STRUCTURE GEOTECHNICAL REPORT
CULVERT AT STATION 310+50
IL ROUTE 176 EAST OVER UNNAMED CREEK
PR SN 056-0110
MCHENRY COUNTY, ILLINOIS

For
Strand Associates, Inc.

1170 South Houbolt Road

Joliet, IL 60432

Submitted by

Wang Engineering, Inc.

1145 North Main Street

Lombard, IL 60148

Original Report: May 17, 2023
Revised Report: NA

Technical Report Documentation Page

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11. Abstract

The existing 3-foot wide by 3-foot tall, concrete box culvert carrying Illinois Route 176 East over unnamed creek will be removed and replaced with a longer, 8-foot wide by 4-foot tall box culvert. The proposed culvert will be 132.8-foot long and will have horizontal wingwalls at both ends. The proposed culvert will have upstream and downstream invert elevations of 908.92 and 908.76 feet, respectively.

Beneath topsoil, the general lithologic profile includes 3 to 11 feet of medium stiff to very stiff clay and silty clay loam fill over up to 8 feet of soft to medium stiff clay to silty clay loam with organic matter and peat followed by stiff to very stiff silty clay to silty clay loam and clay loam. The groundwater was observed at elevations ranging from 894 to 911 feet during drilling and was measured at elevations ranging from 883 to 993 feet upon completion of drilling.

At the culvert base elevations, soft to medium stiff clay to silty clay with organic matter and peat are expected. We recommend removing these soils to elevations 905 to 902 feet and replacing with granular aggregate. Prior to placement of granular fill, we recommend installing fabric for ground stabilization. Following the recommended removal and replacement, we estimate long-term settlement of 0.2 to 0.5 inches with a differential settlement of about 0.3 inches. As an alternative to removal and replacement, aggregate columns can be considered for subgrade improvements

We recommend the culvert barrel and wingwalls be designed for a maximum factored bearing resistance of 4,000 psf. Global stability analyses of the wingwalls show factors of safety meeting the minimum requirement of 1.5.

To accommodate stage construction, the sheet piling and temporary geotextile wall are shown on GPE. We estimate a temporary steel sheet piling according to IDOT Design Guide 3.13.1 is feasible. Temporary geotextile wall should be designed in accordance with IDOT Standard specifications.

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STRUCTURE GEOTECHNICAL REPORT
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IL ROUTE 176 EAST OVER UNNAMED CREEK
PR SN 056-0110
MCHENRY COUNTY, ILLINOIS
FOR
STRAND ASSOCIATES, INC.

1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluations to support the removal and replacement of a culvert carrying Illinois Route 176 East (IL 176 E) over an unnamed Creek at Station 310+50 that is about 600 feet east of the intersection between IL 176 E and IL Route 47 (IL 47). The proposed structure replacement is part of the widening and reconstruction of 1.65-mile long of IL 47 between Station 565+80 and Station 660+92 in McHenry County, Illinois. A *Site Location Map* is presented as Exhibit 1.

1.1 Proposed Structure

Based on the *General Plan and Elevation* (GPE) dated in August, 2020 provided by Strand Associates, Inc. (Strand), Wang Engineering, Inc. (Wang) understands the existing 3-foot wide by 3-foot tall culvert will be removed and replaced with a 8-foot wide by 4-foot tall culvert. The proposed culvert will be 132.8-foot long, which is about 68 feet longer than the existing one. The proposed culvert will have the upstream invert elevation at 908.92 feet and the downstream invert elevation at 908.76 feet; with flow directed from north to south. The proposed culvert will have horizontal wingwalls at both the upstream and downstream ends. The roadway will be widened at both sides and the traffic will be maintained in two construction stages.

1.2 Existing Structure and Land Use

The existing 3-foot wide by 3-foot-tall concrete box culvert has a total length of 65 feet. The land use of the surrounding area consists of a golf course on the south side and wooden area on the north side.

The purpose of this investigation was to characterize the site soil and groundwater conditions, perform geotechnical analyses, and provide recommendations for the design and construction of the proposed culvert and wingwalls.

2.0 GEOLOGICAL SETTING

The project area is located in Dorr Townships, McHenry County, Illinois. On the USGS *Huntley 7.5 Minute Series Quadrangle* map, the culvert is located in the SE ¼ of Section 33, Tier 44 N, Range 7 E of the Third Principal Meridian.

The following review of published geologic data, with emphasis on factors that might influence the design and construction of the proposed engineering works, is meant to place the project area within a geological framework and confirm the dependability and consistency of the subsurface investigation results. For the study of the regional geologic framework, Wang considered northeastern Illinois in general and McHenry County in particular. Exhibit 2 illustrates the Site and Regional Geology.

2.1 Physiography

The Wheaton Morainal Country Physiographic Subsection (Leighton et al. 1948) dominates the eastern two thirds of McHenry County. The culvert is located along the former outwash valleys carved by glacial meltwater through the Barlina Moraine. The morainic surface is marked by kettle depressions left behind by ice blocks that were, in time, filled with lacustrine and organic sediments giving the topography a hummocky look.

In general, the relief within the project area is flat and occasionally hummocky. The culvert is at IL 176 East crossing over an unnamed creek tributary to Kishwakee River. About 1000 yards south of the project, the Kishwaukee River. The existing surface elevation is about 920 feet.

2.2 Surficial Cover

The project area was shaped during the Wisconsin-age glaciation and about 190-foot thick overburden covers the bedrock. The glacigenic deposits were emplaced during pulsating advances and retreats of an icesheet lobe responsible for the formation of end moraines and associated low-relief till and lake plains (Hansel and Johnson 1996). The surficial cover within the project area consists of organic silt and clay, peat, and marl of the Grayslake Peat, found discontinuously throughout the project area. The Grayslake Peat overlies either the clay and silt of the Equality Formation, or the silty clayey diamicton of the Yorkville Member of the Lemont Formation, which in turn overlies the loamy diamicton of the Tiskilwa Formation or gravelly sand outwash of the Henry Formation that interfinger with the two diamictons.

The Grayslake Peat, less than 10-foot thick, consists of black to brown peat interbedded with gray organic rich sand and silty clay and white to light gray marl (Curry and Thomason 2012, Flaherty et al. 2013). The Equality Formation, less than 15-foot thick, consists of brown to gray, bedded fine sand, silt, and clay lacustrine deposits (Curry and Thomason 2012). The Henry Formation consists of stratified sand and gravel outwash with thicknesses of about 2 feet, within the project limits to about 100 feet (Curry and Thomason 2012). The Yorkville Member of the Lemont Formation, up to 30-foot thick, consists of yellowish brown to gray silty clay to silty clay loam diamicton that contains lenses of gravel, sand, silt, and clay (Hansel and Johnson 1996, Curry and Thomason 2012). The Tiskilwa Formation, about 110-foot thick, consists of calcareous reddish brown to gray clay loam, loam to sandy loam diamicton that contains lenses of gavel, sand, silt, and clay (Wickham et al. 1988, Curry and Thomason 2012). The Tiskilwa Formation diamicton rests over the Illinoian-age drift, which in turn unconformably rests over the Silurian-age dolostone (Curry and Thomason 2012). The diamicton accounts for about 90% of the soil profile.

From a geotechnical viewpoint, the Yorkville Member characterized by low to moderate plasticity, high strength, and low to moderate moisture content and the Tiskilwa Formation characterized by low plasticity, medium to high strength, low moisture content, moderately to highly pebbly (Wickham et al. 1988, Bauer et al. 1991).

2.3 Bedrock

In McHenry County, the surficial cover rests unconformably on top of Silurian-age and Ordovician-age bedrock. The top of the bedrock lies about 190 feet below the ground surface (bgs). Structurally, the site is located on the eastern flank of the Wisconsin Arch (Willman 1971). No active faults or underground mines are known in the area.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area encountered native sediments consisting of lacustrine clay and silt of the Equality Formation, silty clay diamicton of the Yorkville Member of the Lemont Formation and loamy diamicton of the Tiskilwa Formation. None of the borings were deep enough to encounter bedrock.

3.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations performed by Wang.

3.1 Field Investigation

The subsurface investigation consisted of three structure borings, designated as CUL-10 through CUL-12, and one peat delineation boring, designated as PT10-01. The borings were drilled by Wang from June 24 to July 13, 2020 and were advanced to depths of 15 to 35 feet bgs. In addition, Borings PT9-05, SGB-21, and shelby tube boring SGB-21ST drilled in 2017 by Wang were included in our analysis.

The as-drilled northings and eastings were acquired with a mapping-grade GPS unit; boring elevations were surveyed with a level. Stations and offsets were determined from drawings provided by Strand. Boring location data are presented in the *Boring Logs* (Appendix A). The as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 3).

Truck- and ATV- mounted drilling rigs, equipped with hollow stem augers, were used to advance and maintain open boreholes. Soil sampling was performed according to AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils*." The soil was sampled at 2.5-foot intervals to 30 feet below ground surface (bgs) and at 5-foot intervals, thereafter. Peat delineation borings were sampled continuously or at 2.5-foot intervals. Soil samples collected from each sampling interval were placed in sealed jars and transported to the laboratory for further examination and laboratory testing.

Field boring logs, prepared and maintained by Wang geologists, include lithological descriptions, visual-manual soil classifications (IDH Textural), results of Rimac and pocket penetrometer unconfined compressive strength testing on cohesive soils, and results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration.

Groundwater observations were made during and at the end of drilling operations. Due to safety considerations, boreholes were backfilled immediately upon completion with soil cuttings and/or chips. The pavement surface was restored to its original condition.

3.2 Laboratory Testing

The soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limits (AASHTO T89/T90) and particle size (AASHTO T88) analyses were performed on selected samples.

A one-dimensional consolidation test (AASHTO T216) was performed on a shelby tube sample. Field visual descriptions of the soil samples were verified in the laboratory and index tested samples were classified according to the IDH Soil Classification System. Laboratory test results are shown in the *Boring Logs* (Appendix A) and in the *Laboratory Test Results* (Appendix B).

4.0 INVESTIGATION RESULTS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 4). Please note that strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical directions.

4.1 Lithological Profile

The borings encountered 3 to 20 inches of silty clay loam topsoil at the surface. Boring CUL-11 encountered 2 inches of loam at the surface. In descending order, the general lithologic succession encountered beneath the surface includes: 1) man-made ground (fill); 2) soft to medium stiff organic clay to silty clay; and 3) stiff to very stiff silty clay to silty clay loam and clay loam.

1) Man-made ground (fill)

Beneath the topsoil, borings revealed 3 to 11 feet of fill material. The fill material is cohesive, consisting of medium stiff to very stiff, brown to gray clay loam and silty clay loam. The fill has unconfined compressive strength (Q_u) values of 0.3 and 2.2 tsf and the moisture content values of 12 to 27%. Laboratory index testing on sample from this layer shows a liquid limit (L_L) value of 34% and a plastic limit (P_L) value of 15%. Below the fill, Borings CUL-11 and CUL-12 encountered 0.7 to 2.5 feet of buried silty clay loam topsoil.

2) Soft to medium stiff organic clay to silty clay

Beneath the fill and topsoil, at elevations of 898 to 910 feet (1.5 to 10.5 feet bgs), the borings encountered 3 to 8 feet of soft to medium stiff, brown to gray clay to silty clay with organic matter, organic silty loam, and peat. The unit has Q_u values of 0.16 to 0.9 tsf and moisture content values of 21 to 164%. Laboratory index testing on samples from this layer shows L_L values of 24 to 74% and P_L values of 13 to 40%. Laboratory tests show 14.5 and 15.0% of organic content. The consolidation properties of this very soft to soft organic silty loam were obtained and are summarized in Table 1.

Table 1: Summary of Consolidation Testing

Boring ID	Test Depth (feet)	Test Elevation (feet)	C_C	C_S	e_O	OCR/ P'_c (psf)	Moisture Content (%)
SGB-21ST	14 to 16	903	1.038	0.146	2.251	1.16/1391	73

C_C : Compression index; C_S : Swelling index ; e_O : Initial void ratio; OCR: Over consolidation ratio; and $P'c$: Preconsolidation pressure.

3) Stiff to very stiff silty clay to silty clay loam and clay loam

At elevations of 899 to 911 feet (1.3 to 18.5 feet bgs), the borings encountered gray and brown to gray, stiff to very stiff silty clay to silty clay loam and clay loam with wet to saturated sand and loam interbeds. The unit has Q_u values of 1.1 to 3.5 tsf and moisture content values of 9 to 18%.

4.2 Groundwater Conditions

Groundwater was observed while drilling at elevations of 894 to 904 feet (13 to 19 feet bgs) and at an elevation of 911 feet (at the surface) in Boring PT10-01. At completion of drilling, the groundwater was measured at elevations of 883 to 893 feet (20 to 31 feet bgs). As per the GPE, at the unnamed creek culvert, the Estimated Water Surface Elevation (EWSE) is 910.02 feet.

5.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

Geotechnical evaluations and recommendations for the culvert and wingwalls are included in the following sections. The proposed culvert will have upstream and downstream invert elevations of 908.92 and 908.76 feet, respectively. Horizontal wingwalls are proposed at both ends of the culvert.

Wang has performed bearing capacity, settlement, and global stability analyses for the proposed culvert barrel and wingwalls.

5.1 Scour Considerations

The design scour elevation should be taken at the bottom of the cutoff wall (IDOT 2012). At the horizontal cantilever wingwalls, the cutoff walls are established at 3.0 feet below the culvert invert elevations; whereas for T-type wingwalls, the cutoff walls are established at 4.0 feet below the invert elevations. To prevent local erosion, we recommend placing stone riprap or a concrete apron at the ends of the culvert; this will be particularly important if precast sections are used. This will also prevent sediments from entering and accumulating in the culvert, minimize long term maintenance, and provide protection to the stream bed at the interface.

5.2 Ground Improvement

The subsurface investigation indicates the soils along the culvert base are primarily very soft to medium stiff clay to silty clay, and silty clay loam with organic matter. To mitigate settlement issues and to provide stable working platforms, Wang recommends removal and replacement of very soft to medium stiff soil along the proposed culvert barrel and wingwalls. The recommended removal limit and depth are:

- From the downstream end of the culvert going 66 feet upstream, for a depth of 5.6 feet below the proposed bottom of the culvert or to elevation 902 feet; and
- From 66 feet of downstream to upstream end, for a depth of 2.5 feet below the proposed bottom of the culvert or to elevation 905 feet.

Please note that Boring SGB-21, located about 50 feet from the culvert centerline, shows deeper soft soil to elevation 899 feet. The contractor should be prepared for deeper removal limits.

The removal and replacement material should extend a minimum of two feet beyond each side of the box (IDOT 2016). Prior to placement of replacement material, we recommend installing fabric for ground stabilization in accordance with IDOT Section 210 (IDOT 2016). In addition, the following note should be shown in the plans.

"The limits and quantities of removal and replacement shown are based on the boring data may be modified by the District Geotechnical and Field Engineers for variable subsurface conditions encountered in the field"

Based on information we received in October 2022; we understand that aggregate column is the preferred ground improvement method for the roadway section of IL 47. Therefore, as an alternative to removal and replacement, aggregate columns can be considered for subgrade improvements for the culvert. The soil within the limits as shown above could be improved by the installation of aggregate (stone) columns.

5.3 Bearing Capacity

Following the recommended removal and replacement, the walls should be designed based on a maximum factored bearing resistance of 4,000 psf, determined with a bearing resistance factor (ϕ_b) of 0.45 (AASHTO 2016). The wingwalls should be sized and designed based on the information and typical sections shown in IDOT *Culvert Manual*, Sections 4.3 and 4.4 (IDOT 2017).

The culvert wingwalls could also be constructed as horizontal cantilever walls if they are less than 16 feet in length and the wingwall location can be adequately dewatered (IDOT 2017). Horizontal cantilever walls should be designed based on the structural guidelines provided in Section 4.2 of the IDOT (2017). These wingwalls should be founded at a minimum depth of 3.0 feet below the culvert invert elevations.

The wingwalls types suitable for precast concrete culvert include apron, driven sheet pile and cast-in-place T-type wingwalls. For the cast-in-place culvert, the horizontal cantilever, L-type or T-type wingwalls are typically considered. The apron wingwalls should be designed and constructed based on IDOT Specifications and IDOT Base Sheet dated 2/17/2017 "*SCB-GPE*."

5.4 Settlement

As discussed in Section 5.2, very soft to medium stiff soil clay to silty clay and silty clay loam with organic matter will be encountered below the base of proposed culvert. Without removal and replacement, we estimate approximately 7 inches of settlement under the new culvert and fill loads at the widening portions. After the proposed removal and replacement, we estimate the foundation soils will experience total long-term settlements of about 0.2 to 0.5 inches, with differential settlement of 0.3 inches. We estimate the settlements are acceptable for the construction of the proposed culvert and wingwalls.

5.5 Global Stability

We performed global stability of the wingwalls for the maximum wingwall height of 6 feet and weakest soil conditions encountered in downstream end in Borings CUL-12 and PT10-01. *Slide v6.0* evaluation exhibits employing the Bishop Simplified method of analysis are shown in Appendix C. We estimate the wingwall has a minimum factor of safety (FOS) of 2.43 for undrained soil condition and a minimum FOS of 1.82 for drained soil condition. The FOSs meet the minimum FOS requirement of 1.5 (IDOT 2015).

5.6 Cast-In-Place or Precast Culvert Considerations

After the recommended removal of unsuitable soil, the results of the analyses indicate that both the cast-in-place and precast culvert options are appropriate and feasible at the site. The differential settlement will be about 0.3 inches, which will not cause excessive separation of the precast sections. For precast end sections, we recommend considering either a concrete apron or riprap armoring at the downstream invert to protect against scour and erosion that could undermine the precast end section assuming a hydraulic analysis does not indicate a low-scour condition.

5.7 Stage Construction Considerations

Based on the GPE, Wang understands temporary sheet piling system and temporary geotextile retaining wall will be utilized to accommodate stage construction. The sheet piling should be designed based on IDOT *Design Guide 3.13.1*. Assuming an exposed height of about 17 feet (from elevation 919 to 902 feet) located at the stage construction line, our evaluations indicate the temporary steel sheet piling is feasible. To accommodate stage construction, the geotextile wall show in the GPE should be designed based on IDOT Section 522.11 (IDOT 2016).

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

The existing culvert will be removed and any vegetation, surface topsoil, pavements, and debris should be cleared and stripped where the new culvert and wingwalls will be placed. If unstable or unsuitable materials are exposed during excavation, they should be removed and replaced with compacted fill material as described in Section 6.3.

6.2 Excavation, Dewatering, and Utilities

Excavations should be performed in accordance with local, state, and federal regulations. The potential effect of ground movements upon nearby utilities should be considered during construction. Excavations for the placement of the culvert barrel should be steeped at no steeper than 1:2.5 (V:H). Any slopes that cannot be graded at 1:2 (V: H) should be properly shored with temporary sheeting or soil retention systems. Excavated material should not be stockpiled immediately adjacent to the top of slopes, nor should equipment be allowed to operate too closely to open excavations.

During the subsurface investigation, the groundwater was encountered at elevation ranging from 894 to 911 feet, which are about 4 and 7 feet above the culvert and wingwall base elevations. In addition, the EWSE is 910.02 feet, which is about 3.3 feet above the culvert base and 5.3 feet above the wingwall. Therefore, we recommend Type I Cofferdam for the construction.

Any water that accumulates in open excavations by seepage or runoff should be immediately removed by sump-pump. Depending upon prevailing climate conditions and the time of the year when culvert construction takes place, control runoff and maintenance of existing flows may require temporary water diversion and control.

6.3 Filling and Backfilling

Fill material used to attain the final design elevations should be IDOT Standard Specifications. Coarse aggregate of IDOT gradation CA-6 or pre-approved, compacted, cohesive or granular soils conforming to Section 204 would be acceptable as fill material (IDOT 2016). The fill material should be free of organic matter and debris and should be placed in lifts and compacted according to IDOT Section 205, *Embankment* (IDOT 2016).

Groundwater may exist beneath the culvert. As mentioned in IDOT Culvert Manual (IDOT 2017), in cases such as replacement below box culvert where dewatering and compaction may not be possible, the pay item “Rockfill” is commonly used. In this case, the following note should be added.

“The Rockfill shall be capped with 6 in. of CA7 and satisfy the Standard Specifications unless otherwise indicated in the Special Provisions. The cost of the capping material shall be included in the pay item for Rockfill.”

6.4 Earthwork Operations

The required earthwork can be accomplished with conventional construction equipment. Moisture and traffic will cause deterioration of exposed subgrade soils. Precautions should be taken by the Contractor to prevent water erosion of the exposed subgrade. A compacted subgrade will minimize water runoff erosion.

Earth moving operations should be scheduled to not coincide with excessive cold or wet weather (early spring, late fall or winter). Any soil allowed to freeze or soften due to the standing water should be removed. Wet weather can cause problems with subgrade compaction.

It is recommended that an experienced geotechnical engineer be retained to inspect the exposed subgrade, monitor earthwork operations, and provide material inspection services during the construction phase of this project.

7.0 QUALIFICATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from the borings drilled at the locations shown on the boring logs and in Exhibit 3. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of the structure are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist Strand Associates, Inc. and the Illinois Department of Transportation on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

WANG ENGINEERING, INC.

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Senior Geotechnical Engineer

Corina T. Farez, P.E, P.G.
QA/QC Reviewer

Nesam S. Balakumaran, P.Eng.
Project Geotechnical Engineer

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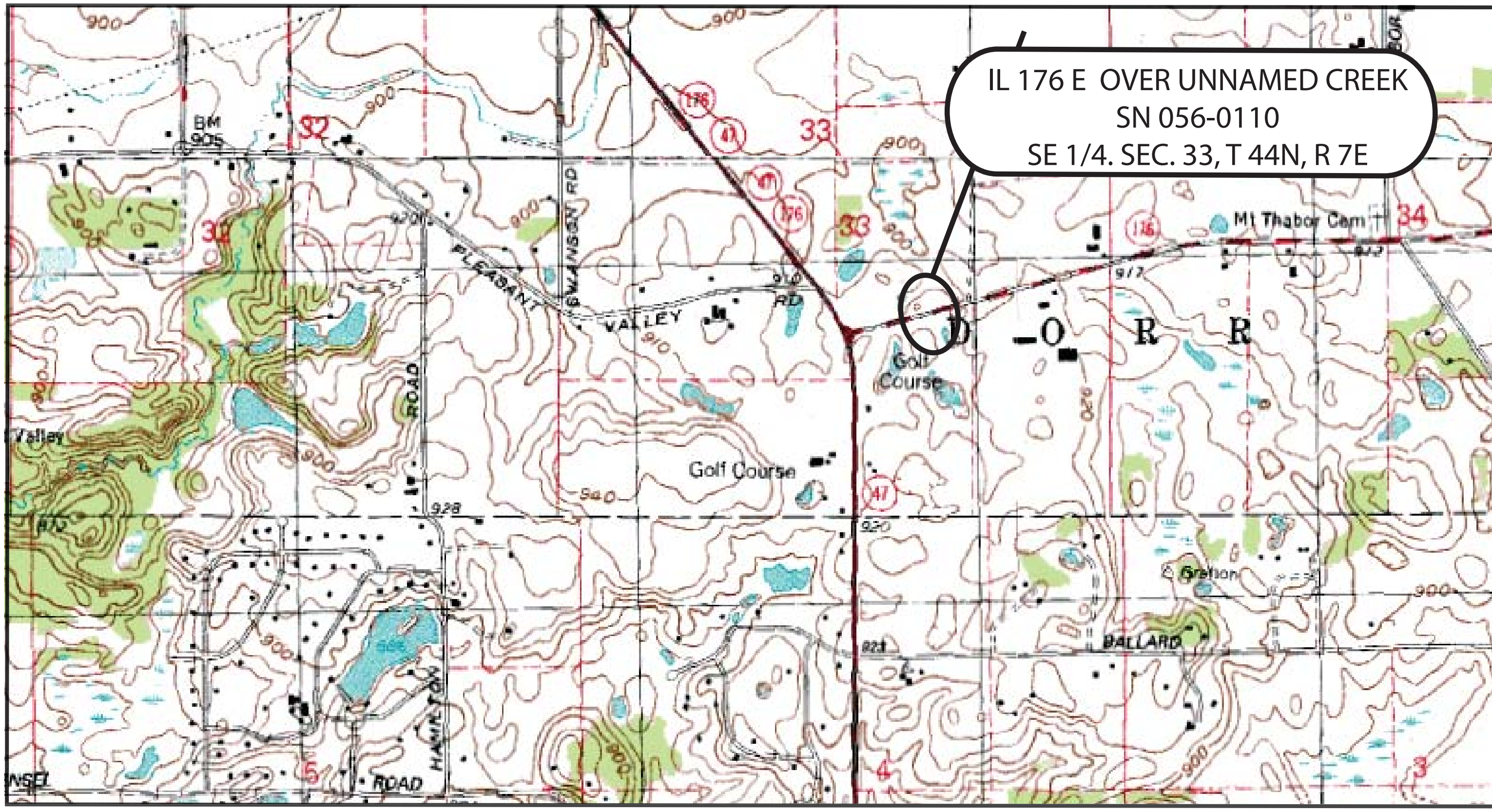
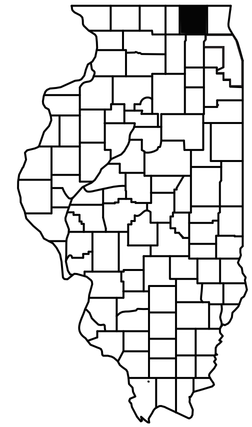
EXHIBITS





McHenry County

Scale

0 1 2 Mile

SITE LOCATION MAP: IL 176 EAST OVER UNNAMED CREEK, SN 056-0110, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: N. Balakumaraan CHECKED BY: A. Kurnia

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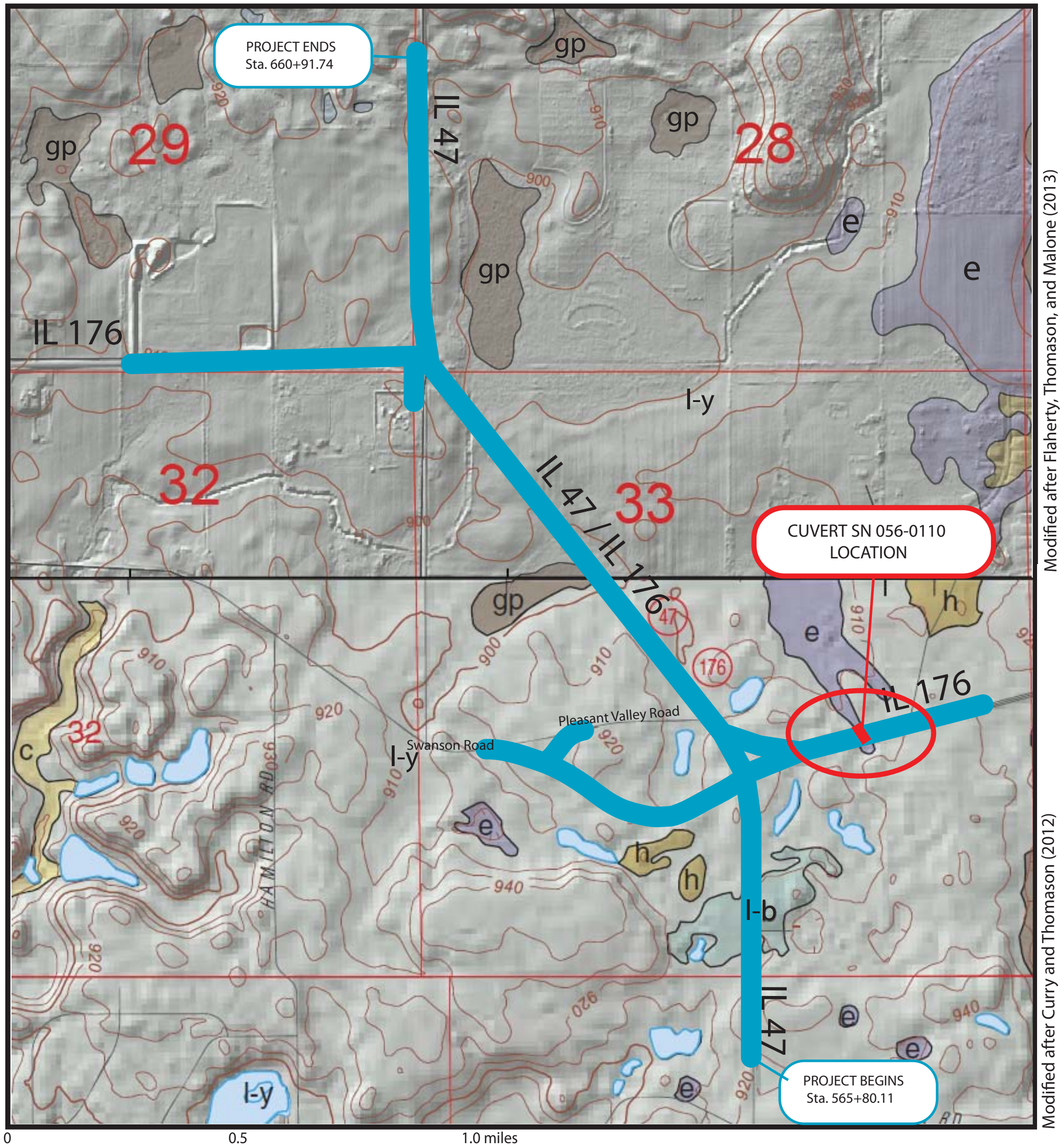
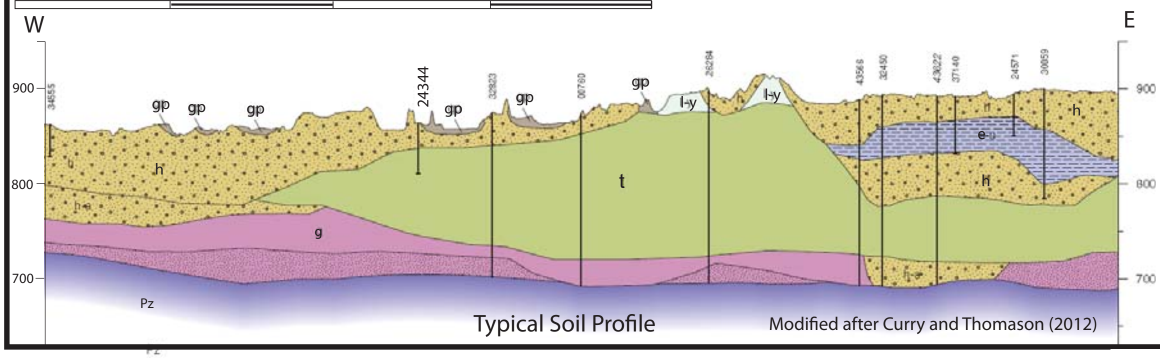
FOR STRAND ASSOCIATES, INC. 195-13-02





REGIONAL GEOLOGY

Wedron Group

- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

LEGEND

HUDSON EPISODE

- **gp** — **Grayslake Peat** Decomposed wetland vegetation and sediment; peat and muck, interbedded sand, silty clay, and marl

WISCONSIN EPISODE

- **e** — **Equality Formation** Lake deposits in kettles and valleys; silt, clay, and fine sand; layered to massive
- **h** — **Henry Formation** Proglacial outwash plains downslope of glacial margins; sand and gravel, or sand; with lenses of silt and clay, or diamicton
- **l-y** — **Lemont Fornation, Yorkville Member** Debris flow deposits and diamicton; silty clay, silty clay loam, and clay, includes layers of sand and gravel
- **l-b** — **Lemont Formation, Batestown Member (Cross section only)** Debris flow deposits and diamicton; sandy loam to loam with abundant cobbles; includes layers of sand and gravel or silt and sorted sediment
- **t** — **Tiskilwa Formation (Cross section only)** Till, debris flow deposits, and outwash; clay loam to loam; includes lenses of sand and gravel.

ILLINOIS EPISODE

- **g** — **Glasford Formation (Cross section only)** Till and debris flow deposits (diamicton) and outwash (sand and gravel); the diamicton is bouldery in places with reddish brown, sandy loam to loam matrix, with abundant lenses, and channel fills of sand and gravel.

PALEOZOIC BEDROCK

- **Pz** — **Bedrock (Cross section only)** Dolomite, shaly dolomite, and shale

Modified after Curry and Thomason (2012)

SITE AND REGIONAL GEOLOGY: IL 176 EAST OVER UNNAMED CREEK
SN 056-0110, McHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: C. Marin CHECKED BY: L. Iordache

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FOR STRAND ASSOCIATES, INC.

195-13-02

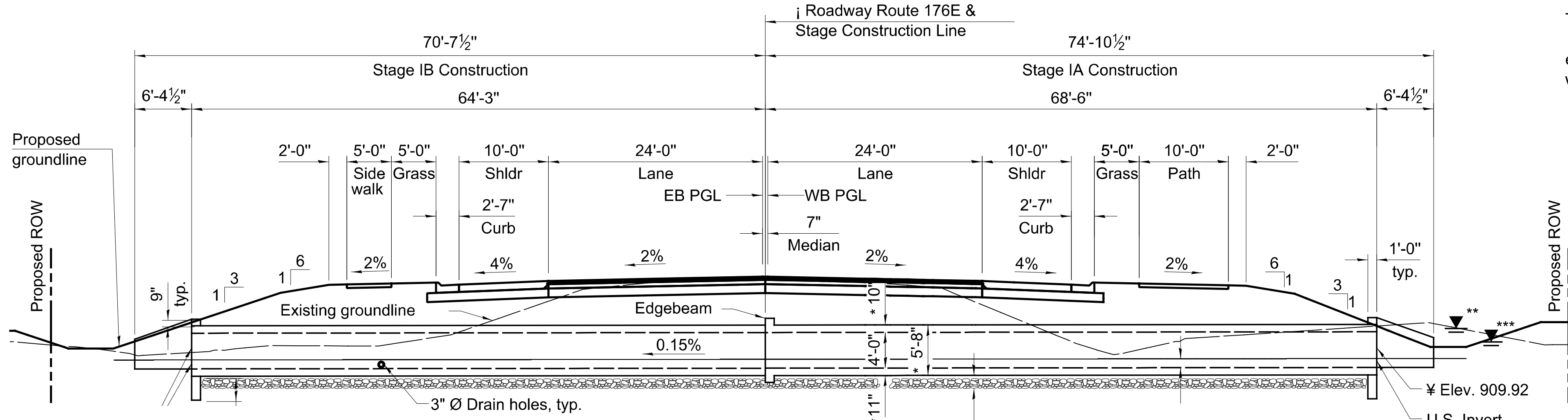
Benchmark: CWA CP #5, dia. rebar Sta. 312+36.71 o/s 29.43 ft left, Elev. 917.84.
Existing Structure: Concrete Box Culvert at Sta. 310+25 3 ft W x 3 ft H by approx. 65 ft in length at 0° skew shall be removed.
Traffic Control: Traffic will be maintained in a two stage construction process.
Salvage: None.

GENERAL NOTES

The 6 in. thick layer of porous granular material shall be placed below the bottom slab and satisfy Standard Specifications. The cost of the porous granular material shall be included in the pay item for Porous Granular Embankment. The subsurface soil foundation will be finalized in conjunction with the SGR during final plan development.

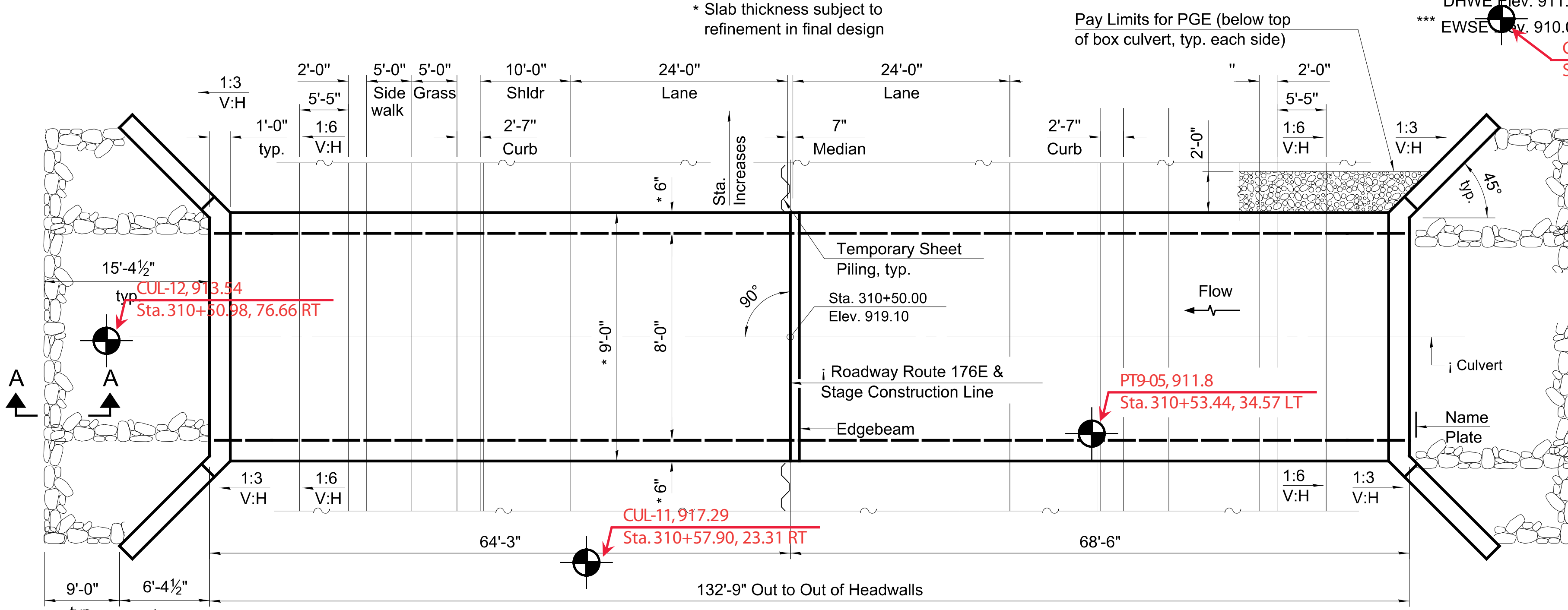
Nonwoven geotextile fabric shall conform to the requirements of Art. 1080.01 of the Standard Specifications. The minimum weight of the fabric shall be 6 ounces per square yard.

Concrete box culverts shall be backfilled with Porous Granular Embankment below the top of the box culvert extending to a vertical plane 2 ft from the exterior sides of the culvert, 2 ft from the back face of the wingwalls, and not closer than 2 ft from the face of embankment.



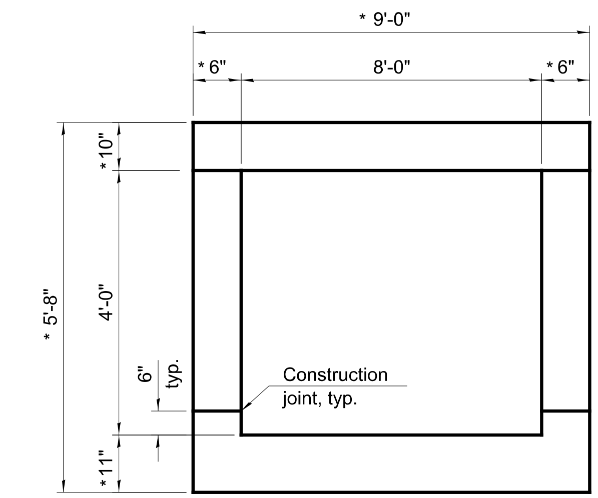
ELEVATION

* Slab thickness subject to refinement in final design



PLAN

* Wall thickness subject to refinement in final design



SECTION THRU BARREL

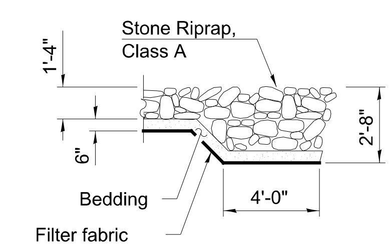
* Slab and wall thickness subject to refinement during final design

HIGHWAY CLASSIFICATION

F.A.P. Rte. 326 (IL-176E)
Functional Class: Other Principal Arterial
ADT: 10,600 (2013); 16,000 (2040)
ADTT: 2,290 (2013); 3,456 (2040)
DHV: 1095 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
2-Way Traffic
Directional Distribution: 50:50

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications
8th Edition



SECTION A-A

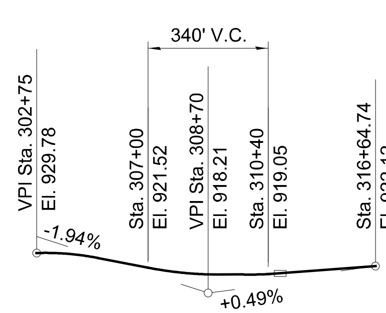
GENERAL PLAN AND ELEVATION
IL RTE. 176E OVER UNNAMED CREEK
F.A.P. RTE. 326(IL-176E) SEC. 105-N-2(15)
McHENRY COUNTY
STATION 310+50
S.N. 056-0110

Legend
Boring Location

PT10-01, 910.93
Sta. 310+65.58, 39.55 RT

WATERWAY INFORMATION

Drainage Area = 0.1155 sq. mi.			Low Grade Elev. =919.01 @ Sta. 311+75						
Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	2	14.29	2.1	5.7	910.63	0.65	0.20	911.28	910.83
	10	27.07	3.3	5.6	911.04	1.23	0.42	912.27	911.46
Design	50	62.54	4.6	7.6	911.45	2.75	0.99	914.20	912.44
Base	100	89.01	5.2	8.7	911.66	4.75	1.37	916.21	913.03
Overtopping	>500								
Max. Calc.	500	151.32	6.3	10.6	912.04	6.81	2.85	918.85	914.89



PROFILE GRADE

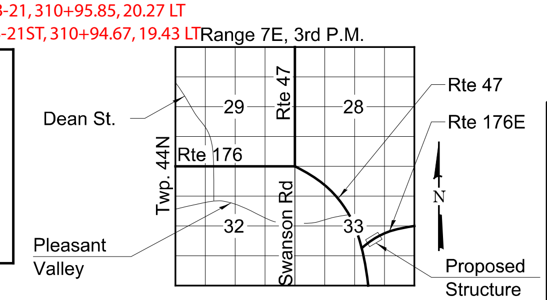
(EB and WB PGL)

STATION 310+50
BUILT 201X BY
STATE OF ILLINOIS
F.A.P. RT. 326(IL-176E)
SEC. 105-N-21(15)
LOADING HL-93
STR. NO. XXX-XXXX

NAME PLATE

See Std. 515001

*Note: Out of Plan
SGB-21, 310+95.85, 20.27 LT
SGB-21ST, 310+94.67, 19.43 LT



LOCATION SKETCH

BORING LOCATION PLAN: IL 176 EAST OVER UNNAMED CREEK, SN 056-0110, MCHENRY COUNTY, ILLINOIS
SCALE: GRAPHICAL
EXHIBIT 3
DRAWN BY: R. KC
CHECKED BY: A. Kurnia

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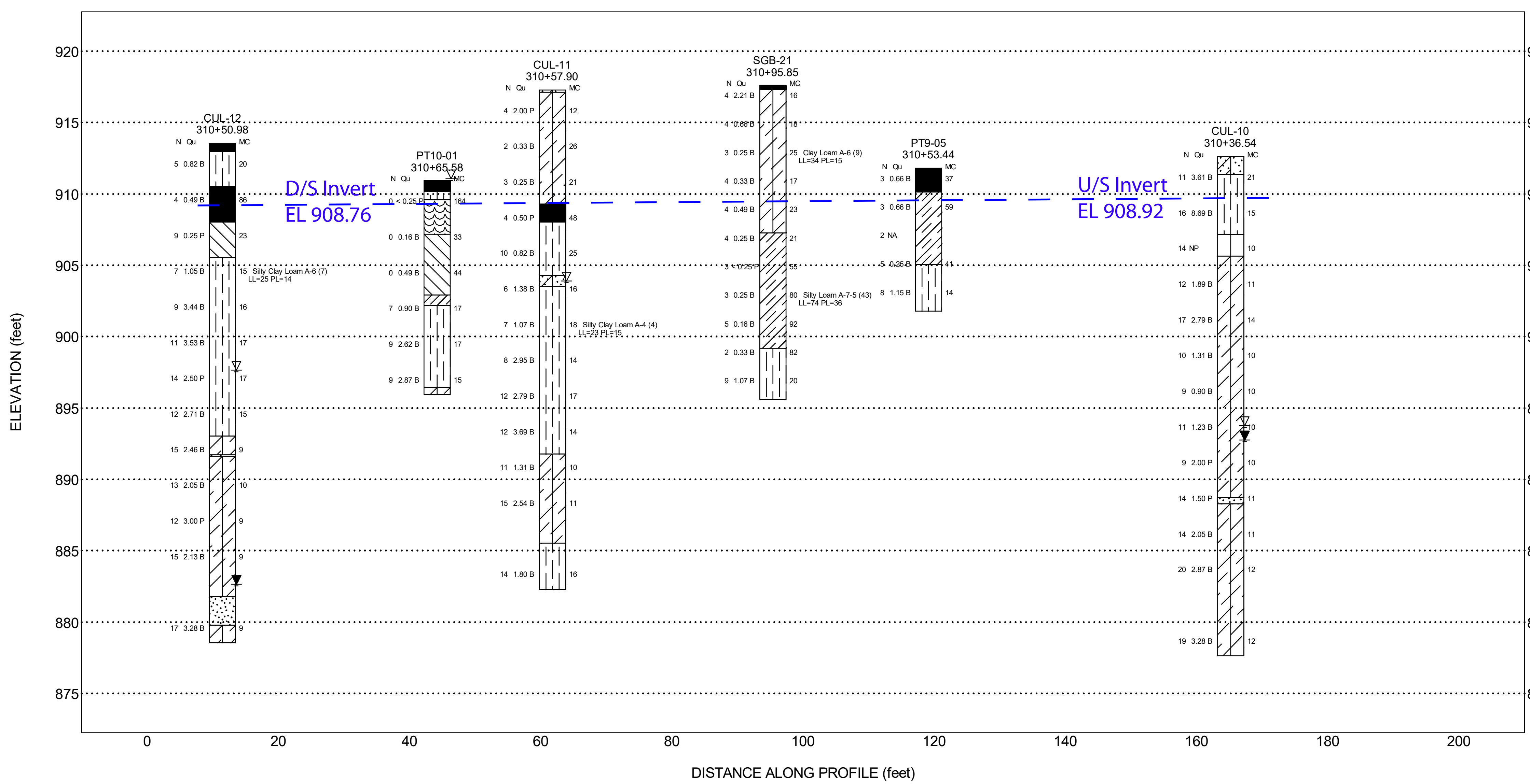
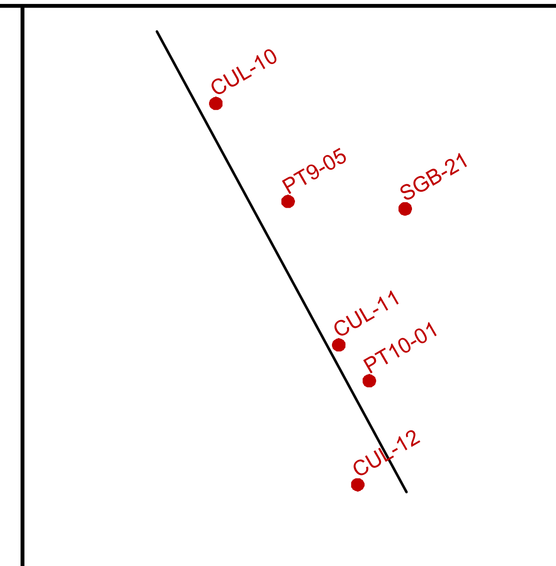
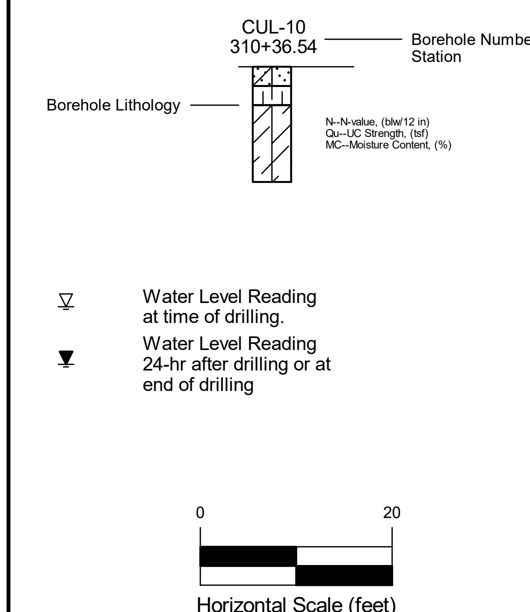
FOR STRAND ASSOCIATES, INC. 195-13-02





Site Map Scale 1 inch equals 75 feet

Explanation:



Vertical Exaggeration: 2x

Lithology Graphics

- IDH Loam
- IDH Silty Clay, Silty Clay Loam
- IDH Silt, Silty Loam
- IDH Clay Loam
- IDH Sand, Sandy Loam
- Topsoil
- IDH Clay
- USCS Peat
- USCS High Plasticity Organic silt or clay

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Soil Profile
IL 176 E over Unnamed Creek
SN 056-0110

WEI
SINCE 1982

IL 47 at IL 176 and Pleasant Valley
Road-Phase II Supplement
McHenry County, Illinois

JOB NUMBER	PLATE NUMBER
195-13-02	EXHIBIT 4

WEI 11X17 1951302.GPJ BEARING-TRIAL.GDT 8/27/20

APPENDIX A

Wang Engineering

LEGEND FOR BORING LOG

Relative Density of Non-Cohesive Soils	
N-Blows/ 12 inches	**Relative Density Term**
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80+	Very Dense

Consistency of Cohesive Soils	
Unconfined Compressive Strength Qu, tsf	**Consistency Term**
<0.25	Very Soft
0.25-0.49	Soft
0.50-0.99	Medium Stiff
1.00-1.99	Stiff
2.00-3.99	Very Stiff
>4.00	Hard

Relative Drilling Resistace	
RDR	**Drilling Resistance Term**
1	Very Easy
2	Easy
3	Moderate
4	Hard
5	Very Hard

Proportional Terms		
Trace	1-9	Percent of Dry Weight
Little	10-19	
Some	20-34	
And	35-50	

Gradation Terminology	
Boulders	>200mm
Cobbles	200mm to 75mm
Gravel	75mm to 2mm
Sand	2-0mm to 0.074mm
Silt	0.074mm to 0.002mm
Clay	<0.002mm

SS = Split Spoon

ST = Shelby Tube

SPT = Standard Penetration Test

Q_u = Unconfined Compressive Strength

P = Pocket Penetrometer

S = Shear failure of sample, Rimac test

B = Bulge failure of sample, Rimac test

SSA = Solid Stem Augers,

HSA = Hollow Stem Augers,

Sample Type Symbols

Split Spoon

No Recovery

Geoprobe

Rock Core

Shelby Tube

Auger Cuttings

Drill Rig:

TMR = Truck Mouted Rig

ATV = All Terrain Vehicle Rig

[--%] = SPT Hammer Efficiency

In-situ Vane Shear Test

SPT = Standard Penetration Test

N Value is the sum of the second and the third numbers

04/28/2017

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BORING LOG CUL-10

WEI Job No.: 195-13-02

Client: **Strand Associates, Inc.**
Project: **IL 47 at IL 176 and Pleasant Valley Road**
Location: **McHenry County, Illinois**

Datum: NAVD 88
Elevation: 912.63 ft
North: 2032368.21 ft
East: 960979.35 ft
Station: 310+36.54
Offset: 77.86 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
911.4	15-inch thick, medium dense, brown LOAM --TOPSOIL--					
	Very stiff to hard, brown SILTY CLAY, trace gravel; damp --RDR 2--		1	5 4 7	3.61 B	21
907.1		5	2	4 7 9	8.69 B	15
905.6	Brown SILTY LOAM, trace gravel; damp --RDR 2--		3	5 7 7	NP	10
	Medium stiff to very stiff, brown, gray to pinkish gray SILTY CLAY LOAM to CLAY LOAM, trace gravel; damp to wet --RDR 2-- --brown--	10	4	4 5 7	1.89 B	11
	--gray--		5	4 5 12	2.79 B	14
	--pinkish gray--	15	6	3 4 6	1.31 B	10
			7	4 4 5	0.90 B	10
	--sand lens; saturated--	20	8	4 4 7	1.23 B	10
			9	3 4 5	2.00 P	10
888.7						
888.3	Pinkish gray SANDY LOAM, little gravel; saturated					
	Very stiff, pinkish gray CLAY LOAM to SILTY CLAY LOAM, trace gravel; damp to moist --RDR 2--	25	10	5 6 8	1.50 P	11
			11	4 6 8	2.05 B	11
		30	12	6 8 12	2.87 B	12
877.6		35	13	6 8 11	3.28 B	12
	Boring terminated at 35.00 ft					
		40				

GENERAL NOTES

Begin Drilling: **07-09-2020** Complete Drilling: **07-09-2020**
Drilling Contractor: **Wang Testing Services** Drill Rig: **17D50A [87%]**
Driller: **K&J** Logger: **E. Yim** Checked by: **C. Marin**
Drilling Method: **3.25" ID HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **19.00 ft**
At Completion of Drilling: **20.00 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG CUL-11

WEI Job No.: 195-13-02

Client: **Strand Associates, Inc.**
Project: **IL 47 at IL 176 and Pleasant Valley Road**
Location: **McHenry County, Illinois**

Datum: NAVD 88
Elevation: 917.29 ft
North: 2032276.05 ft
East: 961026.28 ft
Station: 310+57.90
Offset: 23.31 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
917.1	2-inch thick, brown LOAM, little gravel; damp					
	Soft to very stiff, brown and gray CLAY LOAM, trace to some gravel; damp to wet --FILL-- --RDR 2--		1	2, 2, 2	2.00 P	12
		5	2	2, 1, 1	0.33 B	26
			3	1, 2, 1	0.25 B	21
909.3	Medium stiff, black SILTY CLAY LOAM; moist --BURIED TOPSOIL--					
908.0	Medium stiff, black to gray SILTY CLAY to SILTY CLAY LOAM; moist to wet --RDR 2--	10	4	2, 2, 2	0.50 P	48
			5	4, 5, 5	0.82 B	25
904.3	Gray LOAM; wet					
903.5	Stiff to very stiff, gray and brown SILTY CLAY LOAM, trace gravel; damp to wet --RDR 2--	15	6	3, 3, 3	1.38 B	16
	--L_L(%)=23, P_L(%)=15-- --%Gravel=3.9-- --%Sand=14.6-- --%Silt=57.9-- --%Clay=23.6--		7	2, 3, 4	1.07 B	18
		20	8	2, 3, 5	2.95 B	14
			9	4, 5, 7	2.79 B	17
		25	10	4, 5, 7	3.69 B	14
891.8	Stiff to very stiff, pinkish brown CLAY LOAM to SILTY CLAY LOAM, trace gravel; moist --RDR 2--		11	5, 5, 6	1.31 B	10
		30	12	5, 6, 9	2.54 B	11
885.5	Stiff,gray SILTY CLAY, trace gravel; damp --RDR 2--					
882.3		35	13	5, 6, 8	1.80 B	16
	Boring terminated at 35.00 ft	40				

GENERAL NOTES

Begin Drilling **06-24-2020** Complete Drilling **06-24-2020**
Drilling Contractor **Wang Testing Services** Drill Rig **17D50A [87%]**
Driller **K&J** Logger **E. Yim** Checked by **C. Marin**
Drilling Method **3.25" ID HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **13.50 ft**
At Completion of Drilling **DRY**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG CUL-12

WEI Job No.: 195-13-02

Client: **Strand Associates, Inc.**
Project: **IL 47 at IL 176 and Pleasant Valley Road**
Location: **McHenry County, Illinois**

Datum: NAVD 88
Elevation: 913.54 ft
North: 2032222.74 ft
East: 961033.48 ft
Station: 310+50.98
Offset: 76.66 RT

SOIL AND ROCK DESCRIPTION

Elevation (ft)	Soil and Rock Description
913.0	7-inch thick, black SILTY CLAY LOAM --TOPSOIL--
910.5	Medium stiff, brown and gray SILTY CLAY, trace gravel; moist --FILL-- --RDR 2--
908.0	Soft, black SILTY CLAY LOAM; wet --BURIED TOPSOIL-- --RDR 2--
905.5	Soft, gray CLAY to SILTY CLAY; wet --RDR 2--
893.0	Stiff to very stiff, gray, SILTY CLAY to SILTY CLAY LOAM, trace gravel; damp to moist --RDR 2 to 3-- --L_L(%)=25, P_L(%)=14-- --%Gravel=3.4-- --%Sand=15.1-- --%Silt=56.8-- --%Clay=24.7--
891.7	Very stiff, pinkish gray CLAY LOAM, trace gravel; damp --RDR 2--
891.6	Gray SANDY LOAM, little gravel; saturated
881.8	Very stiff, pinkish gray SILTY CLAY LOAM to CLAY LOAM, trace gravel; damp to moist --RDR 2--
879.8	Medium dense, pinkish gray, medium to coarse, SAND, trace gravel; saturated --RDR 2--
878.5	Very stiff, pinkish gray CLAY LOAM, trace gravel; damp to moist --RDR 2--

Boring terminated at 35.00 ft

Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
1	3, 2, 3	0.82 B	20
2	2, 2, 2	0.49 B	86
3	0, 4, 5	0.25 P	23
4	3, 3, 4	1.05 B	15
5	3, 4, 5	3.44 B	16
6	3, 5, 6	3.53 B	17
7	6, 7, 7	2.50 P	17
8	3, 5, 7	2.71 B	15
9	6, 8, 7	2.46 B	9
10	4, 5, 8	2.05 B	10
11	6, 5, 7	3.00 P	9
12	5, 6, 9	2.13 B	9
13	5, 7, 10	3.28 B	9

GENERAL NOTES

Begin Drilling **07-13-2020** Complete Drilling **07-13-2020**
Drilling Contractor **Wang Testing Services** Drill Rig **17D50A [87%]**
Driller **K&J** Logger **E. Yim** Checked by **C. Marin**
Drilling Method **3.25" ID HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **16.00 ft**
At Completion of Drilling ▼ **31.00 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG PT10-01

WEI Job No.: 195-13-02

Client: **Strand Associates, Inc.**
Project: **IL 47 at IL 176 and Pleasant Valley Road**
Location: **McHenry County, Illinois**

Datum: NAVD 88
Elevation: 910.93 ft
North: 2032262.37 ft
East: 961037.93 ft
Station: 310+65.58
Offset: 39.55 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
910.2	9-inch thick, black SILTY CLAY LOAM, some organic matter; wet --TOPSOIL--						
909.6	Medium stiff (0.5P), gray SILTY CLAY; wet --RDR 1--			1	0 0 0	< 0.25 P	164
	Very soft, black PEAT; wet --RDR 1--						
907.2	Very soft to soft, black to gray CLAY to SILTY CLAY, trace organic matter; wet --RDR 1--	5		2	0 0 0	0.16 B	33
				3	0 0 0	0.49 B	44
902.9	Very soft, brown Organic SILTY CLAY; wet --RDR 1--						
902.2	Medium stiff to very stiff, gray SILTY CLAY, trace gravel; damp to moist --RDR 2--	10		4	0 3 4	0.90 B	17
				5	3 4 5	2.62 B	17
				6	3 4 5	2.87 B	15
896.4	Medium stiff, pinkish gray CLAY LOAM, trace gravel; moist --RDR 2--	15					
895.9	Boring terminated at 15.00 ft						
		20					

GENERAL NOTES

Begin Drilling **07-10-2020** Complete Drilling **07-10-2020**
Drilling Contractor **Wang Testing Services** Drill Rig **17D50A [87%]**
Driller **K&J** Logger **E. Yim** Checked by **C. Marin**
Drilling Method **3.25" ID HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **0.00 ft**
At Completion of Drilling **DRY**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG PT9-05

WEI Job No.: 195-13-02

Client: **Strand Associates, Inc.**
Project: **IL 47 at IL 176 and Pleasant Valley Road**
Location: **McHenry County, Illinois**

Datum: NAVD 88
Elevation: 911.80 ft
North: 2032330.80 ft
East: 961006.90 ft
Station: 310+53.44
Offset: 34.57 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	20-inch thick, medium stiff, brown to black SILTY CLAY LOAM --TOPSOIL--		1	1, 1, 2, 2	0.66 B	37
910.1	Soft to medium stiff, black and dark gray CLAY to SILTY CLAY, little to some organic matter; damp --RDR 1--		2	2, 1, 2, 1	0.66 B	59
		5	3	1, 1, 1, 1	NA	
905.1	Stiff, gray SILTY CLAY LOAM, trace gravel; damp --RDR 2--		4	1, 2, 3, 5	0.25 B	41
			5	3, 3, 5, 8	1.15 B	14
901.8	Boring terminated at 10.00 ft	10				
		15				
		20				

GENERAL NOTES

Begin Drilling **12-19-2017** Complete Drilling **12-19-2017**
Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**
Driller **N&J** Logger **T. Rothschild** Checked by **C. Marin**
Drilling Method **2.25 IDA HSA; 140 lb autohammer; Boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **DRY**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG SGB-21

WEI Job No.: 195-13-02

Client: **Strand Associates, Inc.**
Project: **IL 47 at IL 176 and Pleasant Valley Road**
Location: **McHenry County, Illinois**

Datum: NAVD 88
Elevation: 917.60 ft
North: 2032328.01 ft
East: 961051.60 ft
Station: 310+95.85
Offset: 20.27 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
917.4	3-inch thick, dark brown SILTY CLAY LOAM; damp --TOPSOIL--					
	Soft to very stiff, brown to gray CLAY LOAM, trace gravel; moist --FILL-- --RDR 1--		1	3 2 2 3	2.21 B	16
			2	2 1 3 3	0.66 B	18
	--L_L(%)=34, P_L(%)=15-- --%Gravel=5.0-- --%Sand=33.6-- --%Silt=40.1-- --%Clay=21.2-- --A-6 (9)--	5	3	2 1 2 2	0.25 B	25
			4	3 2 2 3	0.33 B	17
		10	5	2 2 2 2	0.49 B	23
907.3	Very soft to soft, dark brown to gray ORGANIC SILTY LOAM; moist --RDR 1--		6	2 2 2 2	0.25 B	21
			7	1 1 2 1	< 0.25 P	55
	--L_L(%)=74, P_L(%)=36-- --%Gravel=0.2-- --%Sand=7.4-- --%Silt=78.5-- --%Clay=13.9-- --A-7-5 (43)-- --organic content= 16.4%--	15	8	1 2 1 2	0.25 B	80
			9	2 2 3 3	0.16 B	92
899.2	Stiff, gray SILTY CLAY LOAM, trace gravel; moist --RDR 2--	20	10	1 1 1 3	0.33 B	82
			11	2 4 5 5	1.07 B	20
895.6	Boring terminated at 22.00 ft	25, 30, 35, 40				

GENERAL NOTES

Begin Drilling **10-18-2017** Complete Drilling **10-18-2017**
Drilling Contractor **Wang Testing Services** Drill Rig **D25 ATV [93%]**
Driller **R&K** Logger **T. Rothschild** Checked by **C. Marin**
Drilling Method **2.25 IDA HSA; 140 lb autohammer; Boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **DRY**
Time After Drilling **NA**
Depth to Water **NA**

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BORING LOG SGB-21ST

WEI Job No.: 195-13-02

Client: **Strand Associates, Inc.**
Project: **IL 47 at IL 176 and Pleasant Valley Road**
Location: **McHenry County, Illinois**

Datum: NAVD 88
Elevation: 917.60 ft
North: 2032326.88 ft
East: 961050.67 ft
Station: 310+94.67
Offset: 19.43 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
917.1	6-inch thick, black SILTY CLAY LOAM --TOPSOIL--					
	Medium stiff, brown SILTY CLAY, trace gravel; moist --RDR 2--	5	1	PUSH	0.50 P	27
912.1	Very soft to soft, brown SILTY CLAY LOAM to CLAY LOAM, trace gravel; damp --RDR 2-- --Laboratory Q_u=0.71 tsf (B), w_n(%)=23-- --L_L(%)=24, P_L(%)=13-- --%Gravel=3.2-- --%Sand=30.5-- --%Silt=46.3-- --%Clay=20.0-- --A-6 (4)--	10	2	PUSH	< 0.25 P	18
905.3	Very soft to soft, black and dark brown ORGANIC SILTY LOAM; moist --organic content= 20.9%--		3	PUSH	< 0.25 P	92
	--RDR 1-- --organic content= 15.0%-- --Laboratory Q_u=0.33 tsf (B), w_n(%)=73-- --C_c=1.038, OCR=1.16-- --L_L(%)=72, P_L(%)=40-- --%Gravel=0.0-- --%Sand=5.0-- --%Silt=75.8-- --%Clay=19.2-- --A-7-5 (39)-- --organic content= 14.5%--	15	4	PUSH	< 0.25 P	81
901.6	Boring terminated at 16.00 ft	20				

GENERAL NOTES

Begin Drilling **12-20-2017** Complete Drilling **12-20-2017**
Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**
Driller **N&J** Logger **T. Rothschild** Checked by **C. Marin**
Drilling Method **3.25 IDA HSA; 140 lb autohammer; Boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **DRY**
At Completion of Drilling **DRY**
Time After Drilling **NA**
Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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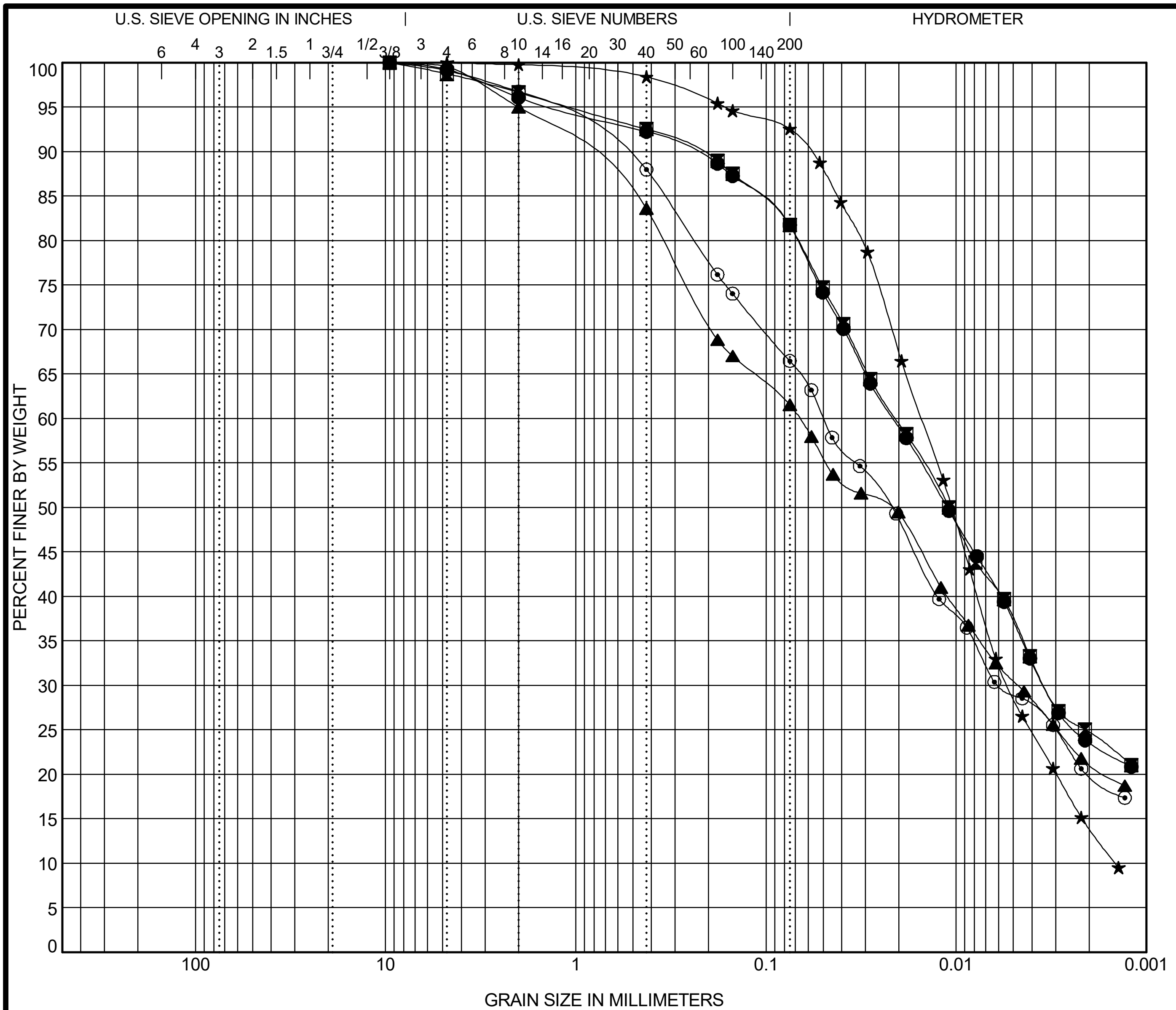
APPENDIX B



COBBLES	GRAVEL	SAND coarse	SAND fine	SILT AND CLAY

	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	CUL-11#7	16.0 ft	**Silty Clay Loam**	23	15	8		
⧗	CUL-12#4	8.5 ft	**Silty Clay Loam**	25	14	11		
▲	SGB-21#3	4.0 ft	**Clay Loam**	34	15	19		
★	SGB-21#8	14.0 ft	**Silty Loam**	74	36	38	1.29	10.44
⊙	SGB-21ST#2	6.0 ft	**Clay Loam**	24	13	11		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	CUL-11#7	16.0 ft	9.5	0.021	0.003		3.9	14.6	57.9	23.6
⧗	CUL-12#4	8.5 ft	9.5	0.021	0.003		3.4	15.1	56.8	24.7
▲	SGB-21#3	4.0 ft	9.5	0.067	0.005		5.0	33.6	40.1	21.2
★	SGB-21#8	14.0 ft	4.75	0.015	0.005	0.001	0.2	7.3	78.5	14.0
⊙	SGB-21ST#2	6.0 ft	9.5	0.05	0.006		3.2	30.5	46.3	20.0

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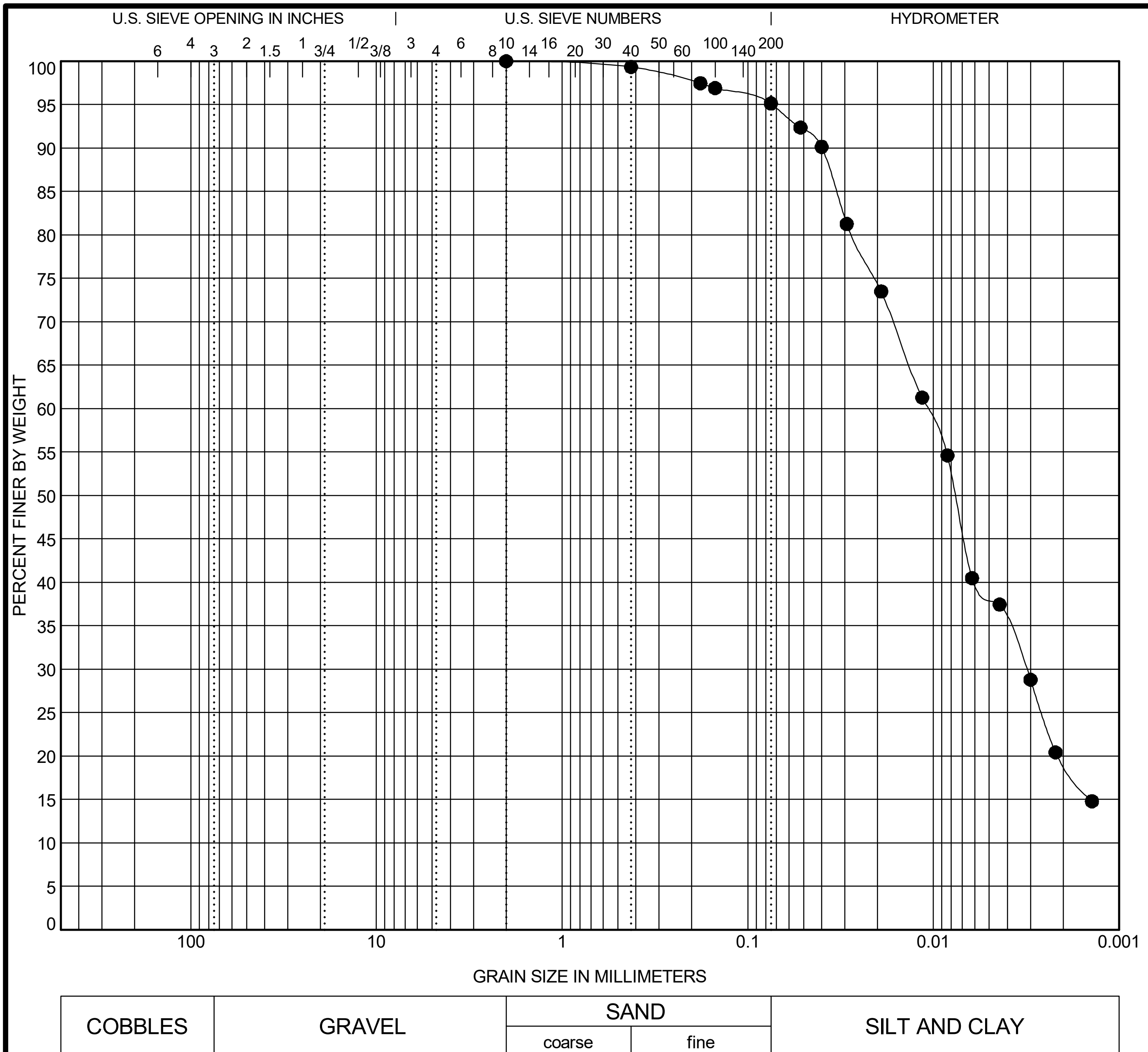
Fax: 6309539938

GRAIN SIZE DISTRIBUTION

Project: IL 47 at IL 176 and Pleasant Valley Road

Location: McHenry County, Illinois

Number: 195-13-02



	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	**SGB-21ST#4**	**14.0 ft**	**Silty Loam**	**72**	**40**	**32**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**SGB-21ST#4**	**14.0 ft**	**2**	**0.011**	**0.003**		**0.0**	**5.0**	**75.8**	**19.2**

WEI GRAIN SIZE IDH 1951302.GPJ US LAB.GDT 9/15/20

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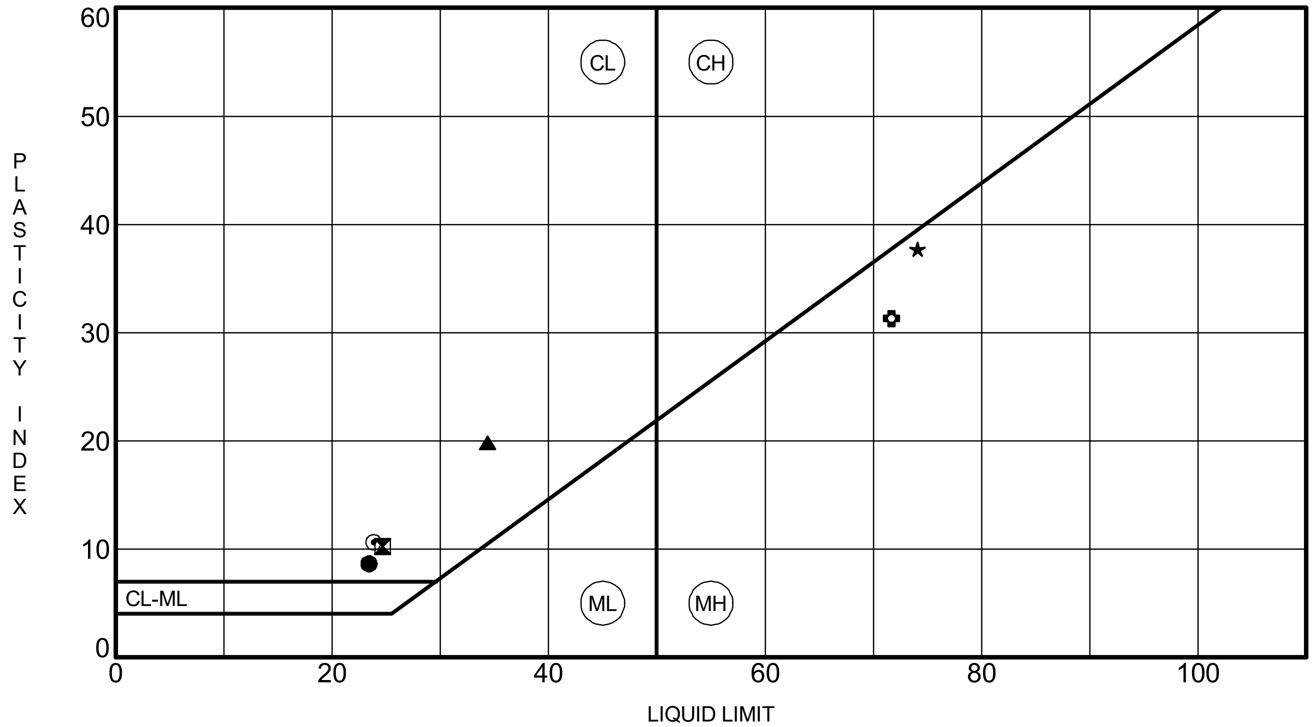
GRAIN SIZE DISTRIBUTION

Project: IL 47 at IL 176 and Pleasant Valley Road

Location: McHenry County, Illinois

Number: 195-13-02



	Specimen Identification		LL	PL	PI	Fines	IDH Classification
●	**CUL-11#7**	**16.0 ft**	**23**	**15**	**8**	**82**	**Silty Clay Loam**
⧗	**CUL-12#4**	**8.5 ft**	**25**	**14**	**11**	**82**	**Silty Clay Loam**
▲	**SGB-21#3**	**4.0 ft**	**34**	**15**	**19**	**62**	**Clay Loam**
★	**SGB-21#8**	**14.0 ft**	**74**	**36**	**38**	**93**	**Silty Loam**
⊙	**SGB-21ST#2**	**6.0 ft**	**24**	**13**	**11**	**66**	**Clay Loam**
✿	**SGB-21ST#4**	**14.0 ft**	**72**	**40**	**32**	**95**	**Silty Loam**

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ATTERBERG LIMITS' RESULTS

Project: IL 47 at IL 176 and Pleasant Valley Road

Location: McHenry County, Illinois

Number: 195-13-02

Organic Content - Loss On Ignition
ASTM D 2974, Method C

AASHTO R18

Client: *Strand*
Project: *IL 47*
WEI Job: *195-13-01*
Type/Condition: *SS*
Testing Furnace Temp °C.: *440*

Analyst: *A. Mohammed*
Date Received: *12/20/2017*
Date Tested: *12/26/17*

Sample No./ Depth	SGB-21ST s#3(12-14ft.) middle	SGB-21ST s#3(12-14ft.) bottom	SGB-21ST s#4(14-16ft.)		
Description	Silt	Silty Loam	Silty Loam		
wet soil + tare	76.36	72.05	102.99		
Dry Soil + Tare	58.17	55.36	75.5		
Tare Mass	41.97	36.45	43.38		
w (%)	112	88	86		
Dry Soil + Tare	58.17	55.36	75.5		
Ash+ Tare	54.79	52.52	70.84		
Tare Mass	41.97	36.45	43.38		
Ash Content (%)	79	85	85		
Organic Content (%)	20.9	15.0	14.5		

Prepared by: [signature] Date: 1.16.18

Checked by: [signature] Date: 2/8/18

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ONE-DIMENSIONAL CONSOLIDATION TEST

AASHTO T 216 / ASTM D 2435

Project: Illinois Route 47
Client: Strand Associates, Inc.
Soil Sample ID: Boring SGB-21ST, ST#4, 14 to 16 feet
Sample Description: Gray ORGANIC SI LOAM

Tested by: M. Snider
Prepared by: M. Snider
Test date: 12/21/2017
WEI: 195-13-01

Initial sample height =	0.993 in
Initial sample mass =	113.25 g
Initial water content =	84.78%
Initial dry unit weight =	47.99 pcf
Initial void ratio =	2.251
Initial degree of saturation =	94.16%
Final sample mass =	88.40 g
Final dry sample mass =	61.29 g
Final water content =	44.23%
Final dry unit weight =	77.11 pcf
Final void ratio =	1.023
Final degree of saturation =	100.00%
Estimated specific gravity =	2.50

Ring diameter =	2.498 in
Ring mass =	109.82 g
Initial sample and ring mass =	223.07 g
Tare mass =	79.30 g
Final ring and sample mass =	198.36 g
Mass of wet sample and tare =	167.70 g
Mass of dry sample and tare =	140.59 g
Initial dial reading =	0.01000 in
Final dial reading =	0.38505 in
LL =	72 %
PL =	40 %
% Sand =	5.0
% Silt =	75.8
% Clay =	19.2
In-Situ Vertical Effective Stress =	1200 psf

Compression and Swelling Indices

Compression index C_c =	0.852
Field corrected C_c =	1.038
Swelling index C_s =	0.146

Preconsolidation pressure,s_C

Casagrande Method =	1391 psf
Over-Consolidation Ratio (OCR) =	1.16

Load number	Vertical stress psf	Dial reading in	System deflection in	Vertical strain %	Void ratio	C_v ft^2/day	Cae %	Elapsed time min
1	50.0	0.01026	0.00005	0.03	2.250	N/A	N/A	1440
2	100.0	0.01430	0.00010	0.44	2.236	0.4465	0.08	1440
3	200.0	0.01912	0.00023	0.94	2.220	0.0053	0.25	1440
4	500.0	0.04574	0.00058	3.66	2.132	0.1472	0.47	720
5	1000.0	0.09096	0.00090	8.24	1.983	0.1170	0.89	1440
6	2000.0	0.14749	0.00135	13.98	1.796	0.0913	1.58	1440
7	4000.0	0.22828	0.00193	22.18	1.530	0.0425	2.34	720
8	8000.0	0.30293	0.00253	29.75	1.284	0.0350	2.57	1440
9	16000.0	0.37205	0.00324	36.79	1.055	0.0314	1.83	720
10	32000.0	0.43400	0.00413	43.11	0.849	0.0226	2.13	720
11	8000.0	0.43807	0.00295	43.41	0.840	N/A	N/A	1440
12	2000.0	0.41801	0.00198	41.29	0.909	N/A	N/A	1440
13	500.0	0.38608	0.00123	38.00	1.016	N/A	N/A	1440

Prepared by: *A.L.* Date: *1/24/18*

Checked by: *AL* Date: *1/31/18*

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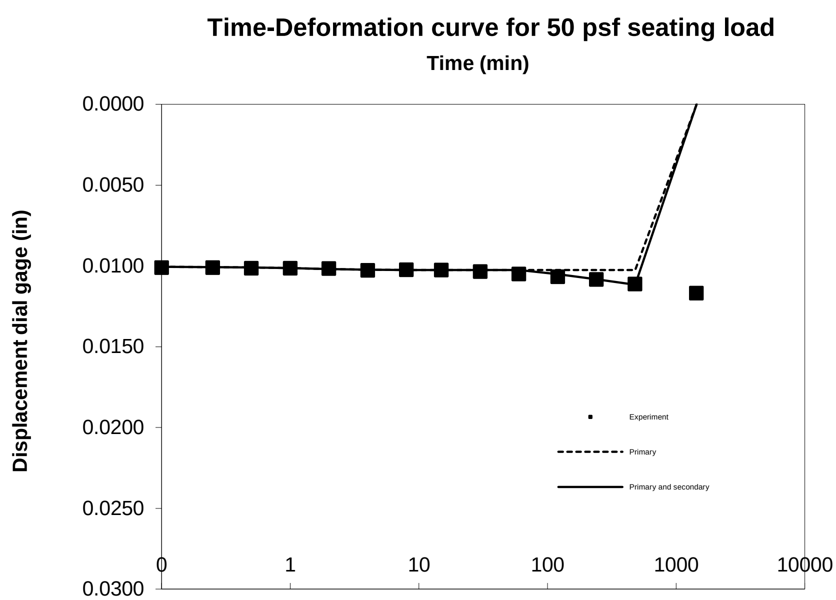
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
50.0	*0.00*	0.01000	0.01000	0.01000
	0.10	0.01012	0.01005	0.01005
	0.25	0.01012	0.01007	0.01007
	0.50	0.01016	0.01010	0.01010
	1.00	0.01016	0.01014	0.01014
	2.00	0.01017	0.01019	0.01019
	4.00	0.01029	0.01024	0.01024
	8.00	0.01026	0.01026	0.01026
	15.00	0.01027	0.01026	0.01026
	30.00	0.01036	0.01026	0.01026
	60.00	0.01052	0.01026	0.01026
	120.00	0.01068	0.01026	0.01051
	240.00	0.01086	0.01026	0.01084
	480.00	0.01113	0.01026	0.01116
	1440.00	0.01169	#NUM!	#NUM!

h_0 =	0.99300	in
U_s =	99%	
t_s =	8.19	min
d_s =	0.01026	in
d_0 =	0.01000	in
d_{100} =	0.01026	in
d =	0.49643	in
C_v =	0.0536	in^2/min
r_i =	0.3%	
r_p =	15.3%	
r_s =	84.4%	
Slope =	0.0011	
Intercept =	0.0083	
h_c =	0.9927	in
t_c =	70.73	min
C_{ae} =	0.109%	



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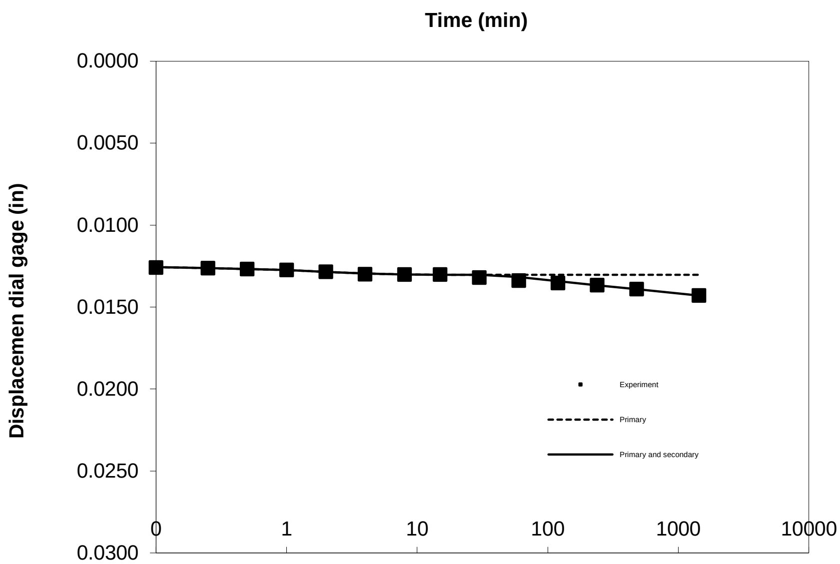
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
100.0	*0.00*	0.01242	0.01249	0.01249
	0.10	0.01259	0.01257	0.01257
	0.25	0.01263	0.01262	0.01262
	0.50	0.01269	0.01267	0.01267
	1.00	0.01275	0.01275	0.01275
	2.00	0.01285	0.01285	0.01285
	4.00	0.01301	0.01295	0.01295
	8.00	0.01302	0.01301	0.01301
	15.00	0.01301	0.01303	0.01303
	30.00	0.01321	0.01303	0.01303
	60.00	0.01340	0.01303	0.01318
	120.00	0.01355	0.01303	0.01342
	240.00	0.01367	0.01303	0.01367
	480.00	0.01391	0.01303	0.01391
	1440.00	0.01430	0.01303	0.01430

h_0 = 0.99058 in
U_s = 99%
t_s = 9.78 min
d_s = 0.01302 in
d_0 = 0.01249 in
d_{100} = 0.01303 in
d = 0.49512 in
C_v = 0.0446 in^2/min
r_i = 3.6%
r_p = 28.5%
r_s = 67.8%
Slope = 0.0008
Intercept = 0.0117
h_c = 0.9900 in
t_c = 39.21 min
C_{ae} = 0.082%

Time-Deformation curve for 100 psf load



s:\netprojects\1951301\lab data\consolidation\set 2\ch12\lws_wang_mls_19513010_sgb21st_20180111.xls

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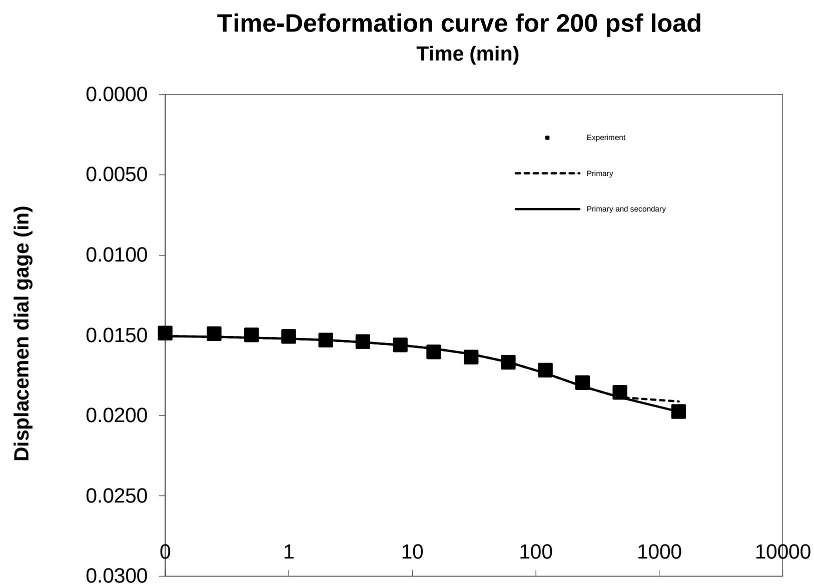
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
200.0	*0.00*	0.01448	0.01499	0.01499
	0.10	0.01488	0.01506	0.01506
	0.25	0.01492	0.01510	0.01510
	0.50	0.01499	0.01514	0.01514
	1.00	0.01508	0.01520	0.01520
	2.00	0.01530	0.01529	0.01529
	4.00	0.01541	0.01542	0.01542
	8.00	0.01561	0.01560	0.01560
	15.00	0.01605	0.01583	0.01583
	30.00	0.01638	0.01617	0.01617
	60.00	0.01670	0.01667	0.01667
	120.00	0.01719	0.01736	0.01736
	240.00	0.01796	0.01819	0.01819
	480.00	0.01858	0.01886	0.01886
	1440.00	0.01976	0.01911	0.01975

h_0 =	0.98852	in
U_s =	99%	
t_s =	823.73	min
d_s =	0.01908	in
d_0 =	0.01499	in
d_{100} =	0.01912	in
d =	0.49297	in
C_v =	0.0005	in^2/min
r_i =	9.6%	
r_p =	78.3%	
r_s =	12.1%	
Slope =	0.0025	
Intercept =	0.0119	
h_c =	0.9839	in
t_c =	794.29	min
C_{ae} =	0.252%	



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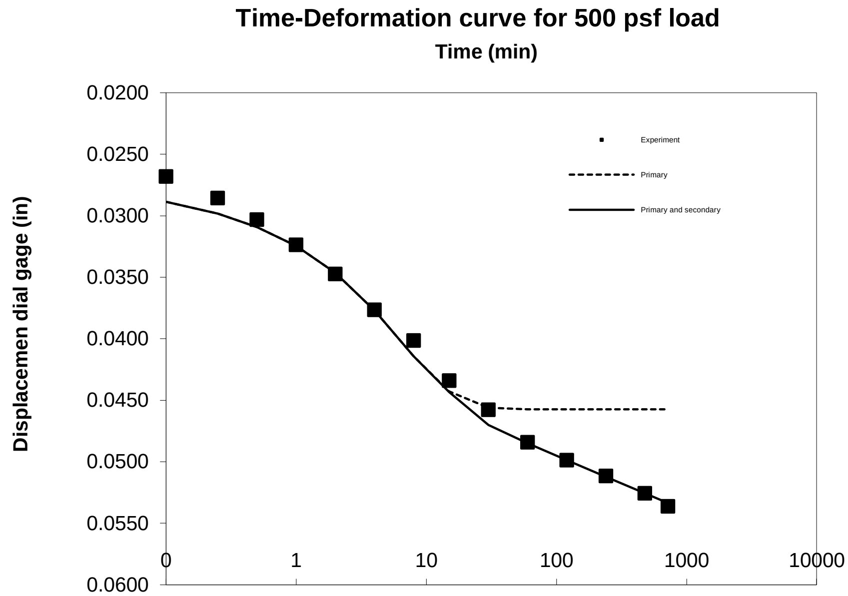
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
500.0	*0.00*	0.02065	0.02720	0.02720
	0.10	0.02681	0.02886	0.02886
	0.25	0.02858	0.02982	0.02982
	0.50	0.03032	0.03091	0.03091
	1.00	0.03238	0.03245	0.03245
	2.00	0.03475	0.03463	0.03463
	4.00	0.03765	0.03770	0.03770
	8.00	0.04015	0.04141	0.04141
	15.00	0.04342	0.04428	0.04434
	30.00	0.04579	0.04560	0.04701
	60.00	0.04842	0.04574	0.04850
	120.00	0.04988	0.04574	0.04986
	240.00	0.05116	0.04574	0.05121
	480.00	0.05258	0.04574	0.05256
	720.00	0.05364	0.04574	0.05335

h_0 =	0.98235	in
U_s =	99%	
t_s =	28.27	min
d_s =	0.04556	in
d_0 =	0.02720	in
d_{100} =	0.04574	in
d =	0.48327	in
C_v =	0.0147	in^2/min
r_i =	19.8%	
r_p =	56.2%	
r_s =	23.9%	
Slope =	0.0045	
Intercept =	0.0405	
h_c =	0.9573	in
t_c =	14.54	min
C_{ae} =	0.469%	



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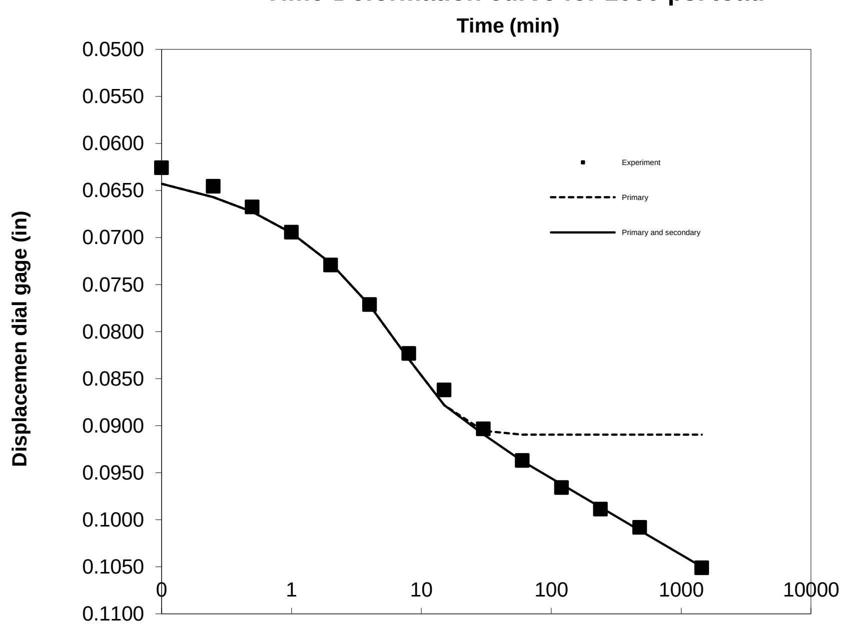
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
1000.0	*0.00*	0.05756	0.06187	0.06187
	0.10	0.06257	0.06429	0.06429
	0.25	0.06454	0.06570	0.06570
	0.50	0.06674	0.06729	0.06729
	1.00	0.06941	0.06953	0.06953
	2.00	0.07292	0.07271	0.07271
	4.00	0.07711	0.07720	0.07720
	8.00	0.08230	0.08292	0.08292
	15.00	0.08619	0.08782	0.08782
	30.00	0.09031	0.09054	0.09090
	60.00	0.09369	0.09095	0.09376
	120.00	0.09656	0.09096	0.09621
	240.00	0.09884	0.09096	0.09866
	480.00	0.10080	0.09096	0.10110
	1440.00	0.10510	0.09096	0.10498

h_0 =	0.94544	in
U_s =	99%	
t_s =	32.67	min
d_s =	0.09067	in
d_0 =	0.06187	in
d_{100} =	0.09096	in
d =	0.46329	in
C_v =	0.0117	in^2/min
r_i =	9.1%	
r_p =	61.2%	
r_s =	29.7%	
Slope =	0.0081	
Intercept =	0.0793	
h_c =	0.9120	in
t_c =	27.08	min
C_{ae} =	0.891%	

Time-Deformation curve for 1000 psf load



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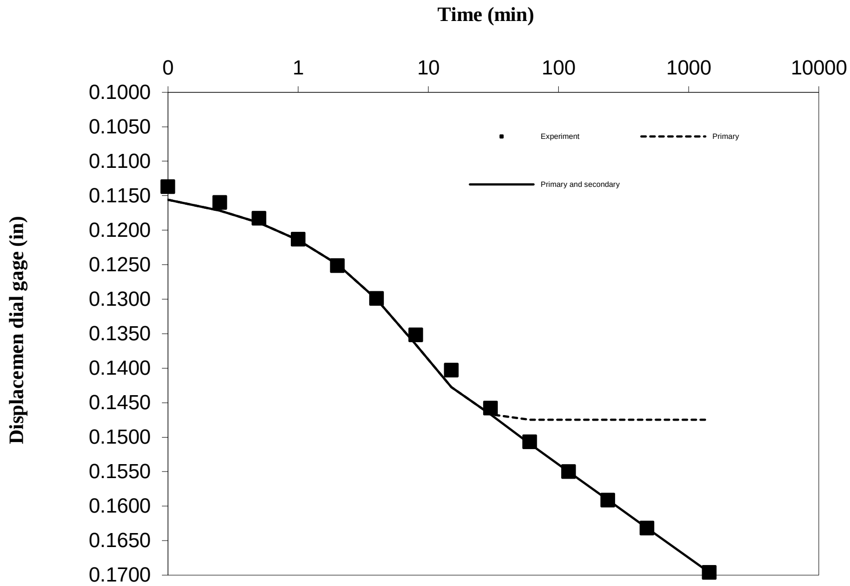
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
2000.0	*0.00*	0.10943	0.11287	0.11287
	0.10	0.11372	0.11558	0.11558
	0.25	0.11599	0.11715	0.11715
	0.50	0.11826	0.11892	0.11892
	1.00	0.12132	0.12143	0.12143
	2.00	0.12516	0.12497	0.12497
	4.00	0.12990	0.12998	0.12998
	8.00	0.13520	0.13660	0.13660
	15.00	0.14028	0.14274	0.14274
	30.00	0.14582	0.14669	0.14669
	60.00	0.15070	0.14747	0.15095
	120.00	0.15501	0.14749	0.15504
	240.00	0.15913	0.14749	0.15910
	480.00	0.16318	0.14749	0.16317
	1440.00	0.16960	0.14749	0.16961

h_0 = 0.89357 in
U_s = 99%
t_s = 37.13 min
d_s = 0.14714 in
d_0 = 0.11287 in
d_{100} = 0.14749 in
d = 0.43641 in
C_v = 0.0091 in^2/min
r_i = 5.7%
r_p = 57.5%
r_s = 36.7%
Slope = 0.0135
Intercept = 0.1269
h_c = 0.8555 in
t_c = 33.16 min
C_{ae} = 1.579%

Time-Deformation curve for 2000 psf load



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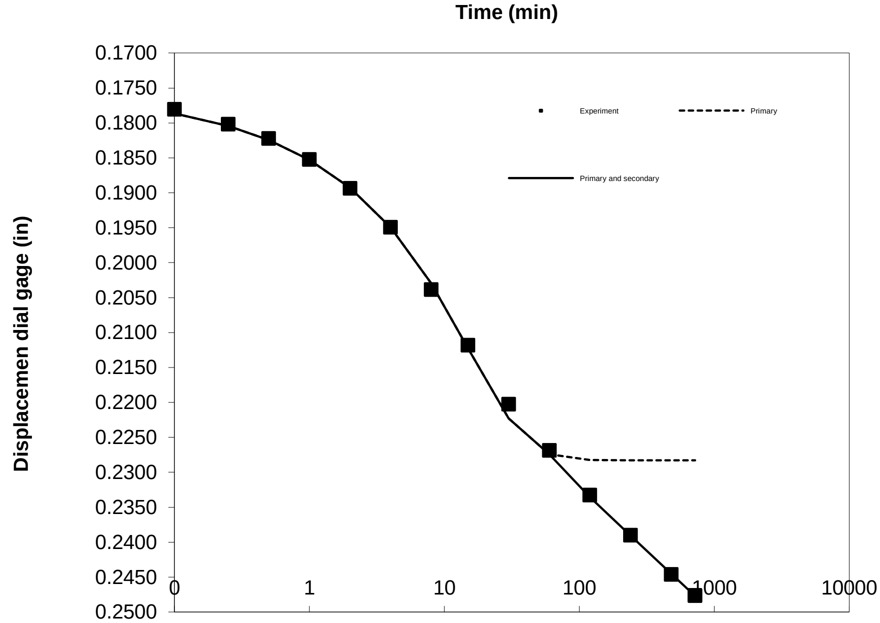
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
4000.0	0.00	0.17460	0.17560	0.17560
	0.10	0.17806	0.17866	0.17866
	0.25	0.18016	0.18044	0.18044
	0.50	0.18223	0.18245	0.18245
	1.00	0.18524	0.18528	0.18528
	2.00	0.18936	0.18929	0.18929
	4.00	0.19493	0.19496	0.19496
	8.00	0.20384	0.20297	0.20297
	15.00	0.21181	0.21227	0.21227
	30.00	0.22024	0.22227	0.22227
	60.00	0.22685	0.22743	0.22743
	120.00	0.23324	0.22826	0.23356
	240.00	0.23899	0.22828	0.23903
	480.00	0.24460	0.22828	0.24449
	720.00	0.24762	0.22828	0.24769

h_0 =	0.82840	in
U_s =	99%	
t_s =	67.20	min
d_s =	0.22775	in
d_0 =	0.17560	in
d_{100} =	0.22828	in
d =	0.40053	in
C_v =	0.0043	in^2/min
r_i =	1.4%	
r_p =	72.1%	
r_s =	26.5%	
Slope =	0.0181	
Intercept =	0.1959	
h_c =	0.7747	in
t_c =	61.27	min
C_{ae} =	2.341%	

Time-Deformation curve for 4000 psf load



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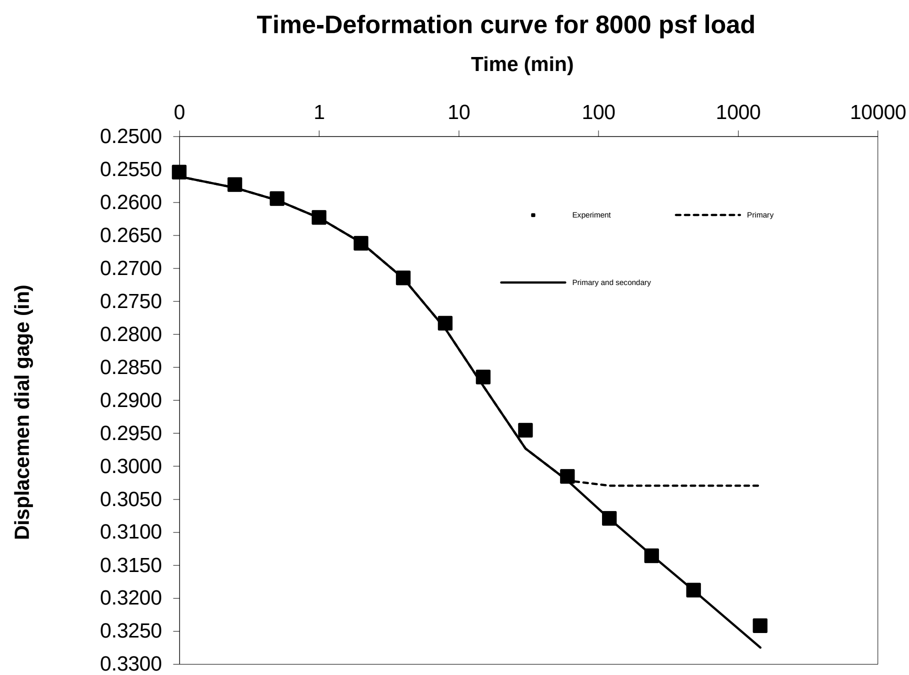
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
8000.0	0.00	0.25171	0.25316	0.25316
	0.10	0.25543	0.25606	0.25606
	0.25	0.25733	0.25775	0.25775
	0.50	0.25942	0.25964	0.25964
	1.00	0.26229	0.26233	0.26233
	2.00	0.26619	0.26613	0.26613
	4.00	0.27147	0.27150	0.27150
	8.00	0.27833	0.27909	0.27909
	15.00	0.28650	0.28788	0.28788
	30.00	0.29458	0.29732	0.29732
	60.00	0.30158	0.30215	0.30215
	120.00	0.30794	0.30292	0.30801
	240.00	0.31360	0.30293	0.31345
	480.00	0.31879	0.30293	0.31887
	1440.00	0.32419	0.30293	0.32747

h_0 =	0.75129	in
U_s =	99%	
t_s =	66.85	min
d_s =	0.30244	in
d_0 =	0.25316	in
d_{100} =	0.30293	in
d =	0.36248	in
C_v =	0.0035	in^2/min
r_i =	2.0%	
r_p =	68.7%	
r_s =	29.3%	
Slope =	0.0180	
Intercept =	0.2706	
h_c =	0.7001	in
t_c =	62.64	min
C_{ae} =	2.574%	



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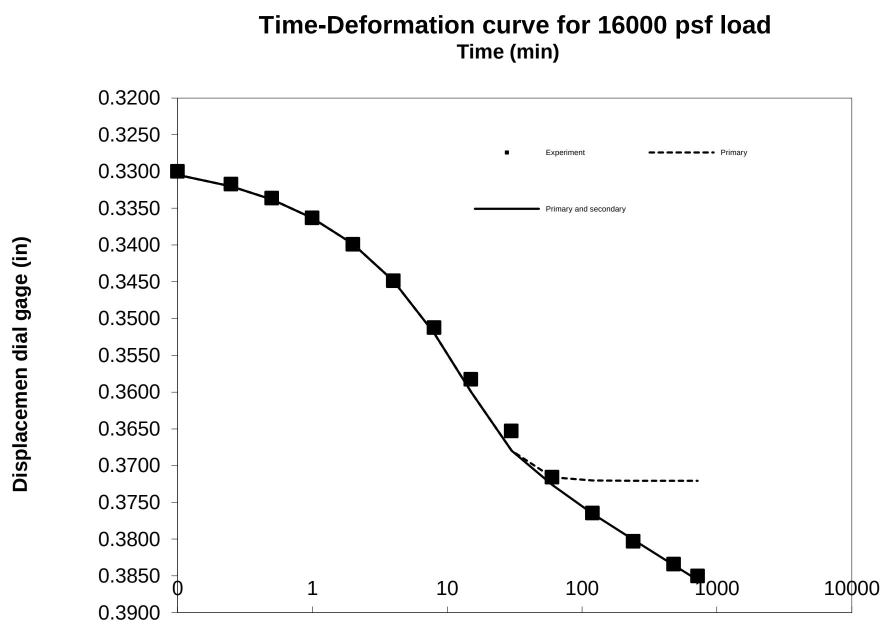
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
16000.0	*0.00*	0.32634	0.32774	0.32774
	0.10	0.32999	0.33046	0.33046
	0.25	0.33174	0.33203	0.33203
	0.50	0.33364	0.33381	0.33381
	1.00	0.33629	0.33632	0.33632
	2.00	0.33992	0.33987	0.33987
	4.00	0.34488	0.34490	0.34490
	8.00	0.35122	0.35201	0.35201
	15.00	0.35825	0.35997	0.35997
	30.00	0.36531	0.36799	0.36799
	60.00	0.37156	0.37159	0.37262
	120.00	0.37644	0.37204	0.37656
	240.00	0.38032	0.37205	0.38005
	480.00	0.38340	0.37205	0.38354
	720.00	0.38502	0.37205	0.38557

h_0 = 0.67666 in
U_s = 99%
t_s = 60.49 min
d_s = 0.37161 in
d_0 = 0.32774 in
d_{100} = 0.37205 in
d = 0.32655 in
C_v = 0.0031 in^2/min
r_i = 2.4%
r_p = 75.5%
r_s = 22.1%
Slope = 0.0116
Intercept = 0.3525
h_c = 0.6310 in
t_c = 48.83 min
C_{ae} = 1.834%



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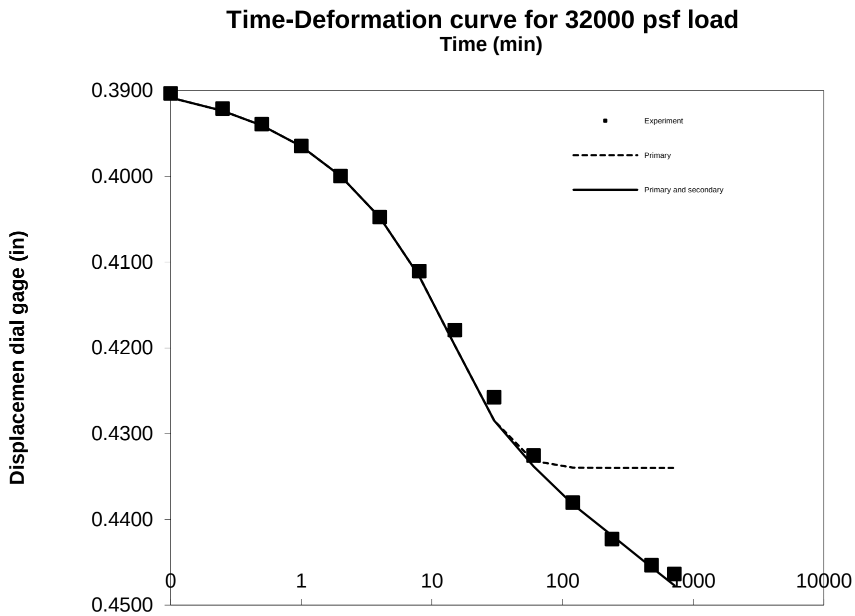
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
32000.0	*0.00*	0.38644	0.38820	0.38820
	0.10	0.39035	0.39082	0.39082
	0.25	0.39210	0.39235	0.39235
	0.50	0.39393	0.39407	0.39407
	1.00	0.39646	0.39650	0.39650
	2.00	0.39999	0.39994	0.39994
	4.00	0.40478	0.40480	0.40480
	8.00	0.41106	0.41168	0.41168
	15.00	0.41794	0.41971	0.41971
	30.00	0.42577	0.42850	0.42850
	60.00	0.43257	0.43318	0.43381
	120.00	0.43808	0.43398	0.43826
	240.00	0.44233	0.43400	0.44193
	480.00	0.44539	0.43400	0.44559
	720.00	0.44639	0.43400	0.44773

h_0 =	0.61656	in
U_s =	99%	
t_s =	69.01	min
d_s =	0.43354	in
d_0 =	0.38820	in
d_{100} =	0.43400	in
d =	0.29595	in
C_v =	0.0023	in^2/min
r_i =	2.9%	
r_p =	76.4%	
r_s =	20.7%	
Slope =	0.0121	
Intercept =	0.4130	
h_c =	0.5690	in
t_c =	53.31	min
C_{ae} =	2.135%	



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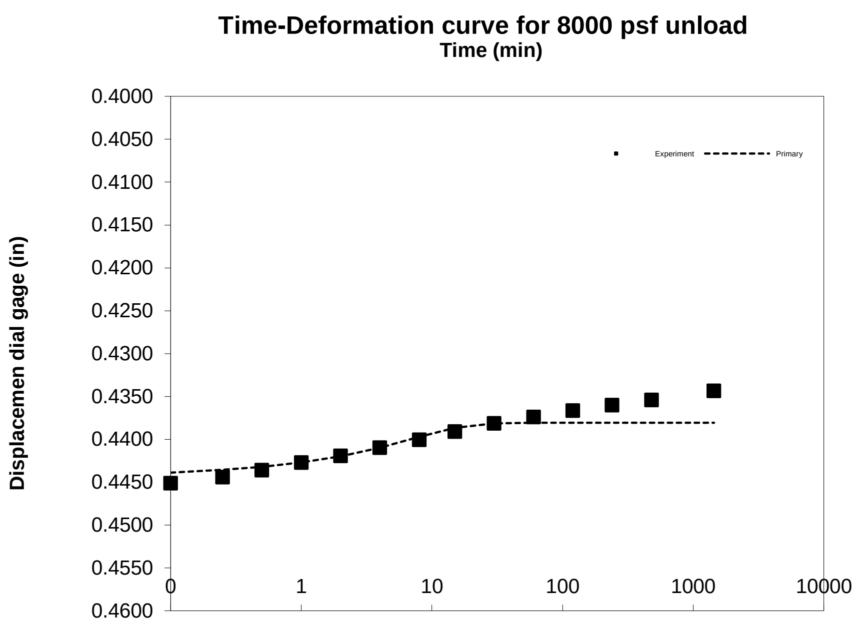
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
8000.0	*0.00*	0.44744	0.44443	0.44443
	0.10	0.44513	0.44388	0.44388
	0.25	0.44444	0.44356	0.44356
	0.50	0.44359	0.44320	0.44320
	1.00	0.44273	0.44270	0.44270
	2.00	0.44193	0.44198	0.44198
	4.00	0.44099	0.44097	0.44097
	8.00	0.44008	0.43971	0.43971
	15.00	0.43912	0.43867	0.43867
	30.00	0.43815	0.43814	0.43814
	60.00	0.43741	0.43807	0.43874
	120.00	0.43667	0.43807	0.43948
	240.00	0.43602	0.43807	0.44022
	480.00	0.43542	0.43807	0.44096
	1440.00	0.43436	0.43807	0.44213

h_0 =	0.55556	in
U_s =	99%	
t_s =	30.60	min
d_s =	0.43814	in
d_0 =	0.44443	in
d_{100} =	0.43807	in
d =	0.28088	in
C_v =	0.0046	in^2/min
r_i =	25.1%	
r_p =	52.9%	
r_s =	22.1%	
Slope =	-0.0025	
Intercept =	0.4418	
h_c =	0.5649	in
t_c =	32.12	min
C_{ae} =	0.434%	



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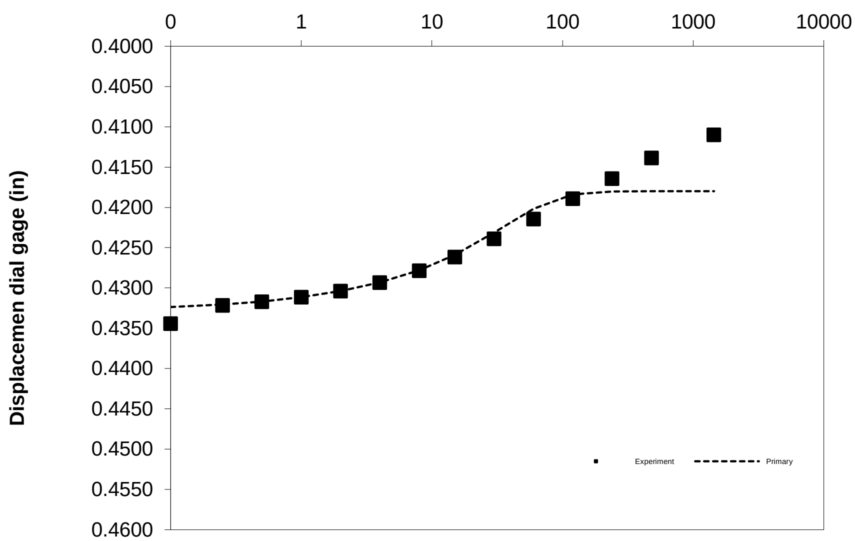
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
2000.0	*0.00*	0.43444	0.43296	0.43296
	0.10	0.43444	0.43239	0.43239
	0.25	0.43218	0.43205	0.43205
	0.50	0.43171	0.43168	0.43168
	1.00	0.43114	0.43114	0.43114
	2.00	0.43038	0.43039	0.43039
	4.00	0.42932	0.42932	0.42932
	8.00	0.42787	0.42781	0.42781
	15.00	0.42617	0.42590	0.42590
	30.00	0.42392	0.42312	0.42312
	60.00	0.42147	0.42016	0.42016
	120.00	0.41892	0.41839	0.41895
	240.00	0.41644	0.41802	0.42038
	480.00	0.41385	0.41801	0.42216
	1440.00	0.41100	0.41801	0.42501

h_0 = 0.56856 in
U_s = 99%
t_s = 152.58 min
d_s = 0.41816 in
d_0 = 0.43296 in
d_{100} = 0.41801 in
d = 0.28876 in
C_v = 0.0010 in^2/min
r_i = 6.3%
r_p = 63.8%
r_s = 29.9%
Slope = -0.0060
Intercept = 0.4299
h_c = 0.5850 in
t_c = 96.67 min
C_{ae} = 1.021%

Time-Deformation curve for 2000 psf unload



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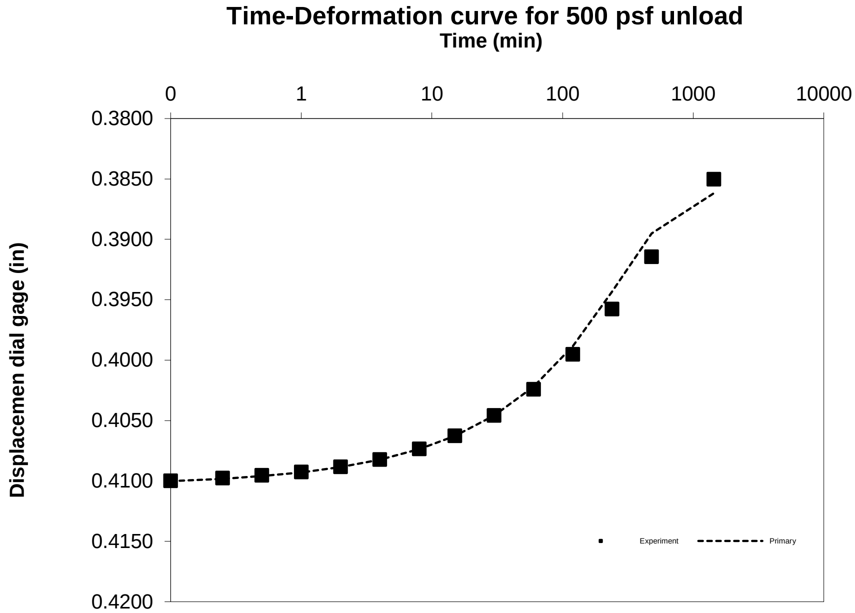
Applied stress psf	Elapsed time min	Dial in	Fitted Primary in	Fitted Primary and Secondary in
500.0	*0.00*	0.41075	0.41034	0.41034
	0.10	0.40999	0.41001	0.41001
	0.25	0.40977	0.40982	0.40982
	0.50	0.40955	0.40960	0.40960
	1.00	0.40926	0.40929	0.40929
	2.00	0.40884	0.40885	0.40885
	4.00	0.40824	0.40824	0.40824
	8.00	0.40736	0.40737	0.40737
	15.00	0.40627	0.40627	0.40627
	30.00	0.40459	0.40458	0.40458
	60.00	0.40242	0.40220	0.40220
	120.00	0.39954	0.39883	0.39883
	240.00	0.39579	0.39430	0.39430
	480.00	0.39146	0.38951	0.38951
	1440.00	0.38505	0.38618	0.38618

h_0 =	0.59225	in
U_s =	99%	
t_s =	1208.68	min
d_s =	0.38632	in
d_0 =	0.41034	in
d_{100} =	0.38608	in
d =	0.30240	in
C_v =	0.0001	in^2/min
r_i =	1.6%	
r_p =	94.4%	
r_s =	4.0%	
Slope =	-0.0125	
Intercept =	0.4254	
h_c =	0.6169	in
t_c =	1445.55	min
C_{ae} =	2.019%	



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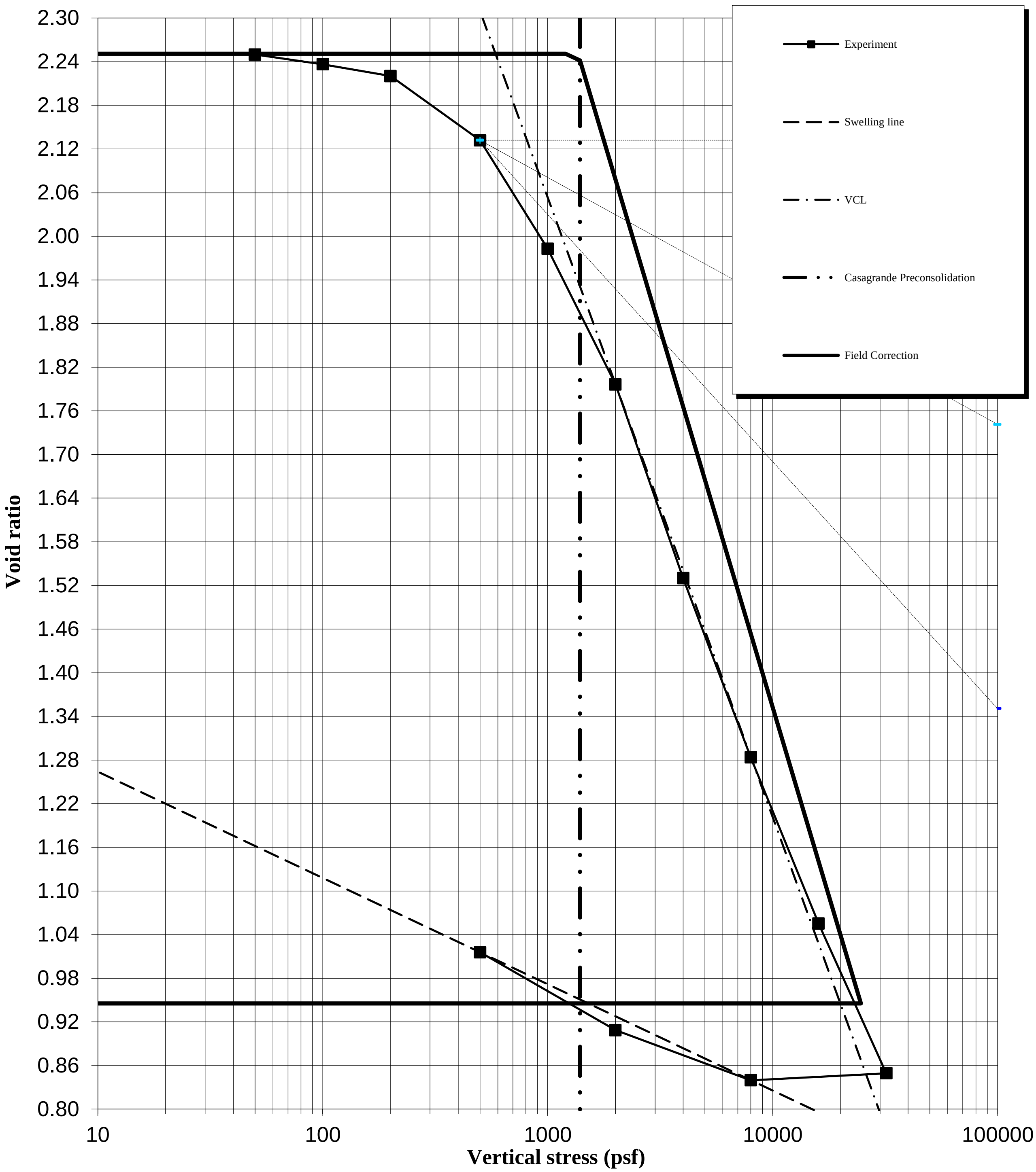
CONSOLIDATION CURVE
Sample SGB-21ST, ST#4, 14 to 16 feet



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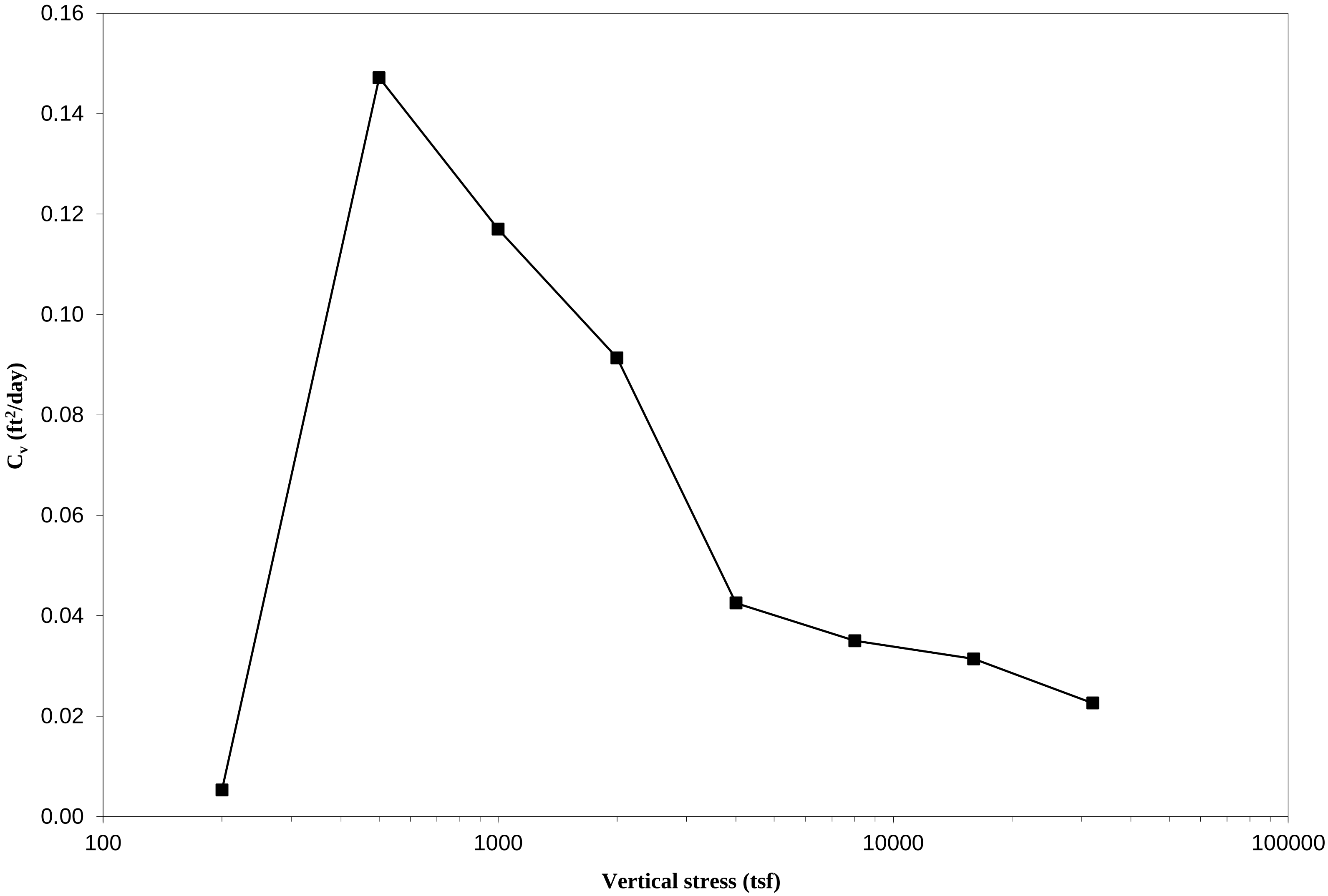
CONSOLIDATION COEFFICIENT (C_v) vs. VERTICAL STRESS

Sample SGB-21ST, ST#4, 14 to 16 feet



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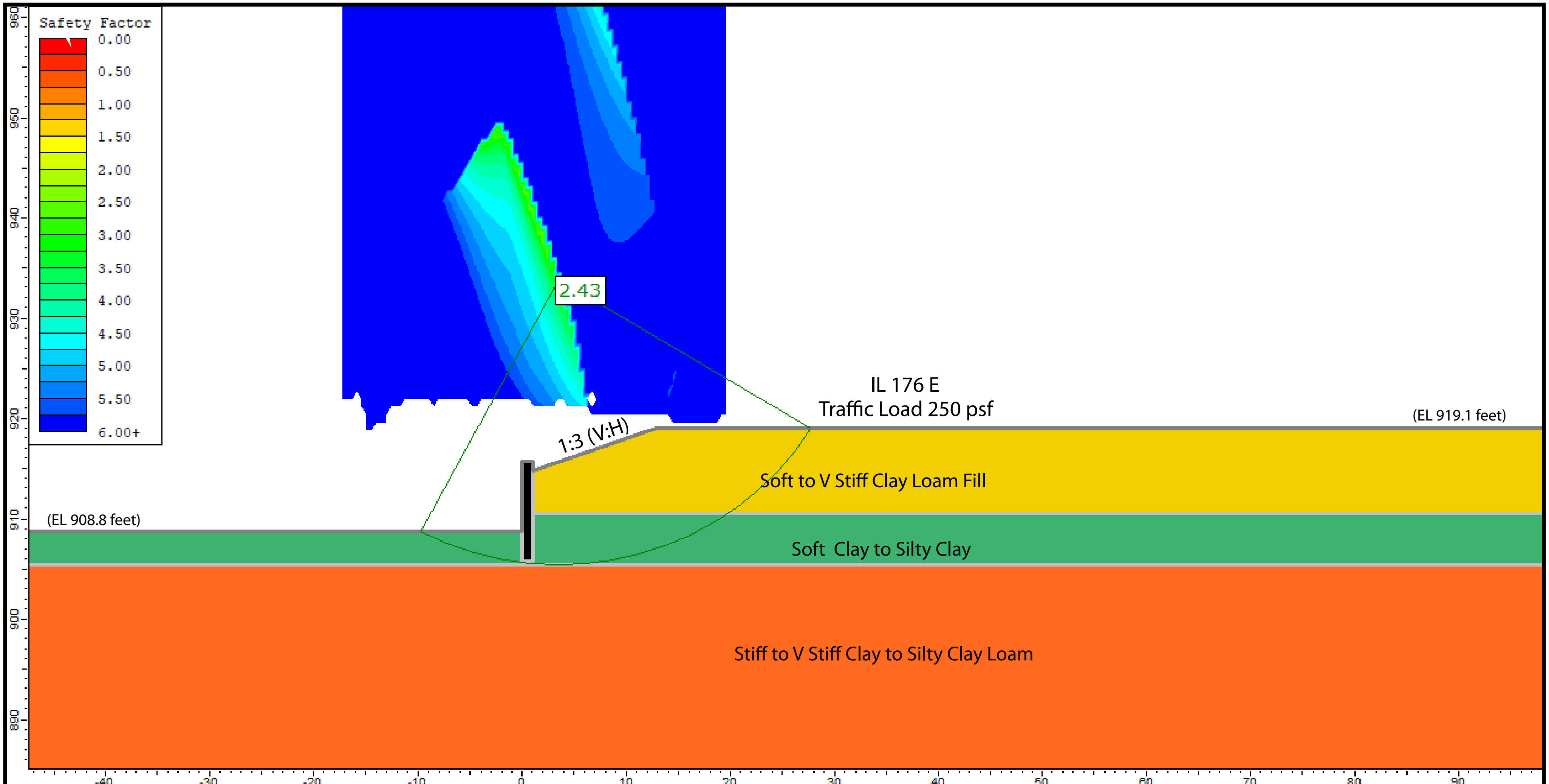
APPENDIX C



Undrained Analysis, Wingwall, Ref. Borings: CUL-11 and CUL-12

Layer ID	Description	Total Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	Soft to V Stiff Clay Loam Fill	120	800	0
2	Soft Clay to Silty Clay	115	500	0
3	Stiff to V Stiff Clay to Silty Clay Loam	120	2300	0

GLOBAL STABILITY ANALYSIS: IL 176 E OVER UNANAMED CREEK , CULVERT AT 310+50
SN 056-0110, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-1 | DRAWN BY: N. Balakumaran
CHECKED BY: A. Kurnia

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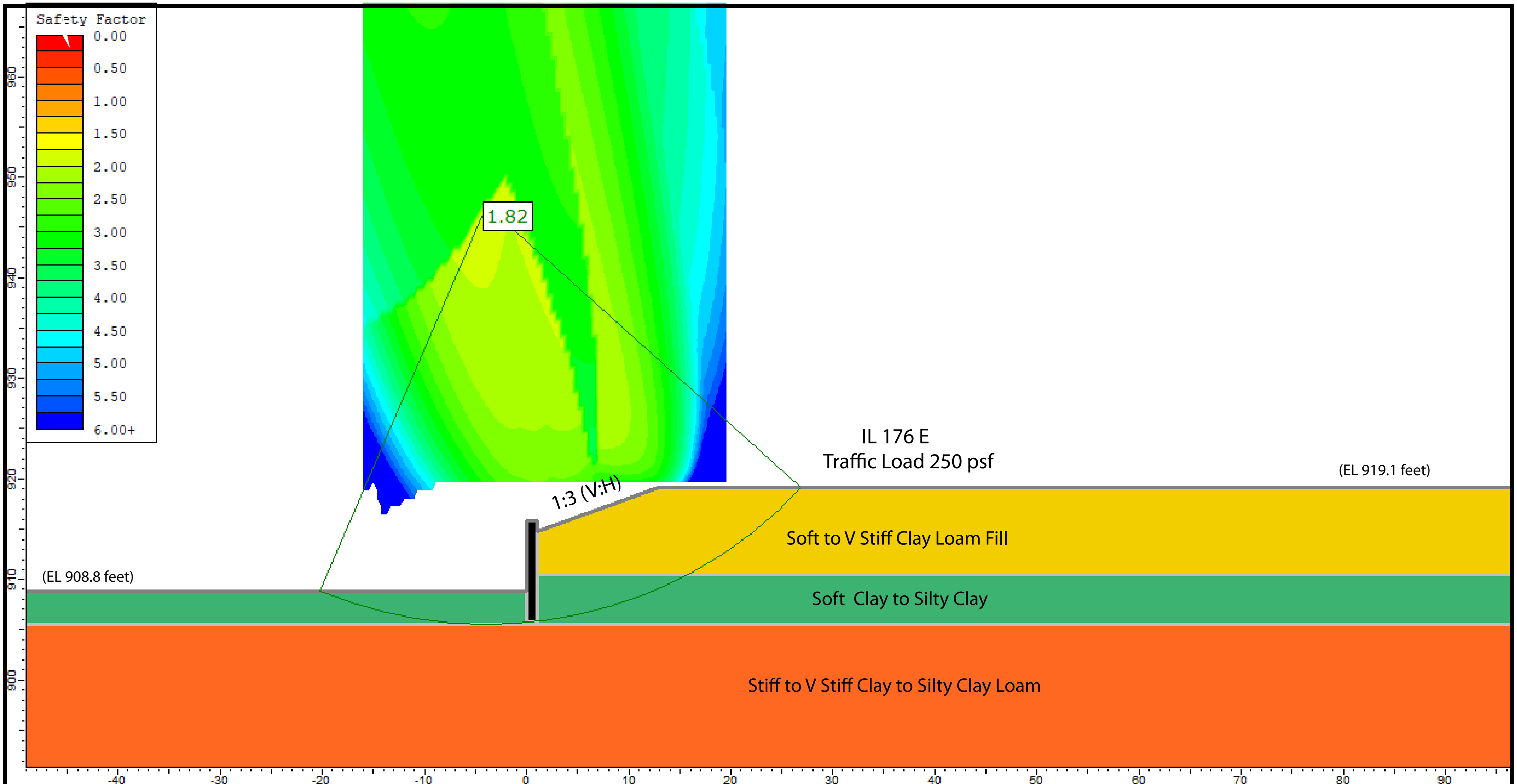
FOR STRAND ASSSOCIATES, INC. | 195-13-01



Drained Analysis, Wingwall, Ref. Borings: CUL-11 and CUL-12

Layer ID	Description	Total Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	Soft to V Stiff Clay Loam Fill	120	0	29
2	Soft Clay to Silty Clay	115	0	29
3	Stiff to V Stiff Clay to Silty Clay Loam	120	100	30

GLOBAL STABILITY ANALYSIS: IL 176 E OVER UNANAMED CREEK , CULVERT AT 310+50
SN 056-0110, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-2 | DRAWN BY: N. Balakumaran | CHECKED BY: A. Kurnia

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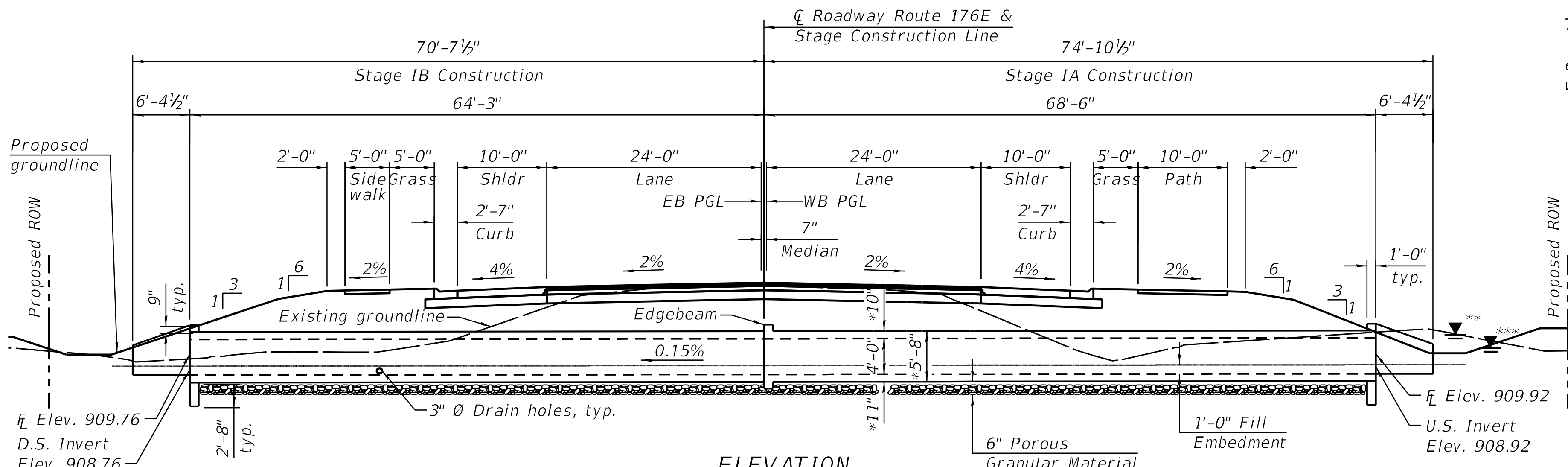
FOR STRAND ASSSOCIATES, INC. | 195-13-01

APPENDIX D

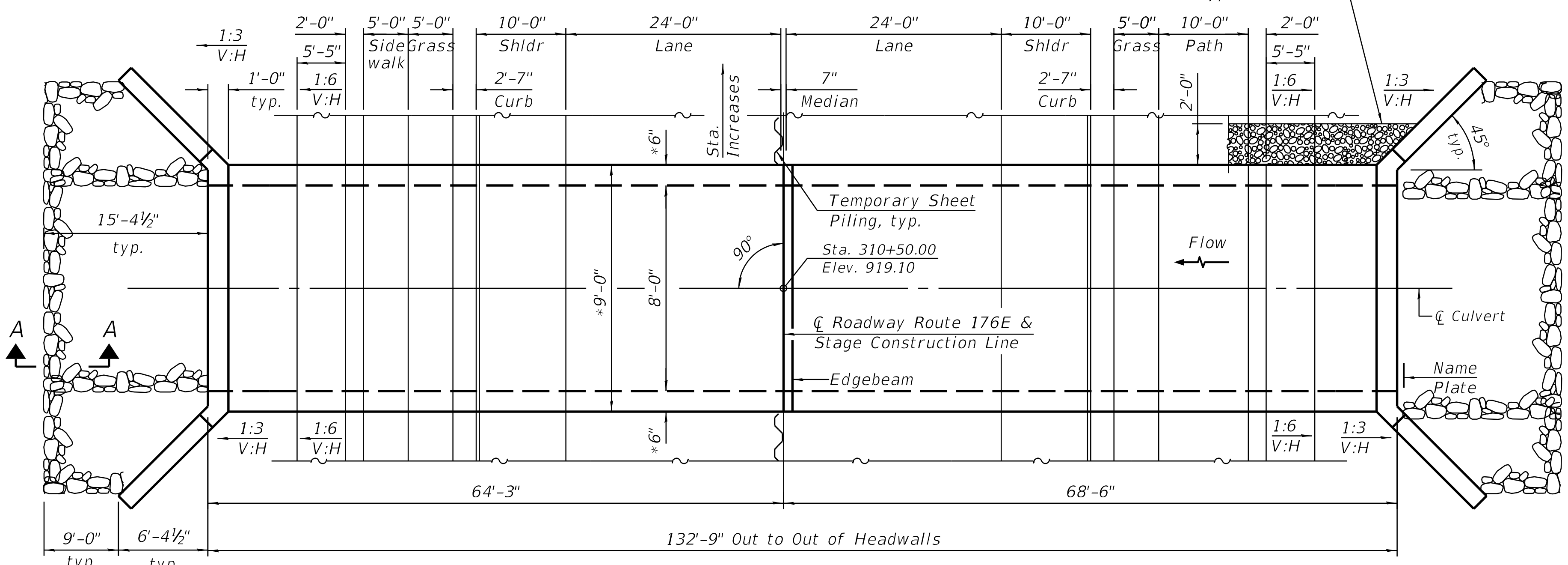
Benchmark: CWA CP #5, ⅝" dia. rebar Sta. 312+36.71 o/s 29.43 ft left, Elev. 917.84.
Existing Structure: Concrete Box Culvert at Sta. 310+25 3 ft W x 3 ft H by approx. 65 ft in length at 0° skew shall be removed.
Traffic Control: Traffic will be maintained in a two stage construction process.
Salvage: None.



ELEVATION

* Slab thickness subject to refinement in final design

** DHWE Elev. 911.45
*** EWSE Elev. 910.02



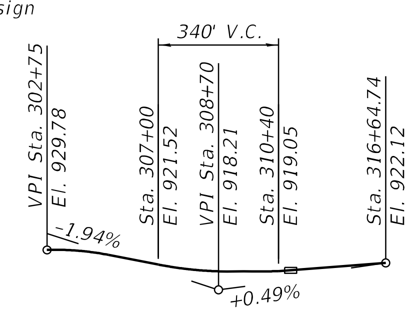
PLAN

* Wall thickness subject to refinement in final design

WATERWAY INFORMATION

Drainage Area = 0.1155 sq. mi. Low Grade Elev. =919.01 @ Sta. 311+75

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	2	14.29	2.1	5.7	910.63	0.65	0.20	911.28	910.83
	10	27.07	3.3	5.6	911.04	1.23	0.42	912.27	911.46
Design	50	62.54	4.6	7.6	911.45	2.75	0.99	914.20	912.44
Base	100	89.01	5.2	8.7	911.66	4.75	1.37	916.21	913.03
Overtopping	>500								
Max. Calc.	500	151.32	6.3	10.6	912.04	6.81	2.85	918.85	914.89



PROFILE GRADE

(EB and WB PGL)

STATION 310+50
BUILT 201X BY
STATE OF ILLINOIS
F.A.P. RT. 326(IL-176E)
SEC. 105-N-21(15)
LOADING HL-93
STR. NO. XXX-XXXX

NAME PLATE

See Std. 515001

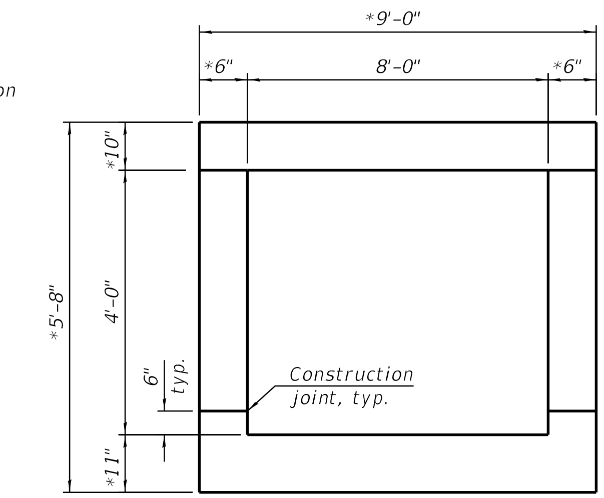
GENERAL NOTES

The 6 in. thick layer of porous granular material shall be placed below the bottom slab and satisfy Standard Specifications. The cost of the porous granular material shall be included in the pay item for Porous Granular Embankment. The subsurface soil foundation will be finalized in conjunction with the SGR during final plan development.

Nonwoven geotextile fabric shall conform to the requirements of Art. 1080.01 of the Standard Specifications. The minimum weight of the fabric shall be 6 ounces per square yard.

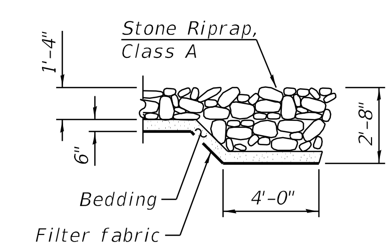
Concrete box culverts shall be backfilled with Porous Granular Embankment below the top of the box culvert extending to a vertical plane 2 ft from the exterior sides of the culvert, 2 ft from the back face of the wingwalls, and not closer than 2 ft from the face of embankment.

INDEX OF SHEETS

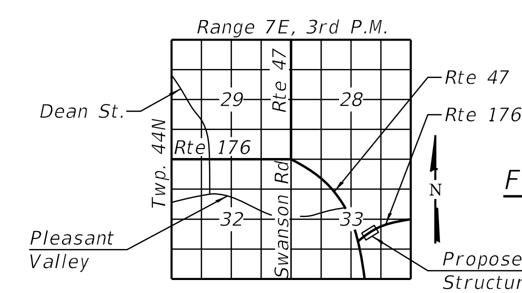


SECTION THRU BARREL

* Slab and wall thickness subject to refinement during final design



SECTION A-A



LOCATION SKETCH

HIGHWAY CLASSIFICATION

F.A.P. Rte. 326 (IL-176E)
Functional Class: Other Principal Arterial
ADT: 10,600 (2013); 16,000 (2040)
ADTT: 2,290 (2013); 3,456 (2040)
DHV: 1095 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
2-Way Traffic
Directional Distribution: 50:50

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications
8th Edition

LOADING HL-93

Allow 50 #/sq.ft for future wearing surface
Structure designed for a min fill height of 0.75' and a max. fill height of 5.43'

DESIGN STRESSES

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

PRECAST UNITS
f'c = 5,000 psi
fy = 60,000 psi (Reinforcement)

GENERAL PLAN AND ELEVATION
IL RTE. 176E OVER UNNAMED CREEK
F.A.P. RTE. 326(IL-176E) SEC. 105-N-2(15)
McHENRY COUNTY
STATION 310+50
S.N. 056-0110

FILE NAME = S:\JOL\6300--6399\6346\069\Micros\CAD_Sheets\D162843-SN-056-0110-TS&L-GP&E 01.dgn

STRAND ASSOCIATES®
1170 SOUTH HOUBOLT ROAD
JOLIET, ILLINOIS 60431
(815) 744-4200
IDFPR NO. 184-001273

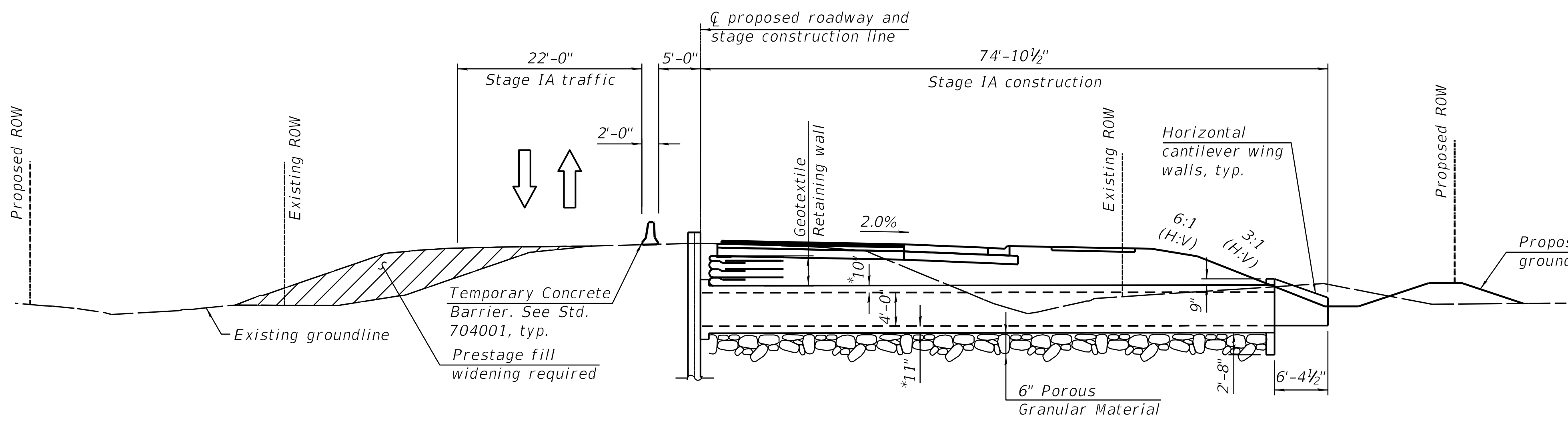
USER NAME = brianf	DESIGNED - BRL	REVISED -	
	CHECKED - KRB	REVISED -	
PLOT SCALE =	DRAWN - BJF	REVISED -	
PLOT DATE = 8/7/2020	CHECKED - BRL	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
STRUCTURE NO. 056-0110
SHEET NO. X OF 7 SHEETS

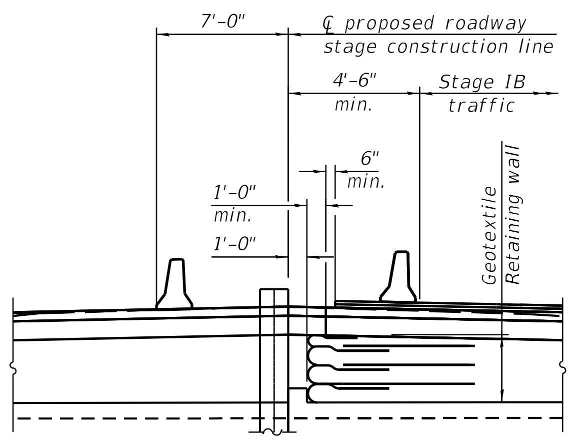
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	105-N-2(15)	McHENRY	TOT	X

CONTRACT NO. 62B43
ILLINOIS FED. AID PROJECT

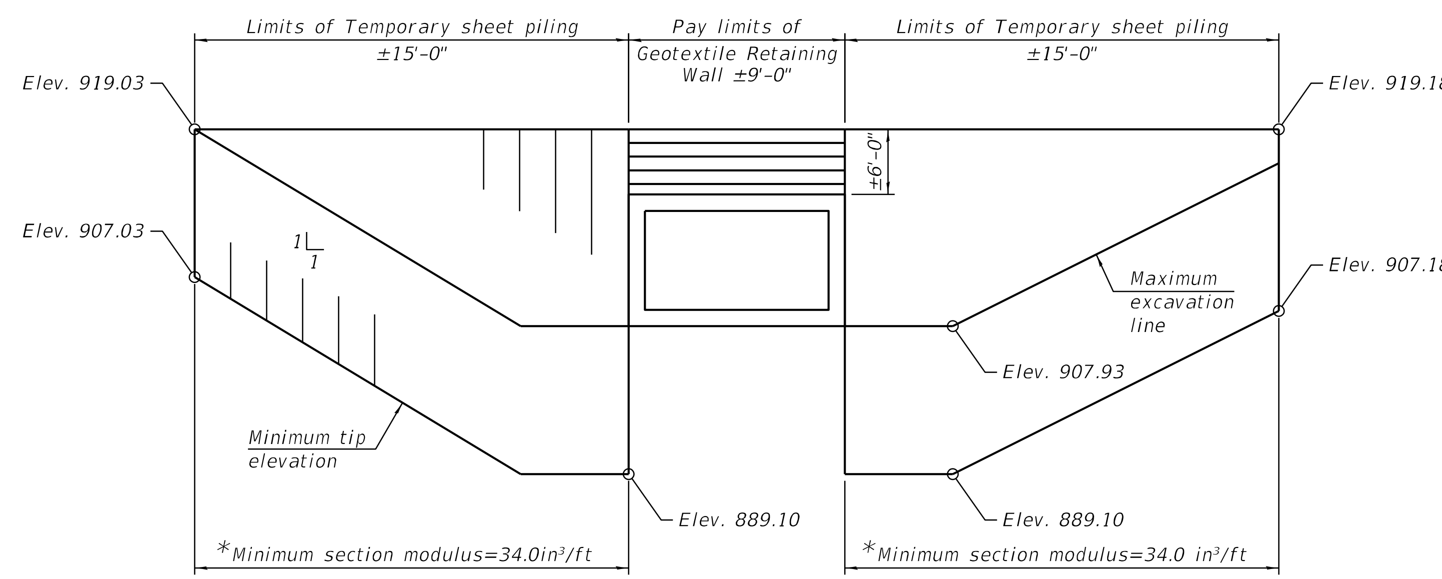


STAGE IA REMOVAL AND CONSTRUCTION

(Horizontal dimensions at Rt. L's to ℄ roadway)
∗Slab thickness to be revised during final design

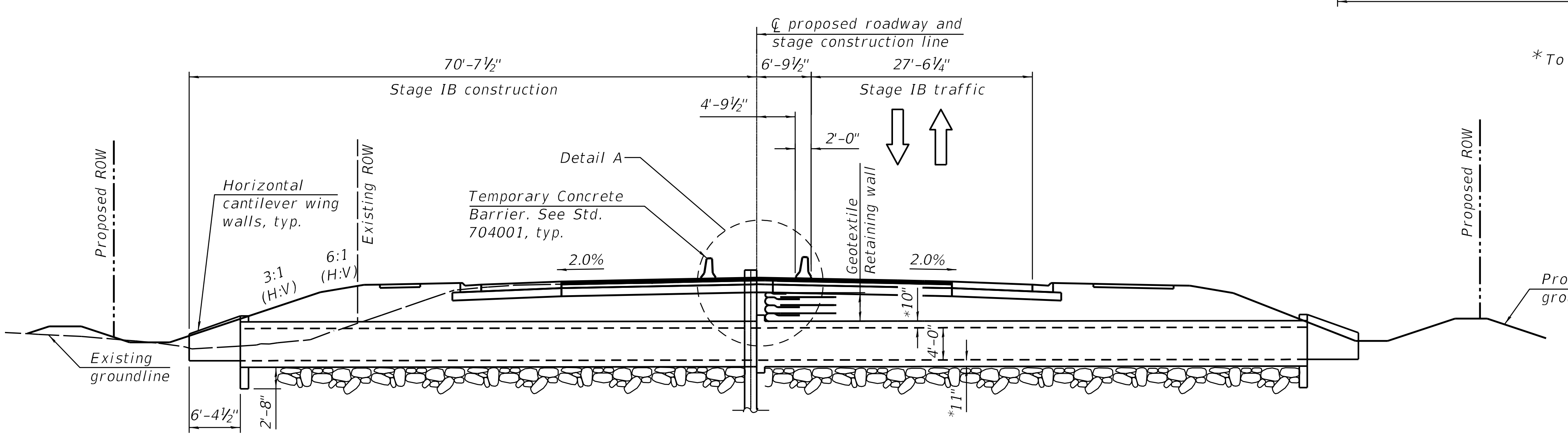


DETAIL A



TEMPORARY SHEET PILING

*To be revised in final design in accordance with SGR



STAGE IB REMOVAL AND CONSTRUCTION

(Horizontal dimensions at Rt. L's to ℄ roadway)
∗Slab thickness to be revised during final design

STAGE CONSTRUCTION DETAILS
IL RTE. 176E OVER UNNAMED CREEK
F.A.P. RTE. 326(IL-176E) SEC. 105-N-2(15)
McHENRY COUNTY
STATION 310+50
S.N. 056-0110

FILE NAME = S:\JOL\6300--6399\6346\069\Micros\CAD_Sheets\D162B43-SN-056-0110-TS&L-GP&E 02.dgn

STRAND ASSOCIATES®
1170 SOUTH HOUBOLT ROAD
JOLIET, ILLINOIS 60431
(815) 744-4200
IDFPR NO. 184-001273

USER NAME = brianf	DESIGNED - BRL	REVISED -	
	CHECKED - KRB	REVISED -	
PLOT SCALE =	DRAWN - BJF	REVISED -	
PLOT DATE = 8/7/2020	CHECKED - BRL	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

STAGE CONSTRUCTION DETAILS
STRUCTURE NO. 056-0110

SHEET NO. X OF 7 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	105-N-2(15)	McHENRY	TOT	X

CONTRACT NO. 62B43

ILLINOIS FED. AID PROJECT