of Asphalt | 592.41 | | | | |
| Brown, Moist FILL: SILTY CLAY, trace sand and gravel | 591.57 | | 4<br>3<br>5 | 1.7<br>B | 17 |
| Very Dense Light Brown, Dry SAND, with limestone fragments (SP) | 589.07 | | 50/5" | | 4 |
| Auger refusal at 4.5 feet Light Gray LIMESTONE, slightly weathered, heavily fractured Run 1: 4.5' - 14.5' Recovery: 100% RQD: 25.8% (Poor) | | -5 | | | |
| | | -10 | | | |
| No recovery from 14 to 15 feet Run 2: 14.5' - 19.5' Recovery: 85% RQD: 29.2% (Poor) | 574.07 | -15 | | | |
| End of Boring | | -20 | | | |

**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)**

Center Street Bridge
Boring Number: BSB-67, Run 1

Depth = 4.5 ft
Elev. = 589.07 ft

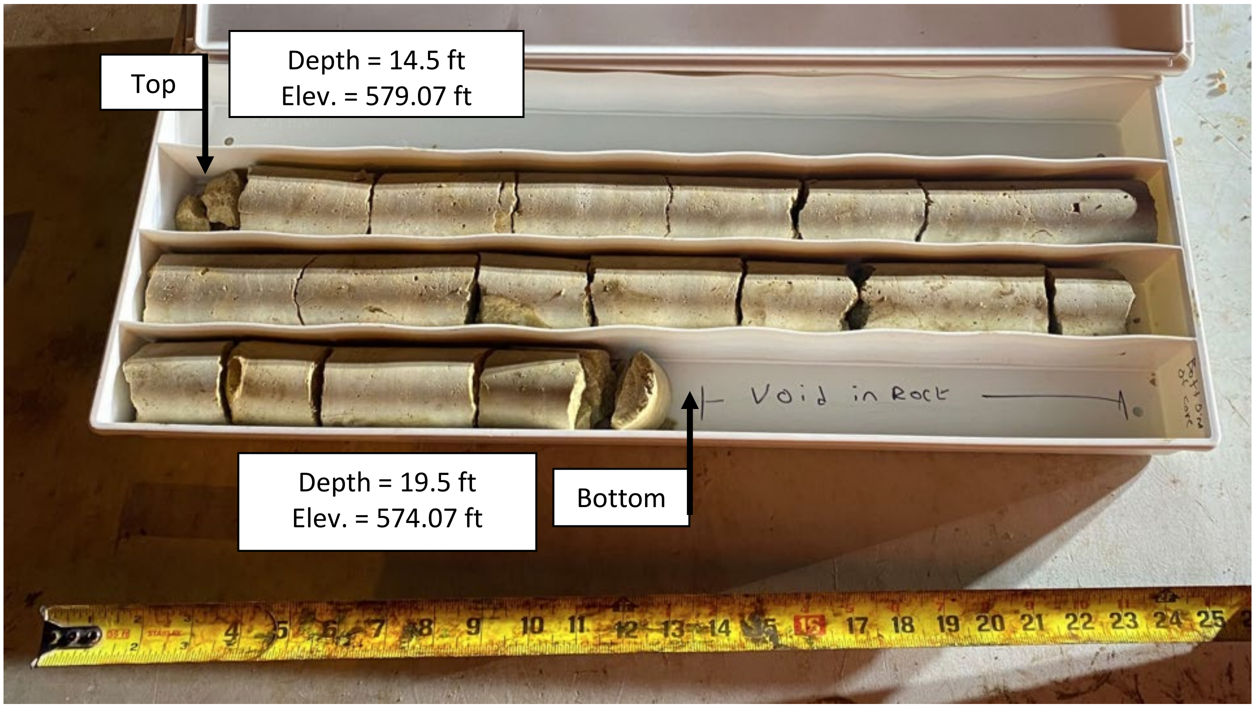
Top

Depth = 14.5 ft
Elev. = 579.07 ft

Bottom

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-67 | 1 | 4.5' – 14.5' | 100 | 25.8 | Poor | 8,380 | Light Gray Limestone, Slightly Weathered, Highly Fractured |

Center Street Bridge
Boring Number: BSB-67, Run 2




| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Description |
|---|---|---|---|---|---|---|
| BSB-67 | 2 | 14.5' – 19.5' | 85.0 | 29.2 | Poor | Light Gray Limestone, Slightly Weathered, Highly Fractured |

Illinois Department of Transportation
Division of Highways
GSG

# SOIL BORING LOG

Date 4/21/22

**ROUTE** I-80 **DESCRIPTION** I-80 at Center Street **LOGGED BY** MH

**SECTION** I-80 over Des Plaines River **LOCATION** , **SEC.** 16, **TWP.** 35 N, **RNG.** 10 E, **Latitude** , **Longitude**

**COUNTY** Will **DRILLING METHOD** HSA

**DRILLING RIG** Diedrich D-50
**HAMMER TYPE** AUTO
**HAMMER EFF (%)** 98

**STRUCT. NO.** 099-8332
**Station**

**BORING NO.** BSB-68
**Station** 27+05.61'
**Offset** 174.55ft RT
**Ground Surface Elev.** 575.39 ft

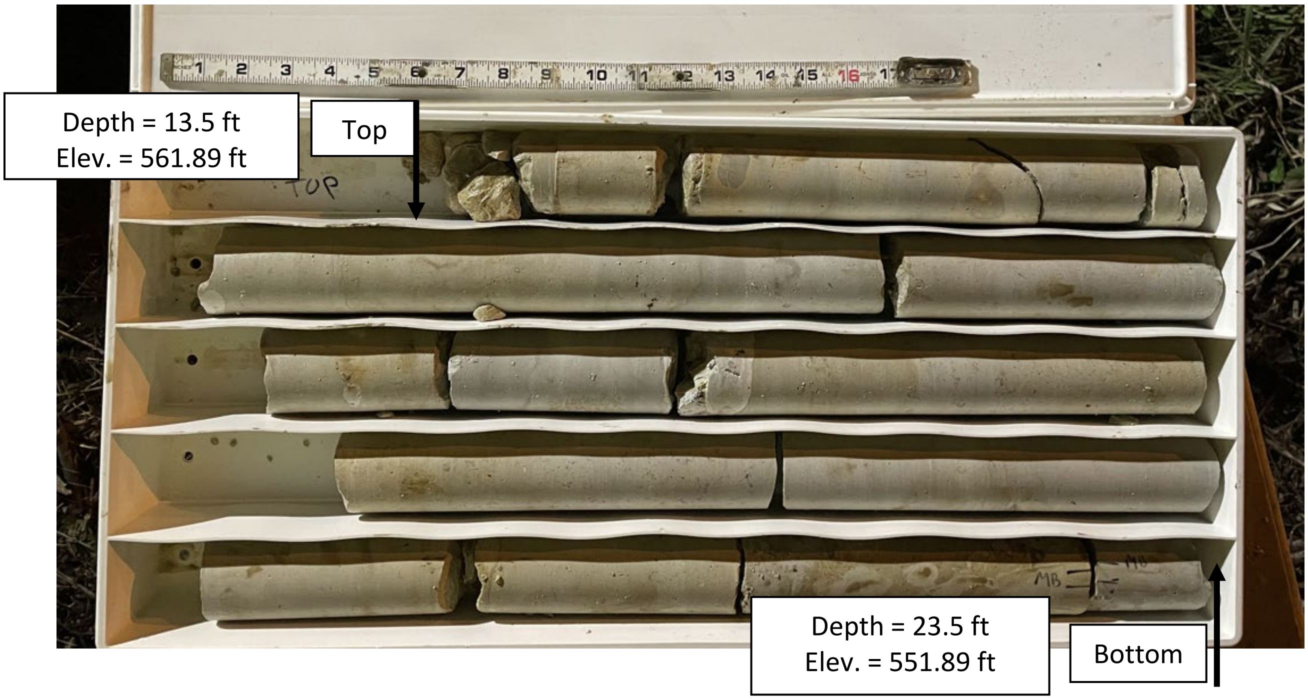
**Surface Water Elev.** N/A ft
**Stream Bed Elev.** N/A ft

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

| Description | Elev. | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 15 inches of Asphalt<br>3 inches of Aggregate Base Course | 574.14 | | 4 | | |
| Brown and Gray, Dry to Moist<br>FILL: SAND AND GRAVEL, with limestone fragments | 573.89 | | 9<br>21 | | 15 |
| | | | 7<br>11<br>9 | | 4 |
| | | -5 | | | |
| | | | 2<br>2<br>3 | | 4 |
| | | | 4<br>16<br>8 | | 2 |
| | | -10 | | | |
| Very Dense<br>Light Brown, Dry<br>SAND, with gravel (SPG) | 564.39 | | 23<br>50/5" | | 2 |
| Auger refusal at 13.5 feet<br>Light Gray<br>LIMESTONE, slightly weathered, lightly fractured<br>Run 1: 13.5' - 23.5'<br>Recovery: 95%<br>RQD: 76.7% (Good) | 561.89 | | | | |
| | | -15 | | | |
| | | -20 | | | |
| Light Gray<br>LIMESTONE, slightly weathered, lightly fractured *(continued)* | | | | | |
| Run 2: 23.5' - 28.5'<br>Recovery: 95%<br>RQD: 92.5% (Excellent) | | | | | |
| | | -25 | | | |
| End of Boring | 546.89 | | | | |
| | | -30 | | | |
| | | -35 | | | |
| | | -40 | | | |

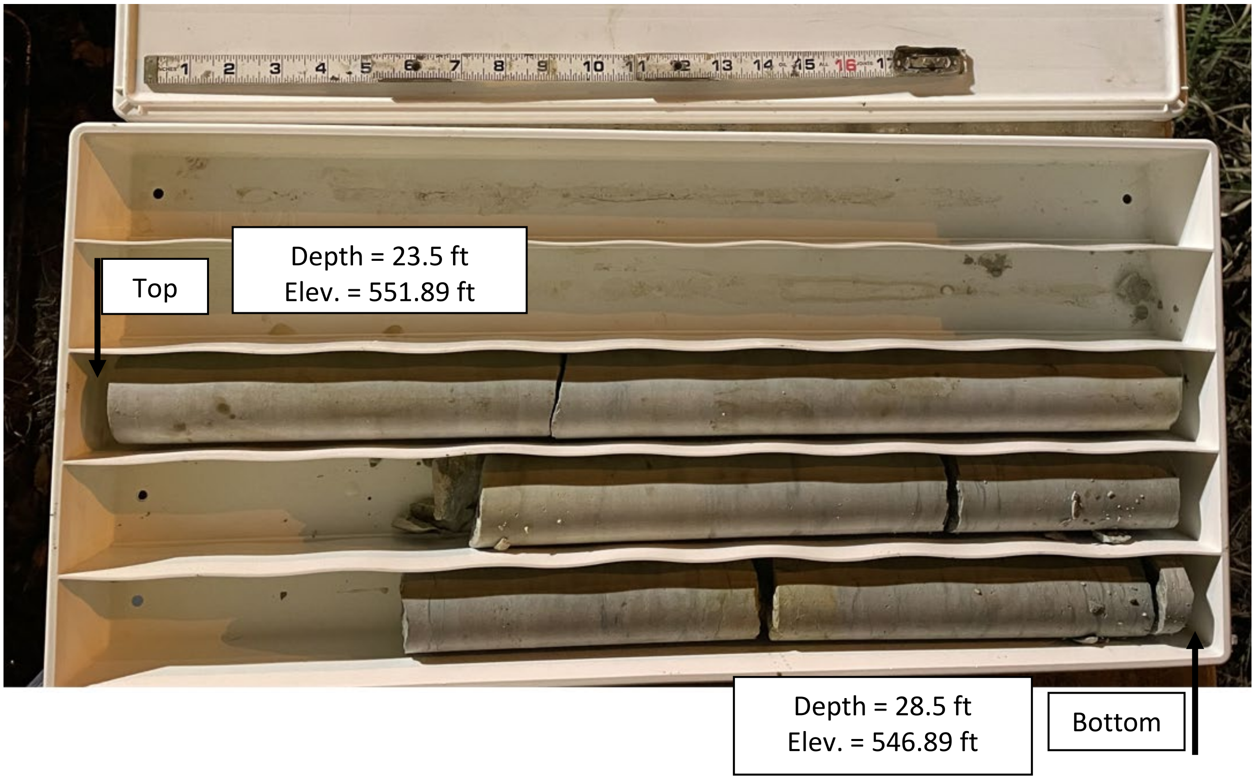
**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)**

Center Street Bridge
Boring Number: BSB-68, Run 1




| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Description |
|---|---|---|---|---|---|---|
| BSB-68 | 1 | 13.5’ – 23.5’ | 95.0 | 76.7 | Good | Light Gray Limestone, Slightly Weathered, Lightly Fractured |

Center Street Bridge
Boring Number: BSB-68, Run 2




| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-68 | 1 | 23.5’ – 28.5’ | 95.0 | 92.5 | Excellent | 14,412 | Light Gray Limestone, Slightly Weathered, Lightly Fractured |

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# SOIL BORING LOG

Date 6/18/23

**ROUTE** I-80 **DESCRIPTION** I-80 at Center Street **LOGGED BY** AA

**SECTION** I-80 over Des Plaines River **LOCATION** , **SEC.** 16, **TWP.** 35 N, **RNG.** 10 E, **Latitude** , **Longitude**

**COUNTY** Will **DRILLING RIG** CME-75 **HAMMER TYPE** AUTO
**DRILLING METHOD** HSA **HAMMER EFF (%)** 79.8

**STRUCT. NO.** 099-8332
**Station**

**BORING NO.** BSB-301
**Station** 27+64.99'
**Offset** 162.09ft LT
**Ground Surface Elev.** 599.00 ft

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

**Groundwater Elev.:**
**First Encounter** Dry ft
**Upon Completion** N/A ft
**After** ___ **Hrs.** N/A ft

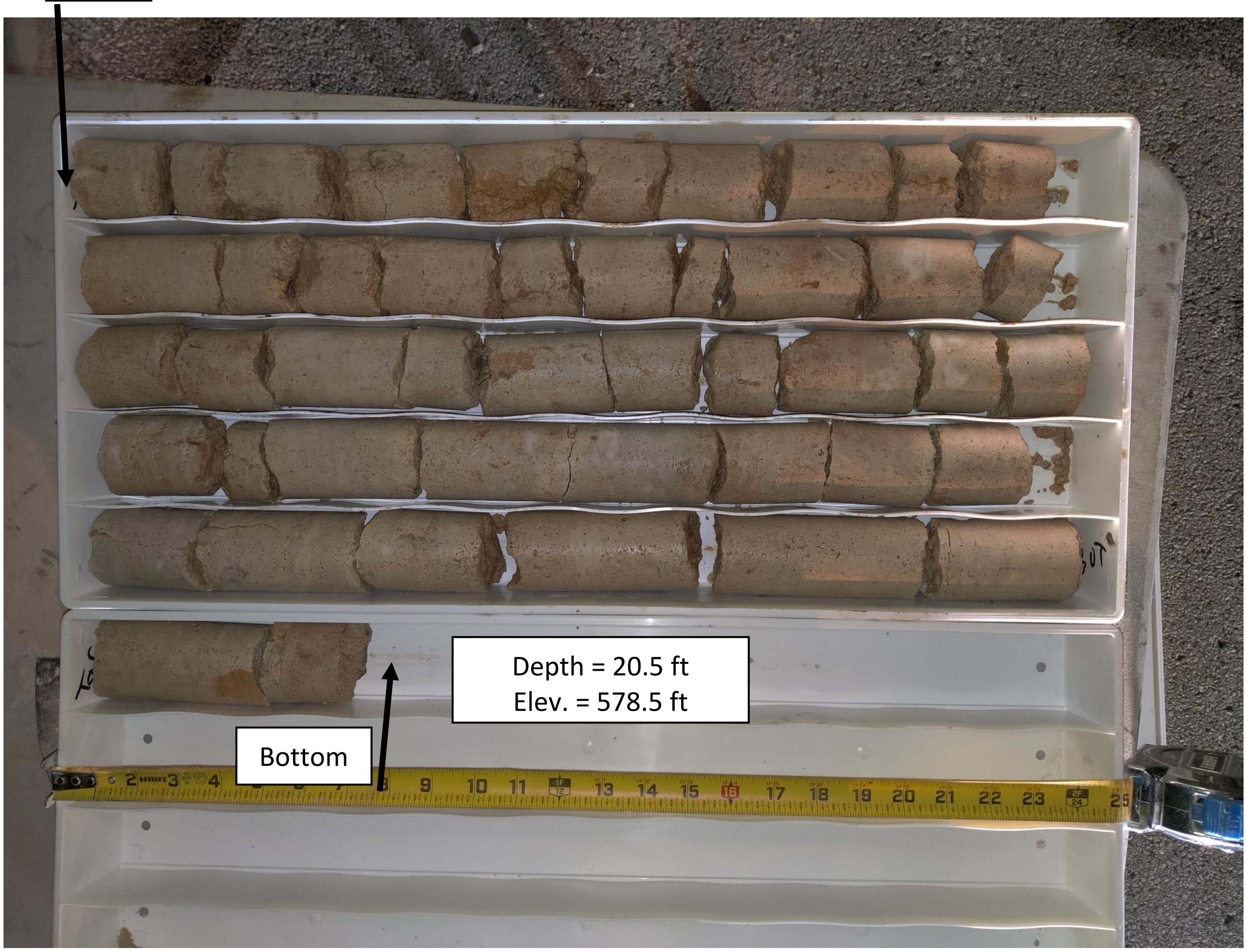
| Description | Elev. | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 3 inches of Asphalt | 598.75 | | | | |
| 8 inches of Concrete | 598.08 | | | | |
| 5 inches of Aggregate Subbase | 597.67 | | 9 | | |
| Stiff to Very Stiff Brown, Moist SILTY CLAY, trace gravel and cobbles (CL/ML) | | | 4<br>5 | 2.5<br>P | |
| | | | 4<br>3<br>4 | 1.5<br>P | |
| | | -5 | | | |
| | | | 4<br>5<br>13 | 1.0<br>P | |
| | 590.50 | | | | |
| WEATHERED LIMESTONE | | | 50/3" | | |
| | | -10 | | | |
| Auger refusal at 10.5 feet | 588.50 | | | | |
| Brown and Gray LIMESTONE, extremely weathered, extremely fractured<br><br>Run 1: 10.5' - 20.5'<br>Recovery: 100%<br>RQD: 0% (Very Poor) | | | | | |
| | | -15 | | | |
| | | -20 | | | |
| | 578.50 | | | | |
| Brown and Gray LIMESTONE, extremely weathered, moderately fractured<br><br>Run 2: 20.5' - 25.5'<br>Recovery: 100%<br>RQD: 9.4% (Very Poor) | | | | | |
| | | -25 | | | |
| | 573.50 | | | | |
| End of Boring | | | | | |
| | | -30 | | | |
| | | -35 | | | |
| | | -40 | | | |

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

Center Street over I-80
Boring Number: BSB-301
Will County, IL

Top

Depth = 10.5 ft
Elev. = 588.5 ft




| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Depth (ft) / Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-301 | 1 | 10.5’ – 20.5’ | 100.0 | 16.7 | Very Poor | n/a | Light Gray Limestone Extremely Weathered & Heavily Fractured |

Center Street over I-80
Boring Number: BSB-301
Will County, IL

Top

Depth = 20.5 ft
Elev. = 578.5 ft


Depth = 25.5 ft
Elev. = 573.5 ft

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Depth (ft) / Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-301 | 2 | 20.5' – 25.5' | 100.0 | 38.3 | Poor | n/a | Light Gray Limestone Extremely Weathered & Heavily Fractured |

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# SOIL BORING LOG



Date 6/22/23

**ROUTE** I-80 **DESCRIPTION** I-80 at Center Street **LOGGED BY** EH

**SECTION** I-80 over Des Plaines River **LOCATION** , **SEC.** 16, **TWP.** 35 N, **RNG.** 10 E,
**Latitude** , **Longitude**

**COUNTY** Will **DRILLING RIG** CME-75 **HAMMER TYPE** AUTO
**DRILLING METHOD** HSA **HAMMER EFF (%)** 79.8

**STRUCT. NO.** 099-8332
**Station**

**BORING NO.** BSB-302
**Station** 26+94.09'
**Offset** 132.49ft RT
**Ground Surface Elev.** 573.14 ft

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

**Groundwater Elev.:**
**First Encounter** Dry ft
**Upon Completion** N/A ft
**After** ___ **Hrs.** N/A ft

| Description | Elev. (ft) | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 14 inches of Asphalt | 571.97 | | | | |
| Brown and Gray, Moist FILL: SILTY CLAY, with gravel | 570.14 | | 9<br>20<br>50/2" | 3.5<br>P | |
| WEATHERED LIMESTONE Auger refusal at 3.5 feet | 569.64 | | | | |
| Light Gray LIMESTONE, slightly weathered<br><br>Run 1: 3.5' - 13.5'<br>Recovery: 100%<br>RQD: 83% (Good) | 559.64 | -5<br>-10 | | | |
| Light Gray LIMESTONE, slightly weathered<br><br>Run 2: 13.5' - 18.5'<br>Recovery: 100%<br>RQD: 100% (Excellent) | 554.64 | -15 | | | |
| End of Boring | | -20 | | | |

**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)**

Center Street over I-80
Boring Number: BSB-302
Will County, IL

Depth = 3.5 ft
Elev. = 569.5 ft

Top

Depth = 13.5 ft
Elev. = 559.5 ft

Bottom

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Depth (ft) / Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-302 | 1 | 3.5' – 13.5' | 100.0 | 83.0 | Good | n/a | Light Gray Limestone Slightly Weathered |

Center Street over I-80
Boring Number: BSB-302
Will County, IL

Top

Depth = 13.5 ft
Elev. = 559.5 ft

Depth = 18.5 ft
Elev. = 554.5 ft

Bottom

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Depth (ft) / Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-302 | 2 | 13.5’ – 18.5’ | 100.0 | 100 | Excellent | n/a | Light Gray Limestone Slightly Weathered |

Illinois Department of Transportation
Division of Highways
GSG

# SOIL BORING LOG



Date 6/18/23

**ROUTE** I-80 **DESCRIPTION** I-80 at Center Street **LOGGED BY** AA

**SECTION** I-80 over Des Plaines River **LOCATION** , **SEC.** 16, **TWP.** 35 N, **RNG.** 10 E, **Latitude** , **Longitude**

**COUNTY** Will **DRILLING RIG** CME-75 **HAMMER TYPE** Auto
**DRILLING METHOD** HSA **HAMMER EFF (%)** 79.8

**STRUCT. NO.** 099-8332
**Station**

**BORING NO.** BSB-303
**Station** 25+96.54'
**Offset** 150.34ft RT
**Ground Surface Elev.** 593.14 ft

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

**Groundwater Elev.:**
**First Encounter** Dry ft
**Upon Completion** N/A ft
**After** ___ **Hrs.** N/A ft

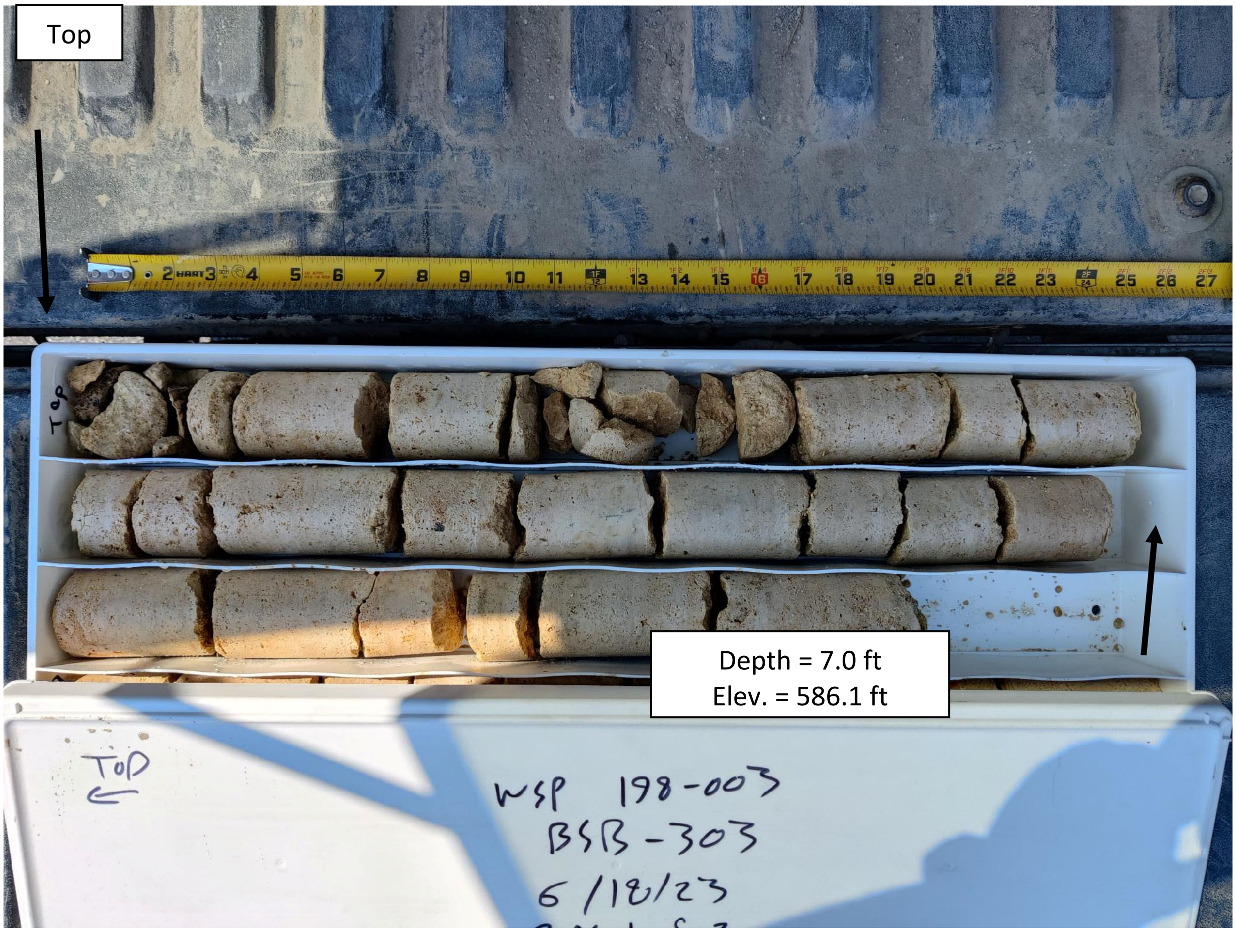
| Description | Elev. | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|---|
| 4 inches of Topsoil | 592.81 | | | | |
| Dark Brown, Moist<br>FILL: SILTY CLAY<br>Auger refusal at 2 feet | 591.14 | | | | |
| Light Gray<br>LIMESTONE, slightly weathered<br>Run 1: 2' - 7'<br>Recovery: 100%<br>RQD: 0% (Very Poor) | 586.14 | -5 | | | |
| Light Gray<br>LIMESTONE, slightly weathered<br>Run 2: 7' - 12'<br>Recovery: 100%<br>RQD: 0% (Very Poor) | 581.14 | -10 | | | |
| Light Gray<br>LIMESTONE, slightly weathered<br>Run 3: 12' - 17'<br>Recovery: 100%<br>RQD: 0% (Very Poor) | 576.14 | -15 | | | |
| End of Boring | | -20 | | | |

**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)**

Center Street over I-80
Boring Number: BSB-303
Will County, IL

Depth = 2.0 ft
Elev. = 591.1 ft

Top




Depth = 7.0 ft
Elev. = 586.1 ft

Bottom

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Depth (ft) / Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-303 | 1 | 2’ – 7’ | 100.0 | 20.0 | Very Poor | n/a | Light Gray Limestone Slightly Weathered |

Center Street over I-80
Boring Number: BSB-303
Will County, IL

Depth = 7.0 ft
Elev. = 586.1 ft


Depth = 12.0 ft
Elev. = 581.1 ft

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Depth (ft) / Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-303 | 2 | 7’ – 12’ | 100.0 | 6.7 | Very Poor | n/a | Light Gray Limestone Slightly Weathered |

Center Street over I-80
Boring Number: BSB-303
Will County, IL

Depth = 12.0 ft
Elev. = 581.1 ft


Depth = 17.0 ft
Elev. = 576.1 ft

| Boring No. | Run | Depth (ft) | Recovery (%) | RQD (%) | RQD Classification | Depth (ft) / Compressive Strength (psi) | Description |
|---|---|---|---|---|---|---|---|
| BSB-303 | 3 | 12' – 17' | 100.0 | 20.0 | Very Poor | n/a | Light Gray Limestone Slightly Weathered |

# Appendix D
# Laboratory Test Results

# Compressive Strength of Rock by ASTM D7012 - Method C

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

| | | | |
|---|---|---|---|
| Project Name: | WSP 198-003 I-80 | Project No: | 21-2007 |
| Boring ID: | BSB-65 | Bulk/Prep | MC/CS |
| Sample Depth (ft): | 22-22.5 | Tester: AJ | Tester: AJ |
| Lithological Description: | Limestone | Date: 5/20/22 | Date: 5/25/22 |
| Formation Name: | Silurian, Undivided | Load Direction: vertical | Angle Drilled: vertical |
| Appearance (e.g. cracks, shearing, spalling): | >90% homogeneous | | |

**Bulk Density Determination**

| | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Height, *in.* | 3.5430 | 3.5450 | 3.5395 | 3.5425 |
| Diameter, *in.* | 1.9830 | 1.9880 | 1.9895 | 1.9868 |
| Specimen Mass, *g* | 476.7 | | Ratio (2.0-2.5) | |
| Bulk Density, *pcf* | 165.4 | | 1.78 | |

**Moisture Condition - D2216**

| | |
|---|---|
| Container ID | 01 |
| container, *g* | 515.2 |
| container + wet rock, *g* | 976.7 |
| container + dry soil, *g* | 966.3 |
| moisture content, *w%* | 2.3 |

| Preparation Check | Yes | No | Reason/Readings If No: |
|---|---|---|---|
| Ends Flat within 0.02 mm prior to capping? | X | | |
| Ends perpendicular to side within 0.25 degrees? | | X | 55 degrees |
| Ends parallel to each other within 0.25 degrees? | X | | |

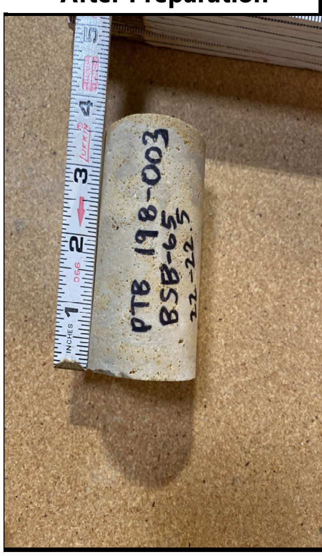
**Axial Loading**

| | |
|---|---|
| Seating Load (≤1000 psi) | 1000 |
| Rate of Loading (73-145 psi/s) | 75 |
| Time to Failure (2-15 min) | 3 min 0 sec |
| Load @ Failure, *lbf* | 30,333 |
| Uniaxial Compressive Strength, *psi* | 9,784 |

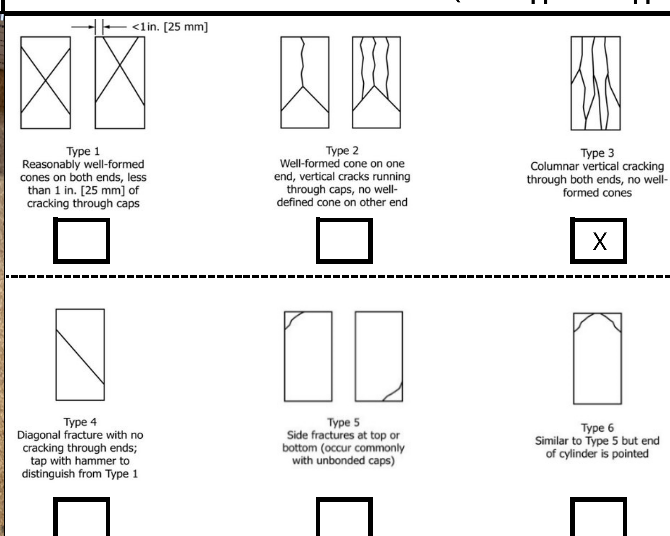
Remarks

Best efforts have been made for the specimen to meet the required tolerances of D4543. See IH3 Procedure for efforts made.

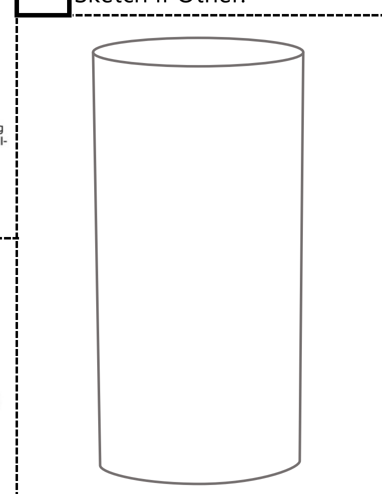
**After Preparation**




**After Break** (check applicable appearance)




Sketch if Other:



| | | | |
|---|---|---|---|
| Form ID | TF-RCS | Reviewed By | DE |
| Revision Date | 10/21/2021 | Review Date | 05/26/22 |

# Compressive Strength of Rock by ASTM D7012 - Method C

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

| | | | |
|---|---|---|---|
| Project Name: | WSP 198-003 I-80 | Project No: | 21-2007 |
| Boring ID: | BSB-67 | | |
| Sample Depth (ft): | 16.5-17 | | |
| Lithological Description: | Limestone | | |
| Formation Name: | Silurian, Undivided | Load Direction: | vertical |
| Appearance (e.g. cracks, shearing, spalling): | >90% homogeneous, crack bisecting center of core | | |

| | Bulk/Prep | MC/CS |
|---|---|---|
| Tester: | AJ | AJ |
| Date: | 5/20/22 | 5/24/22 |
| Angle Drilled: | | vertical |

**Bulk Density Determination**

| | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Height, *in.* | 4.6495 | 4.6510 | 4.6450 | 4.6485 |
| Diameter, *in.* | 1.9905 | 1.9945 | 1.9890 | 1.9913 |

| | | | |
|---|---|---|---|
| Specimen Mass, *g* | 609.0 | Ratio (2.0-2.5) | |
| Bulk Density, *pcf* | 160.3 | | 2.33 |

**Moisture Condition - D2216**

| | |
|---|---|
| Container ID | 06 |
| container, *g* | 517.9 |
| container + wet rock, *g* | 1114.8 |
| container + dry soil, *g* | 1114.3 |
| moisture content, *w%* | 0.1 |

| Preparation Check | Yes | No | Reason/Readings If No: |
|---|---|---|---|
| Ends Flat within 0.02 mm prior to capping? | X | | |
| Ends perpendicular to side within 0.25 degrees? | X | | |
| Ends parallel to each other within 0.25 degrees? | X | | |

**Axial Loading**

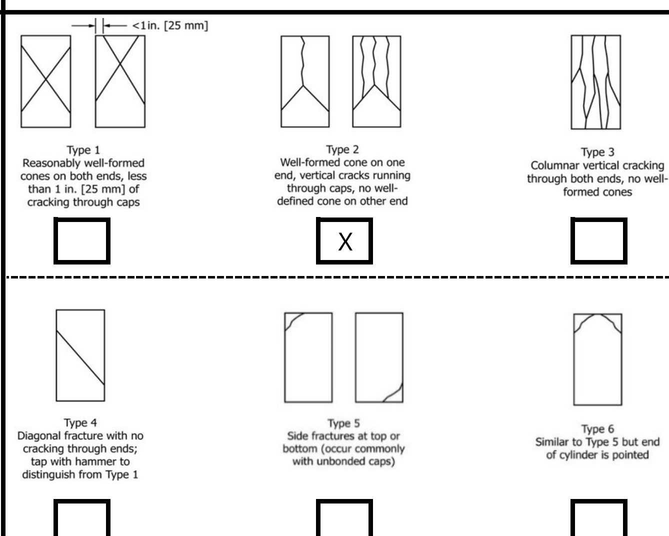
| | |
|---|---|
| Seating Load (≤1000 psi) | 1000 |
| Rate of Loading (73-145 psi/s) | 75 |
| Time to Failure (2-15 min) | 2 min 0 sec |
| Load @ Failure, *lbf* | 26,097 |
| Uniaxial Compressive Strength, *psi* | 8,380 |

Remarks

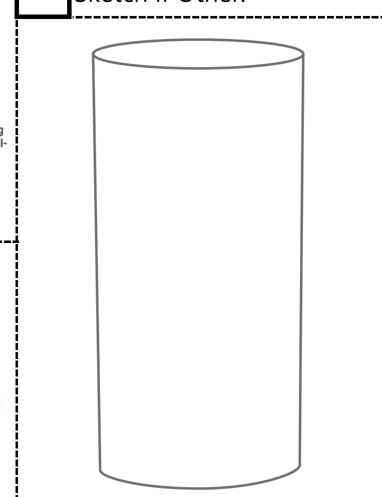
Best efforts have been made for the specimen to meet the required tolerances of D4543. See IH3 Procedure for efforts made.

**After Preparation**

**After Break** (check applicable appearance)




Sketch if Other:



| | | | |
|---|---|---|---|
| Form ID | TF-RCS | Reviewed By | DE |
| Revision Date | 10/21/2021 | Review Date | 05/26/22 |

# Compressive Strength of Rock by ASTM D7012 - Method C

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

| | | | |
|---|---|---|---|
| Project Name: | WSP 198-003 I-80 | Project No: | 21-2007 |
| Boring ID: | BSB-68 | Bulk/Prep | MC/CS |
| Sample Depth (ft): | 27.5-28' | Tester: AJ | Tester: AJ |
| Lithological Description: | Limestone, flaser bedding | Date: 5/20/22 | Date: 5/24/22 |
| Formation Name: | Silurian, Undivided | Load Direction: vertical | Angle Drilled: vertical |
| Appearance (e.g. cracks, shearing, spalling): | >90% homogeneous | | |

**Bulk Density Determination**

| | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Height, *in.* | 4.7355 | 4.7360 | 4.7370 | 4.7362 |
| Diameter, *in.* | 1.9745 | 1.9740 | 1.9750 | 1.9745 |

| | | | |
|---|---|---|---|
| Specimen Mass, *g* | 649.2 | Ratio (2.0-2.5) | |
| Bulk Density, *pcf* | 170.6 | | 2.40 |

**Moisture Condition - D2216**

| | |
|---|---|
| Container ID | 02 |
| container, *g* | 513.8 |
| container + wet rock, *g* | 960.9 |
| container + dry soil, *g* | 960.0 |
| moisture content, *w%* | 0.2 |

| Preparation Check | Yes | No | Reason/Readings If No: |
|---|---|---|---|
| Ends Flat within 0.02 mm prior to capping? | X | | |
| Ends perpendicular to side within 0.25 degrees? | X | | |
| Ends parallel to each other within 0.25 degrees? | X | | |

**Axial Loading**

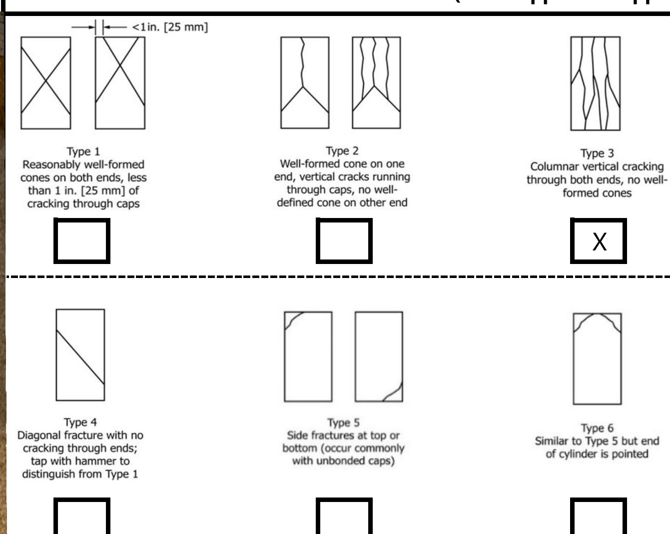
| | |
|---|---|
| Seating Load (≤1000 psi) | 1000 |
| Rate of Loading (73-145 psi/s) | 75 |
| Time to Failure (2-15 min) | 3 min 45 sec |
| Load @ Failure, *lbf* | 44,130 |
| Uniaxial Compressive Strength, *psi* | 14,412 |

Remarks

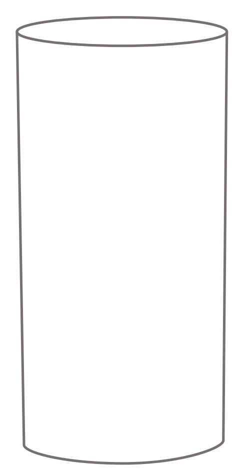
Best efforts have been made for the specimen to meet the required tolerances of D4543. See IH3 Procedure for efforts made.

**After Preparation**


**After Break** (check applicable appearance)



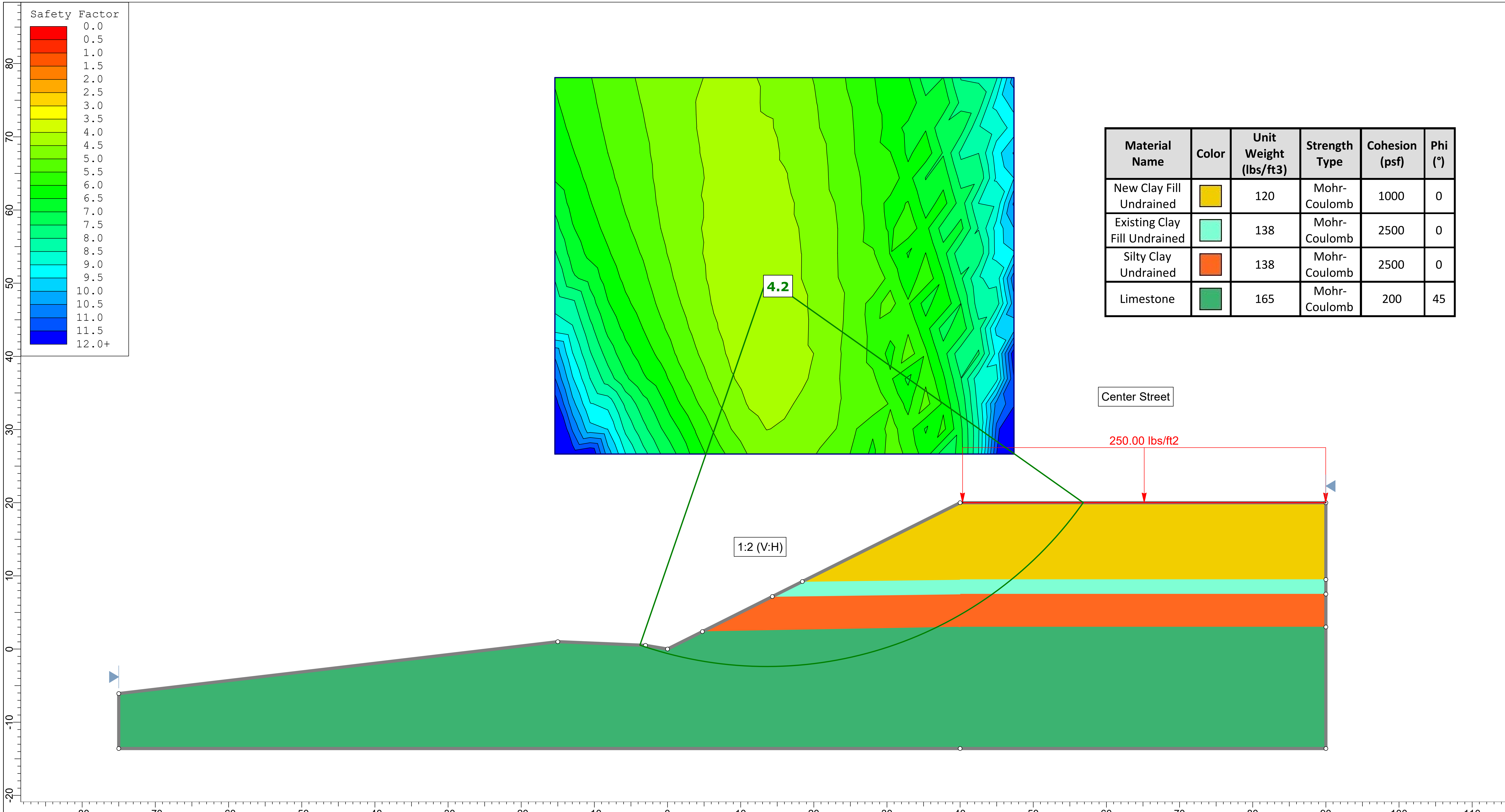

Sketch if Other:



| | | | |
|---|---|---|---|
| Form ID | TF-RCS | Reviewed By | DE |
| Revision Date | 10/21/2021 | Review Date | 05/26/22 |

# Appendix E

# Slope Stability Analyses




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (°) |
|---|---|---|---|---|---|
| New Clay Fill Undrained | | 120 | Mohr-Coulomb | 1000 | 0 |
| Existing Clay Fill Undrained | | 138 | Mohr-Coulomb | 2500 | 0 |
| Silty Clay Undrained | | 138 | Mohr-Coulomb | 2500 | 0 |
| Limestone | | 165 | Mohr-Coulomb | 200 | 45 |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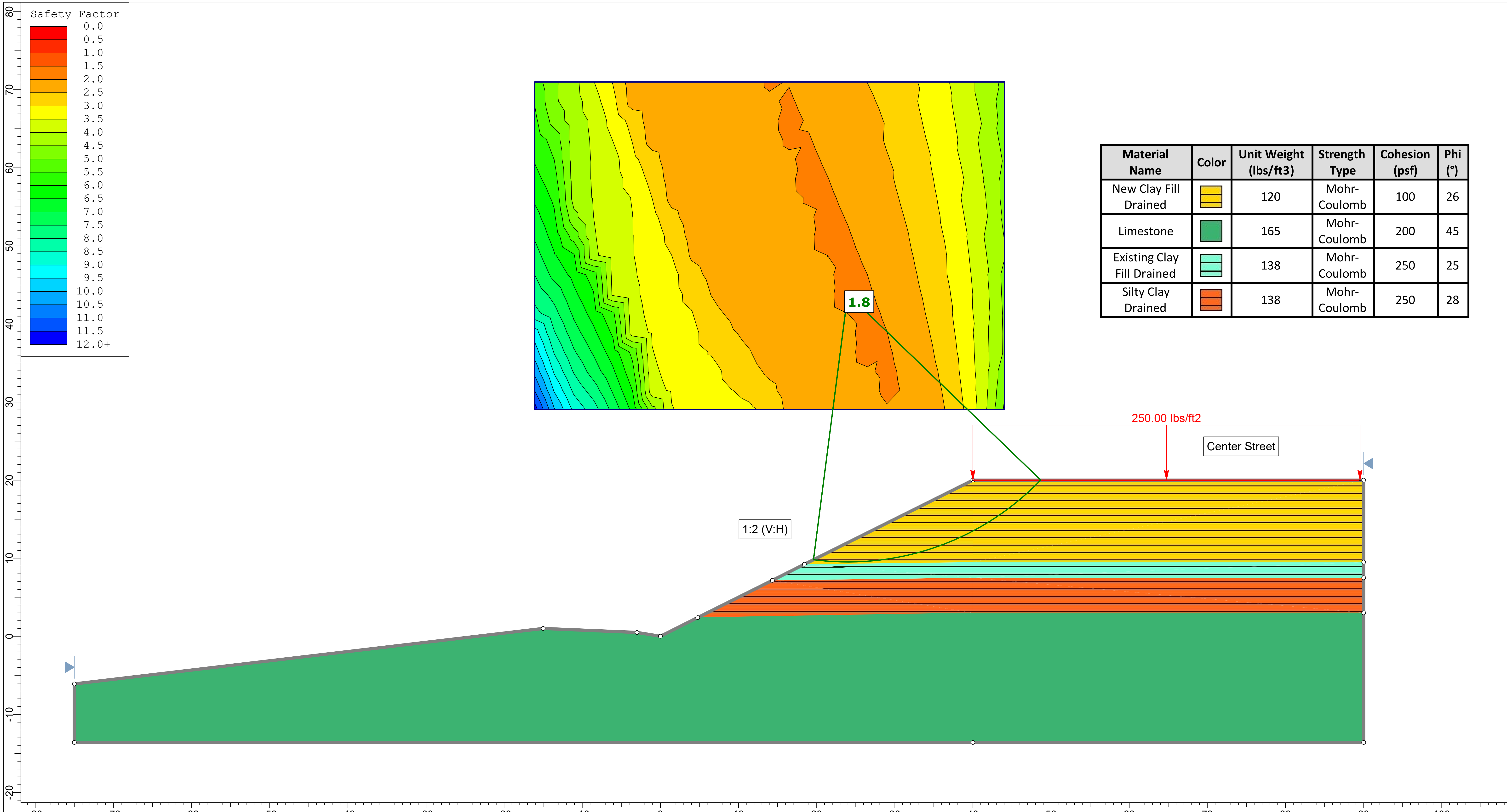
SLIDEINTERPRET 9.031

| | | | |
|---|---|---|---|
| Project | PTB 198-003 SN 099-8332: Proposed Center Street Bridge | | |
| Analysis Description | Exhibit 1 - North Abutment - Circular Failure Short Term | | |
| Drawn By | MH | Company | GSG Consultants, Inc. |
| Date | 6/14/2022, 9:01:31 AM | File Name | north abut side slope_2024.slmd |




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (°) |
|---|---|---|---|---|---|
| New Clay Fill Drained | | 120 | Mohr-Coulomb | 100 | 26 |
| Limestone | | 165 | Mohr-Coulomb | 200 | 45 |
| Existing Clay Fill Drained | | 138 | Mohr-Coulomb | 250 | 25 |
| Silty Clay Drained | | 138 | Mohr-Coulomb | 250 | 28 |

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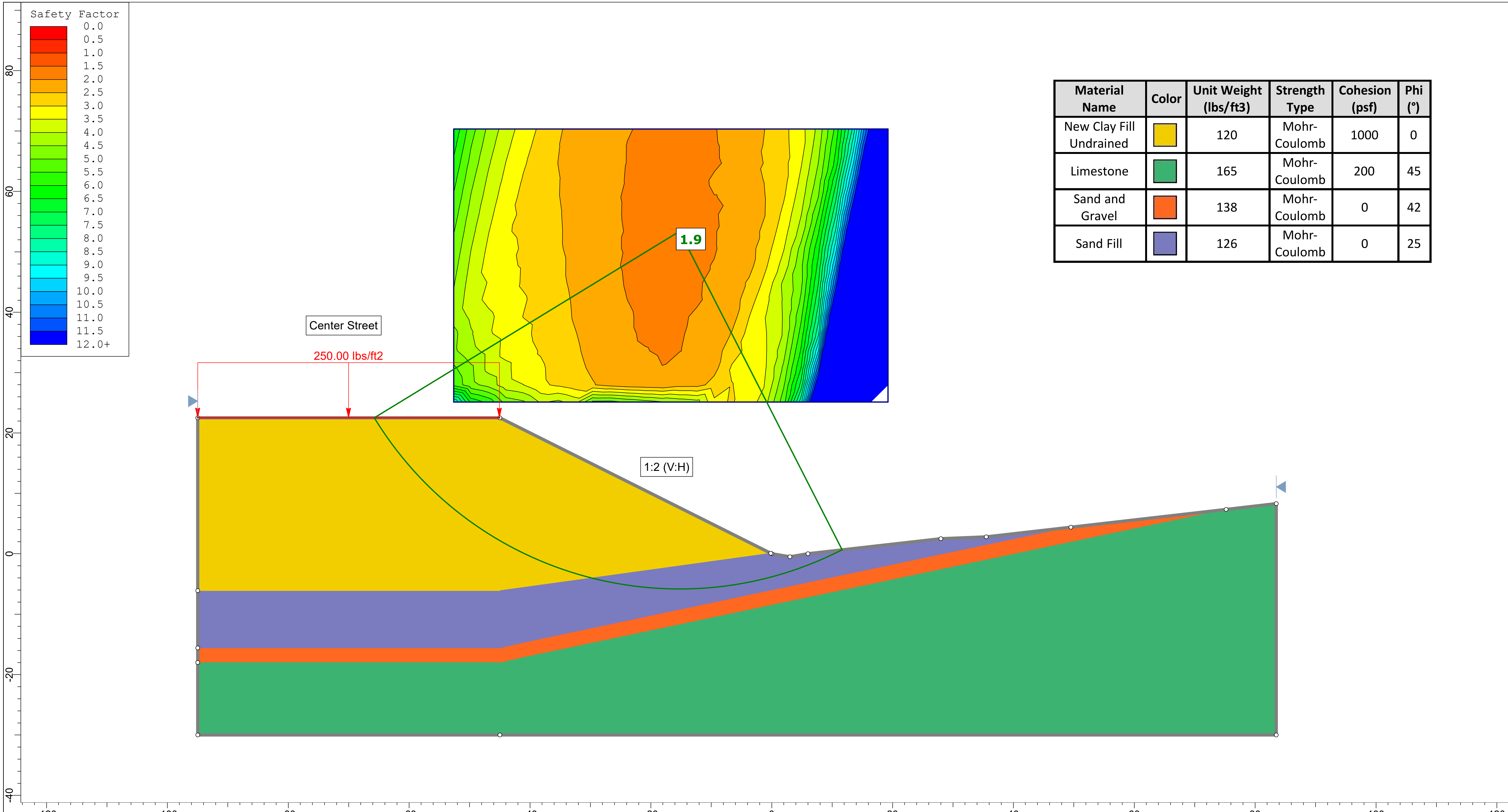
SLIDEINTERPRET 9.031

| | |
|---|---|
| *Project* | PTB 198-003 SN 099-8332: Proposed Center Street Bridge |
| *Analysis Description* | Exhibit 2 - North Abutment - Circular Failure Long Term |
| *Drawn By* | MH |
| *Company* | GSG Consultants, Inc. |
| *Date* | 6/14/2022, 9:01:31 AM |
| *File Name* | north abut side slope_2024.slmd |




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (°) |
|---|---|---|---|---|---|
| New Clay Fill Undrained | | 120 | Mohr-Coulomb | 1000 | 0 |
| Limestone | | 165 | Mohr-Coulomb | 200 | 45 |
| Sand and Gravel | | 138 | Mohr-Coulomb | 0 | 42 |
| Sand Fill | | 126 | Mohr-Coulomb | 0 | 25 |

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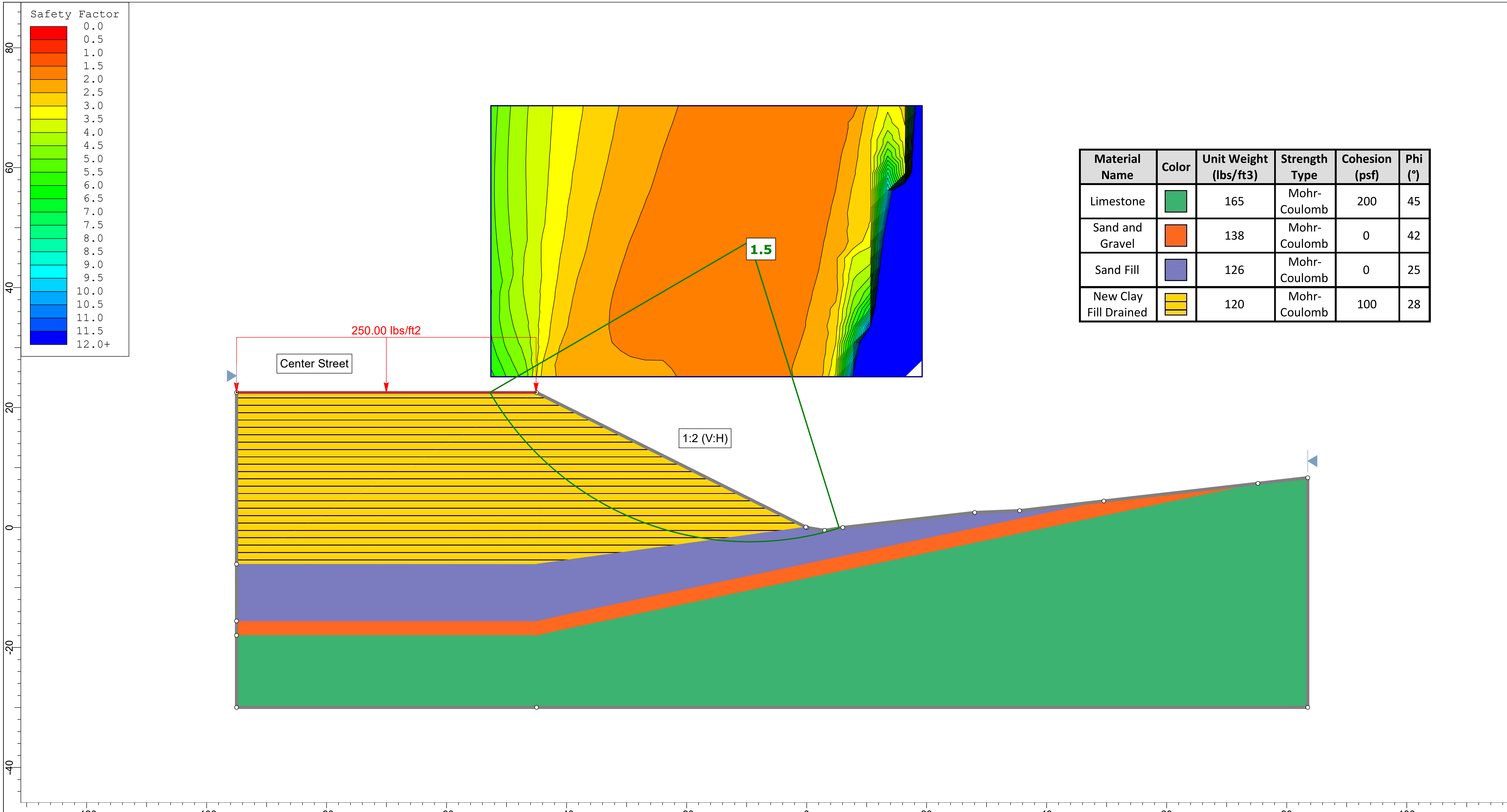
SLIDEINTERPRET 9.031

| | |
|---|---|
| *Project* | PTB 198-003 SN 099-8332: Proposed Center Street Bridge |
| *Analysis Description* | Exhibit 3 - South Abutment - Circular Failure Short Term |
| *Drawn By* | MH |
| *Company* | GSG Consultants, Inc. |
| *Date* | 6/14/2022, 9:01:31 AM |
| *File Name* | south abut side slope_2024.slmd |




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (°) |
|---|---|---|---|---|---|
| Limestone | | 165 | Mohr-Coulomb | 200 | 45 |
| Sand and Gravel | | 138 | Mohr-Coulomb | 0 | 42 |
| Sand Fill | | 126 | Mohr-Coulomb | 0 | 25 |
| New Clay Fill Drained | | 120 | Mohr-Coulomb | 100 | 28 |

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SLIDEINTERPRET 9.031

| | |
|---|---|
| *Project* | PTB 198-003 SN 099-8332: Proposed Center Street Bridge |
| *Analysis Description* | Exhibit 4 - South Abutment - Circular Failure Long Term |
| *Drawn By* | MH |
| *Company* | GSG Consultants, Inc. |
| *Date* | 6/14/2022, 9:01:31 AM |
| *File Name* | south abut side slope_2024.slmd |

# Appendix F

# IDOT Pile Design Tables with No Downdrag

**Pile Design Table for North Abutment utilizing Boring #BSB-65**

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | | |
| | 61 | 33 | 12 |
| | 80 | 44 | 14 |
| | 94 | 52 | 17 |
| **Metal Shell 14"Φ w/.25" walls** | | | |
| | 76 | 42 | 12 |
| | 98 | 54 | 14 |
| | 114 | 63 | 17 |
| **Metal Shell 14"Φ w/.312" walls** | | | |
| | 76 | 42 | 12 |
| | 98 | 54 | 14 |
| | 114 | 63 | 17 |
| **Metal Shell 16"Φ w/.312" walls** | | | |
| | 93 | 51 | 12 |
| | 118 | 65 | 14 |
| | 135 | 74 | 17 |
| **Metal Shell 16"Φ w/.375" walls** | | | |
| | 93 | 51 | 12 |
| | 118 | 65 | 14 |
| | 135 | 74 | 17 |
| **Steel HP 8 X 36** | | | |
| | 30 | 16 | 12 |
| | 45 | 25 | 14 |
| | 56 | 31 | 17 |
| | 89 | 49 | 19 |
| | 286 | 157 | 22 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 10 X 42** | | | |
| | 37 | 20 | 12 |
| | 56 | 31 | 14 |
| | 72 | 40 | 17 |
| | 109 | 60 | 19 |
| | 335 | 184 | 21 |
| **Steel HP 10 X 57** | | | |
| | 39 | 21 | 12 |
| | 58 | 32 | 14 |
| | 74 | 41 | 17 |
| | 117 | 65 | 19 |
| | 454 | 250 | 22 |
| **Steel HP 12 X 53** | | | |
| | 45 | 25 | 12 |
| | 67 | 37 | 14 |
| | 89 | 49 | 17 |
| | 132 | 72 | 19 |
| | 418 | 230 | 21 |
| **Steel HP 12 X 63** | | | |
| | 46 | 25 | 12 |
| | 69 | 38 | 14 |
| | 91 | 50 | 17 |
| | 138 | 76 | 19 |
| | 497 | 273 | 22 |
| **Steel HP 12 X 74** | | | |
| | 47 | 26 | 12 |
| | 70 | 39 | 14 |
| | 92 | 51 | 17 |
| | 145 | 80 | 19 |
| | 589 | 324 | 23 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 12 X 84** | | | |
| | 48 | 27 | 12 |
| | 72 | 39 | 14 |
| | 93 | 51 | 17 |
| | 150 | 83 | 19 |
| | 664 | 365 | 23 |
| **Steel HP 14 X 73** | | | |
| | 54 | 30 | 12 |
| | 82 | 45 | 14 |
| | 108 | 59 | 17 |
| | 163 | 90 | 19 |
| | 578 | 318 | 22 |
| **Steel HP 14 X 89** | | | |
| | 56 | 31 | 12 |
| | 84 | 46 | 14 |
| | 110 | 60 | 17 |
| | 172 | 95 | 19 |
| | 705 | 388 | 23 |
| **Steel HP 14 X 102** | | | |
| | 58 | 32 | 12 |
| | 85 | 47 | 14 |
| | 111 | 61 | 17 |
| | 180 | 99 | 19 |
| | 810 | 445 | 23 |
| **Steel HP 14 X 117** | | | |
| | 59 | 33 | 12 |
| | 87 | 48 | 14 |
| | 113 | 62 | 17 |
| | 188 | 104 | 19 |
| | 929 | 511 | 24 |
| **Precast 14"x 14"** | | | |
| | 97 | 53 | 12 |
| | 125 | 69 | 14 |
| | 145 | 80 | 17 |

**Pile Design Table for North Approach Bent utilizing Boring #BSB-65**

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | | |
| | 79 | 43 | 16 |
| | 98 | 54 | 18 |
| | 112 | 62 | 21 |
| **Metal Shell 14"Φ w/.25" walls** | | | |
| | 97 | 53 | 16 |
| | 120 | 66 | 18 |
| | 135 | 74 | 21 |
| **Metal Shell 14"Φ w/.312" walls** | | | |
| | 97 | 53 | 16 |
| | 120 | 66 | 18 |
| | 135 | 74 | 21 |
| **Metal Shell 16"Φ w/.312" walls** | | | |
| | 117 | 64 | 16 |
| | 143 | 78 | 18 |
| | 159 | 88 | 21 |
| **Metal Shell 16"Φ w/.375" walls** | | | |
| | 117 | 64 | 16 |
| | 143 | 78 | 18 |
| | 159 | 88 | 21 |
| **Steel HP 8 X 36** | | | |
| | 44 | 24 | 16 |
| | 59 | 32 | 18 |
| | 66 | 36 | 21 |
| | 103 | 57 | 23 |
| | 286 | 157 | 25 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 10 X 42** | | | |
| | 55 | 30 | 16 |
| | 74 | 41 | 18 |
| | 85 | 47 | 21 |
| | 127 | 70 | 23 |
| | 335 | 184 | 25 |
| **Steel HP 10 X 57** | | | |
| | 57 | 31 | 16 |
| | 76 | 42 | 18 |
| | 87 | 48 | 21 |
| | 136 | 75 | 23 |
| | 454 | 250 | 26 |
| **Steel HP 12 X 53** | | | |
| | 66 | 36 | 16 |
| | 89 | 49 | 18 |
| | 108 | 59 | 21 |
| | 153 | 84 | 23 |
| | 418 | 230 | 25 |
| **Steel HP 12 X 63** | | | |
| | 68 | 37 | 16 |
| | 91 | 50 | 18 |
| | 109 | 60 | 21 |
| | 160 | 88 | 23 |
| | 497 | 273 | 26 |
| **Steel HP 12 X 74** | | | |
| | 69 | 38 | 16 |
| | 92 | 51 | 18 |
| | 111 | 61 | 21 |
| | 167 | 92 | 23 |
| | 589 | 324 | 26 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 12 X 84** | | | |
| | 70 | 39 | 16 |
| | 94 | 52 | 18 |
| | 112 | 62 | 21 |
| | 172 | 95 | 23 |
| | 664 | 365 | 27 |
| **Steel HP 14 X 73** | | | |
| | 80 | 44 | 16 |
| | 108 | 59 | 18 |
| | 134 | 74 | 21 |
| | 189 | 104 | 23 |
| | 578 | 318 | 26 |
| **Steel HP 14 X 89** | | | |
| | 82 | 45 | 16 |
| | 110 | 60 | 18 |
| | 136 | 75 | 21 |
| | 199 | 109 | 23 |
| | 705 | 388 | 26 |
| **Steel HP 14 X 102** | | | |
| | 84 | 46 | 16 |
| | 112 | 61 | 18 |
| | 137 | 76 | 21 |
| | 206 | 113 | 23 |
| | 810 | 445 | 27 |
| **Steel HP 14 X 117** | | | |
| | 86 | 47 | 16 |
| | 114 | 63 | 18 |
| | 140 | 77 | 21 |
| | 215 | 118 | 23 |
| | 929 | 511 | 28 |
| **Precast 14"x 14"** | | | |
| | 124 | 68 | 16 |
| | 152 | 84 | 18 |
| | 172 | 95 | 21 |

**Pile Design Table for South Abutment utilizing Boring #BSB-302**

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | | |
| | 362 | 199 | 32 |
| **Metal Shell 14"Φ w/.312" walls** | | | |
| | 472 | 260 | 32 |
| **Metal Shell 16"Φ w/.312" walls** | | | |
| | 598 | 329 | 32 |
| **Metal Shell 16"Φ w/.375" walls** | | | |
| | 598 | 329 | 32 |
| **Steel HP 8 X 36** | | | |
| | 90 | 50 | 32 |
| | 109 | 60 | 34 |
| | 286 | 157 | 36 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 10 X 42** | | | |
| | 112 | 62 | 32 |
| | 135 | 74 | 34 |
| | 335 | 184 | 36 |
| **Steel HP 10 X 57** | | | |
| | 117 | 64 | 32 |
| | 143 | 79 | 34 |
| | 454 | 250 | 37 |
| **Steel HP 12 X 53** | | | |
| | 135 | 74 | 32 |
| | 162 | 89 | 34 |
| | 418 | 230 | 36 |
| **Steel HP 12 X 63** | | | |
| | 139 | 76 | 32 |
| | 169 | 93 | 34 |
| | 497 | 273 | 36 |
| **Steel HP 12 X 74** | | | |
| | 143 | 78 | 32 |
| | 176 | 97 | 34 |
| | 589 | 324 | 37 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 12 X 84** | | | |
| | 146 | 80 | 32 |
| | 181 | 100 | 34 |
| | 664 | 365 | 37 |
| **Steel HP 14 X 73** | | | |
| | 164 | 90 | 32 |
| | 200 | 110 | 34 |
| | 578 | 318 | 36 |
| **Steel HP 14 X 89** | | | |
| | 170 | 93 | 32 |
| | 210 | 115 | 34 |
| | 705 | 388 | 37 |
| **Steel HP 14 X 102** | | | |
| | 174 | 96 | 32 |
| | 217 | 119 | 34 |
| | 810 | 445 | 37 |
| **Steel HP 14 X 117** | | | |
| | 179 | 99 | 32 |
| | 226 | 124 | 34 |
| | 929 | 511 | 38 |

**Pile Design Table for South Abutment utilizing Boring #BSB-303**

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | | |
| | 233 | 128 | 15 |
| **Metal Shell 14"Φ w/.25" walls** | | | |
| | 308 | 169 | 15 |
| **Metal Shell 14"Φ w/.312" walls** | | | |
| | 308 | 169 | 15 |
| **Metal Shell 16"Φ w/.312" walls** | | | |
| | 393 | 216 | 15 |
| **Metal Shell 16"Φ w/.375" walls** | | | |
| | 393 | 216 | 15 |
| **Steel HP 8 X 36** | | | |
| | 45 | 24 | 15 |
| | 60 | 33 | 16 |
| | 286 | 157 | 19 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 10 X 42** | | | |
| | 55 | 30 | 15 |
| | 74 | 40 | 16 |
| | 335 | 184 | 19 |
| **Steel HP 10 X 57** | | | |
| | 58 | 32 | 15 |
| | 81 | 45 | 16 |
| | 454 | 250 | 20 |
| **Steel HP 12 X 53** | | | |
| | 66 | 36 | 15 |
| | 89 | 49 | 16 |
| | 418 | 230 | 19 |
| **Steel HP 12 X 63** | | | |
| | 69 | 38 | 15 |
| | 95 | 52 | 16 |
| | 497 | 273 | 19 |
| **Steel HP 12 X 74** | | | |
| | 71 | 39 | 15 |
| | 101 | 56 | 16 |
| | 589 | 324 | 20 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 12 X 84** | | | |
| | 73 | 40 | 15 |
| | 106 | 58 | 16 |
| | 664 | 365 | 20 |
| **Steel HP 14 X 73** | | | |
| | 81 | 45 | 15 |
| | 112 | 62 | 16 |
| | 578 | 318 | 19 |
| **Steel HP 14 X 89** | | | |
| | 85 | 47 | 15 |
| | 121 | 66 | 16 |
| | 705 | 388 | 20 |
| **Steel HP 14 X 102** | | | |
| | 88 | 48 | 15 |
| | 128 | 70 | 16 |
| | 810 | 445 | 20 |
| **Steel HP 14 X 117** | | | |
| | 91 | 50 | 15 |
| | 136 | 75 | 16 |
| | 929 | 511 | 21 |

# Appendix G

# IDOT Pile Design Tables with

# Downdrag

**Pile Design Table for North Abutment utilizing Boring #BSB-65**

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | | |
| | 94 | -4 | 17 |
| **Metal Shell 14"Φ w/.25" walls** | | | |
| | 114 | -3 | 17 |
| **Metal Shell 14"Φ w/.312" walls** | | | |
| | 114 | -3 | 17 |
| **Metal Shell 16"Φ w/.312" walls** | | | |
| | 135 | 0 | 17 |
| **Metal Shell 16"Φ w/.375" walls** | | | |
| | 135 | 0 | 17 |
| **Steel HP 8 X 36** | | | |
| | 283 | 125 | 21 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 10 X 42** | | | |
| | 72 | 2 | 17 |
| | 109 | 23 | 19 |
| | 335 | 147 | 21 |
| **Steel HP 10 X 57** | | | |
| | 74 | 3 | 17 |
| | 117 | 26 | 19 |
| | 454 | 211 | 22 |
| **Steel HP 12 X 53** | | | |
| | 89 | 4 | 17 |
| | 132 | 27 | 19 |
| | 418 | 185 | 21 |
| **Steel HP 12 X 63** | | | |
| | 91 | 5 | 17 |
| | 138 | 31 | 19 |
| | 497 | 228 | 22 |
| **Steel HP 12 X 74** | | | |
| | 92 | 5 | 17 |
| | 145 | 33 | 19 |
| | 589 | 278 | 23 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 12 X 84** | | | |
| | 93 | 5 | 17 |
| | 150 | 36 | 19 |
| | 664 | 319 | 23 |
| **Steel HP 14 X 73** | | | |
| | 108 | 6 | 17 |
| | 163 | 36 | 19 |
| | 578 | 264 | 22 |
| **Steel HP 14 X 89** | | | |
| | 110 | 6 | 17 |
| | 172 | 41 | 19 |
| | 705 | 334 | 23 |
| **Steel HP 14 X 102** | | | |
| | 111 | 7 | 17 |
| | 180 | 44 | 19 |
| | 810 | 391 | 23 |
| **Steel HP 14 X 117** | | | |
| | 113 | 7 | 17 |
| | 188 | 48 | 19 |
| | 929 | 456 | 24 |
| **Precast 14"x 14"** | | | |
| | 145 | -3 | 17 |

**Pile Design Table for North Approach utilizing Boring #BSB-65**

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Metal Shell 12"Φ w/.25" walls** | | | |
| | 112 | -24 | 21 |
| **Metal Shell 14"Φ w/.25" walls** | | | |
| | 135 | -26 | 21 |
| **Metal Shell 14"Φ w/.312" walls** | | | |
| | 135 | -26 | 21 |
| **Metal Shell 16"Φ w/.312" walls** | | | |
| | 159 | -27 | 21 |
| **Metal Shell 16"Φ w/.375" walls** | | | |
| | 159 | -27 | 21 |
| **Steel HP 8 X 36** | | | |
| | 249 | 90 | 25 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 10 X 42** | | | |
| | 309 | 112 | 25 |
| **Steel HP 10 X 57** | | | |
| | 440 | 183 | 26 |
| **Steel HP 12 X 53** | | | |
| | 370 | 134 | 25 |
| **Steel HP 12 X 63** | | | |
| | 453 | 179 | 25 |
| **Steel HP 12 X 74** | | | |
| | 111 | -10 | 21 |
| | 167 | 21 | 23 |
| | 589 | 253 | 26 |

| | Nominal Required Bearing (Kips) | Factored Resistance Available (Kips) | Estimated Pile Length (Ft.) |
|---|---|---|---|
| **Steel HP 12 X 84** | | | |
| | 112 | -10 | 21 |
| | 172 | 23 | 23 |
| | 664 | 293 | 27 |
| **Steel HP 14 X 73** | | | |
| | 134 | -9 | 21 |
| | 189 | 22 | 23 |
| | 578 | 235 | 26 |
| **Steel HP 14 X 89** | | | |
| | 136 | -8 | 21 |
| | 199 | 26 | 23 |
| | 705 | 304 | 26 |
| **Steel HP 14 X 102** | | | |
| | 137 | -9 | 21 |
| | 206 | 29 | 23 |
| | 810 | 361 | 27 |
| **Steel HP 14 X 117** | | | |
| | 140 | -8 | 21 |
| | 215 | 33 | 23 |
| | 929 | 426 | 28 |
| **Precast 14"x 14"** | | | |
| | 172 | -33 | 21 |

# APPENDIX H

# RECOMMENDED GEOTECHNICAL

# DESIGN PARAMETERS -

# NORTH & SOUTH ABUTMENTS

**Table H-1: Summary of Soil and Rock Parameters – North Abutment (Boring BSB-65)**

| Depth / Elevation Range (feet) | Soil Description | In situ Unit Weight γ (pcf) | Undrained | | Drained | | Active Earth Pressure Coefficient ($K_a$) | Passive Earth Pressure Coefficient ($K_p$) | At Rest Earth Pressure Coefficient ($K_o$) | Lateral Modulus of Subgrade Reaction (pci) | Soil Strain ($\varepsilon_{50}$) | OSHA Soil Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cohesion c (psf) | Friction Angle ϕ (°) | Cohesion c (psf) | Friction Angle ϕ (°) | | | | | | |
| | New Engineered Clay Fill* | 120 | 1,000 | 0 | 100 | 28 | 0.41 | 2.46 | 0.58 | 1,000 | 0.005 | Type B |
| | New Engineered Granular Fill* | 120 | 0 | 30 | 0 | 30 | 0.33 | 3.00 | 0.50 | 20 | N/A | Type C |
| 0 – 3.0 (595.2-592.2) | Fill Brown Silty Clay Loam | 138 | 3,100 | 0 | 310 | 25 | 0.41 | 2.46 | 0.58 | 1,000 | 0.005 | Type A |
| 3.0 – 6.0 (592.2-589.2) | Brown Very Stiff Silty Clay Loam | 138 | 3,100 | 0 | 310 | 28 | 0.36 | 2.77 | 0.53 | 1,000 | 0.005 | Type A |
| 6.0 – 7.0 (589.2-588.2) | Gray Very Stiff Silty Clay Loam | 138 | 2,500 | 0 | 250 | 28 | 0.36 | 2.77 | 0.53 | 1,000 | 0.005 | Type A |
| 7.0 – 7.5 (588.2-587.7) | Light Brown Very Dense Sand | 138 | 0 | 42 | 0 | 42 | 0.20 | 5.04 | 0.33 | 125 | N/A | Type C |

*Assumes material placed in accordance with IDOT SSRBC

**Table H-2: Summary of Soil and Rock Parameters – South Abutment (Boring BSB-68)**

| Depth / Elevation Range (feet) | Soil Description | In situ Unit Weight γ (pcf) | Undrained | | Drained | | Active Earth Pressure Coefficient ($K_a$) | Passive Earth Pressure Coefficient ($K_p$) | At Rest Earth Pressure Coefficient ($K_o$) | Lateral Modulus of Subgrade Reaction (pci) | Soil Strain ($\varepsilon_{50}$) | OSHA Soil Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cohesion c (psf) | Friction Angle ϕ (°) | Cohesion c (psf) | Friction Angle ϕ (°) | | | | | | |
| | New Engineered Clay Fill* | 120 | 1,000 | 0 | 100 | 28 | 0.41 | 2.46 | 0.58 | 1,000 | 0.005 | Type B |
| | New Engineered Granular Fill* | 120 | 0 | 30 | 0 | 30 | 0.33 | 3.00 | 0.50 | 20 | N/A | Type C |
| 0 – 11.0 (575.4-564.4) | Fill Brown and Gray Sand and Gravel | 126 | 0 | 42 | 0 | 42 | 0.20 | 5.04 | 0.33 | 60 | N/A | Type C |
| 11.0 – 13.5 (564.4-561.9) | Light Brown Very Dense Sand with Gravel | 137 | 0 | 42 | 0 | 42 | 0.20 | 5.04 | 0.33 | 125 | N/A | Type C |

*Assumes material placed in accordance with IDOT SSRBC