



ECS Midwest, LLC

Geotechnical Engineering Report

Proposed Roadway Extension and Apron Expansion

Appleton International Airport – W6390 Challenger Drive
Appleton, Wisconsin

ECS Project No. 59:3400

March 10, 2023





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Mr. Mike Kohlbeck
McMahon Associates, Inc.
1445 McMahon Drive
Neenah, WI 54956

ECS Project No. 59:3400

Reference: Geotechnical Engineering Report
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Appleton International Airport – W6390 Challenger Drive
Appleton, Wisconsin

Mr. Kohlbeck:

ECS Midwest, LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of services. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to McMahon Associates, Inc. during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations to verify subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Midwest, LLC

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EXECUTIVE SUMMARY

This Executive Summary is intended as a very brief overview of the primary geotechnical conditions that are expected to affect design and construction. Information gleaned from this Executive Summary should not be utilized in lieu of reading the entire geotechnical report.

- The project site has generally adequate subsurface conditions for the proposed roadway extension and apron expansion. After removing inadequate surface materials and cutting to the proposed subgrade, the pavement subgrade should be thoroughly proof-rolled and examined by ECS to document isolated soft/very loose soil areas.
- Excavation Below Subgrade (EBS) should be performed to remove soils containing more than 5 percent organic content or where proof-rolling operations indicated rutting or deflections exceed 1 inch. The *Subgrade Preparation* and *Earthwork Operations* Sections of this report contain additional information regarding our recommended pavement subgrade preparations.
- In our opinion, the site has generally adequate subsurface conditions for the proposed utility construction. The *Utility Installations* Section of this report contains additional general information regarding our recommended utility subgrade preparations.

1.0 INTRODUCTION

ECS prepared this report for the purpose of providing the results of our subsurface exploration and laboratory testing, site characterization, engineering analysis, and geotechnical recommendations for the design and construction of pavements and site utilities for the proposed roadway extension and apron expansion. The recommendations developed for this report are based on project information supplied by McMahon Associates, Inc.

ECS provided services in accordance with our Proposal No. 59:4708-GP dated November 30, 2022, and authorized by Mr. Mike Kohlbeck with McMahon Associates, Inc. on January 11, 2023, which includes our Terms and Conditions of Service.

This report contains the procedures and results of our subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the project.

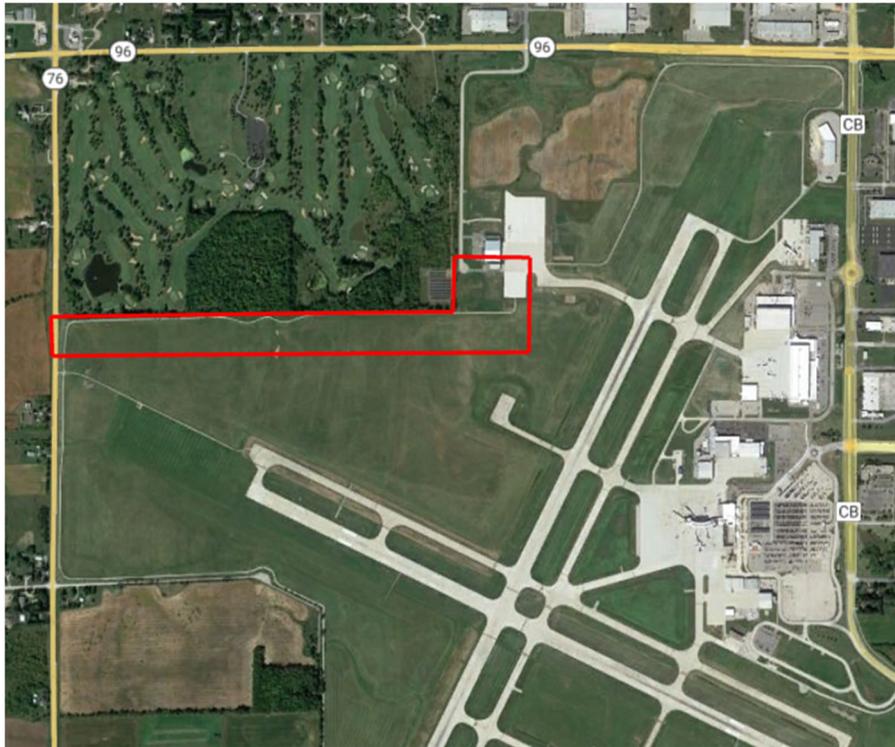
The report includes the following items:

- A brief review and description of our field and laboratory test procedures and results.
- A review of the observed surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil/rock stratigraphy with pertinent available physical properties.
- Final test boring logs.
- Recommendations for site pavements (rigid and flexible) including design parameters, subgrade preparation, and drainage, recommendations.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills to support pavements, and general engineered fill material guidelines.
- Recommendations for additional testing and/or consultation that might be required to complete the geotechnical assessment and related geotechnical engineering for this project.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE/PAST SITE USE

The project site is located at the Appleton International Airport in Appleton, Wisconsin. Specifically, the proposed construction will take place near the northwest corner of the property. The site location is shown in the figure below and on the Site Location Diagram in Appendix A of this report:



Site Location (approximately outlined in red)

The general site vicinity consists of nearly level to gently sloping grass-covered terrain. The properties adjacent to the airport include a golf course and agricultural land. Several existing hangars and an aircraft apron are present near the northeastern corner of the project area. The existing south terminus of Endeavor Drive is also located near the northeast corner of the proposed construction site. ECS interpreted site specific topography from the Outagamie County Zoning Information Map (<https://ocgis.maps.arcgis.com/>) to estimate the existing site grade elevations. According to the interactive map, we anticipate the existing site grade elevations range from approximately EL. +922 feet to EL. +885 feet and generally descend to the east across the site.

ECS reviewed historical aerial photographs of the project site available on Google Earth. Our visual review of the photographs indicated the proposed construction site consisted of mixed agricultural and wooded land until the site was completely cleared around 2006. The existing service road which follows the northern airport property line also appeared on the aerial photographs at this time. In 2011, the aerial photographs indicated filling or grading took place near the center of the project site in the vicinity of Boring B-02. Most recently, the aerial photographs showed construction activity near the northeast corner of the project site which included an expansion of the existing aircraft apron, construction of new buildings, and a solar array.

2.2 PROPOSED CONSTRUCTION

ECS understands the proposed construction includes the extension of Endeavor Drive and an expansion of the existing aircraft apron. Sanitary and/or storm sewer utilities will also be installed. The Endeavor Drive extension will consist of the design and construction of approximately 4,600 feet of a 28-foot-wide roadway. The extended roadway will follow its existing alignment south to the airport property corner before turning to approximately follow the property line in the east/west direction. We anticipate the Endeavor Drive extension will include a bituminous or Portland cement concrete pavement section and the vertical profile will approximately match the existing site grades (within 2 feet +/-). We further understand the aircraft apron expansion will consist of a Portland cement concrete pavement section across an approximate 240-foot by 282-foot area. We understand the vertical profile of the new apron area will approximately match the existing site grades of the north apron (Elevation 887 to 889 feet).

Information regarding the design service life and traffic loadings for the Endeavor Drive extension and apron expansion were not available at the time this report was prepared. Therefore, this report does not include recommended pavement sections. ECS should be contacted when the design traffic loadings become available so that we may review the information, provide recommended pavement sections, and revise our recommendations if necessary.

Where the borings encounter subsurface conditions that might be detrimental to the support of the proposed construction, ECS anticipates the owner will have an acceptable risk level if the detrimental material remains in place. We anticipate the owner would only be willing to accept a low risk for utility settlement exceeding 2 inches and a low to moderate risk for a reduced pavement performance.

If ECS' understanding of the project or the owner's acceptable risk level are not correct or the design changes, then please contact ECS so that we may review these changes and revise our recommendations, as appropriate.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

Our exploration procedures are explained in greater detail in Appendix B including the insert titled "Subsurface Exploration Procedures." Our scope of services included drilling a total of nine (9) Standard Penetration Test (SPT) borings to a depth of 10 feet below the existing grade. ECS personnel located the borings at the site using conventional measuring techniques relative to existing site features and their approximate locations are shown on the Boring Location Diagram in Appendix A.

McMahon Associates, Inc. determined the ground surface elevation at Boring B-01, B-02, and B-03. ECS determined the surface elevation at Boring B-04 through B-09 using conventional survey leveling techniques referenced to the first floor of the new hangar located approximately 30 feet north of Boring B-06. We understand this temporary benchmark to have an elevation of EL. 889.8 feet. A licensed surveyor did not determine the ground surface elevation at the location of B-04 through B-09, so these elevations are approximate. The surface elevation at each boring location can be found on the boring logs included in Appendix B.

3.1 SUBSURFACE CHARACTERIZATION

According to the University of Wisconsin Extension Geological and Natural History Survey and U.S. Geological Survey^{1,2} the site of the proposed construction lies above Phanerozoic bedrock of the Ordovician System consisting of sedimentary rocks of Paleozoic Age. The bedrock formation generally lies within the Sinnipee Group (Os) which consists of dolomite with some limestone and shale; and includes the Galena, Decorah and Platteville Formations. The soil overburden in the project area is generally about 50 feet thick.

According to the Soil Survey from the USDA - Natural Resources Conservation Service (<https://websoilsurvey.nrcs.usda.gov>), which provides soil information to a shallow depth (generally less than 5 feet), the soils in the site area are predominantly mapped as Hortonville silt loam (HrB, HrC2) and Symco silt loam (SyA). A soil map of the project site is presented in Appendix A. These soil types are described with the following properties:

- **Hortonville silt loam (HrB, HrC2)** – Landforms consisting of ground moraines with loess over loamy till parent material. These soils are generally well drained, classified as being in Hydrologic Soil Group C, and have a moderate potential for frost action. This soil type is mapped within the areas of Boring B-01, B-02, B-03, B-05, B-06, B-07, B-08, and B-09.
- **Symco silt loam (SyA)** – Landforms consisting of drainageways with calcareous loamy till parent material. These soils are somewhat poorly drained, classified as being in Hydrologic Soil Group C/D, and have a moderate potential for frost action. This soil type is mapped within the area of Boring B-04.

Except for the existing and possible fill, the subsurface conditions encountered in the borings appeared to match published geological mapping. The following table provides generalized characterizations of the soil strata. For subsurface information at a specific test boring location, refer to the boring logs in Appendix B. A graphical presentation of the subsurface conditions is shown on the Subsurface Cross-Section Diagrams included in Appendix A.

GENERALIZED SUBSURFACE CHARACTERIZATION				
Approximate Depth (ft)	Stratum	Description	Range of SPT ⁽¹⁾ N-values (bpf)	Unconfined Compressive Strength, Q _p ⁽²⁾ (tsf)
0 – 0.8	Surface Cover	Approximately 6 to 10 inches of topsoil.	N/A	N/A
2.0 – 6.0	I	Existing FILL: stiff LEAN CLAY (CL) Possible FILL: stiff to very stiff LEAN CLAY, SANDY LEAN CLAY (CL) and medium dense SILTY GRAVEL (GM)	5 – 30	1.0 – 2.5
10 (end of borings)	II	Glacial till: stiff to hard LEAN CLAY and SANDY LEAN CLAY (CL)	5 – 35	1.5 – 6.0

Notes: (1) Standard Penetration Testing. (2) Estimated from calibrated hand penetrometer.

¹ Trotta, L.C. and Cotter, R.D. *Depth to Bedrock in Wisconsin*. University of Wisconsin Extension Geological and Natural History Survey, U.S. Geological Survey, USGS, 1973.

² Mudrey, M.G., Brown B.A., and Greenburg, J.K. *Bedrock Geologic Map of Wisconsin*. University of Wisconsin Extension Geological and Natural History Survey, 1982.

The soil stratification shown on the boring logs represents the interpreted soil conditions at the actual boring locations. Variations in the stratification can occur between sample intervals and boring locations. The subsurface conditions at other times and locations on the site may differ from those found at the boring locations. If different site conditions are encountered during construction, ECS should be contacted to review our recommendations relative to the new information.

Because of the limitations of the split-spoon sampler, which has a 1 $\frac{3}{8}$ -inch inside diameter, the soil classifications noted on the boring logs may not be representative of the entire soil matrix. Materials larger than the 1 $\frac{3}{8}$ -inch inside diameter of the split-spoon sampler cannot be collected and observed directly. Where possible, the drill crew noted the estimated depth of larger diameter materials, such as cobbles, based on things such as changes in the observed drilling resistance and auger cuttings.

3.2 GROUNDWATER OBSERVATIONS

The drill crew observed the bore holes for a measurable groundwater level during sampling and at the completion of drilling operations. None of the borings contained a measurable groundwater level. However, the project site likely develops areas of perched groundwater overlying a saturated (water table) aquifer. Perched groundwater is distinguished differently from the water table aquifer as defined below:

“Perched water is typically of limited quantity, replenished or recharged very slowly. When encountered in an excavation, perched water will typically drain off very quickly, with limited continuous flow or bleeding, unless a source of recharge, such as a leaking utility is present.”

From: Construction Dewatering and Groundwater Control – New Methods and Applications, 3rd Addition

A water table aquifer is distinguished from a perched groundwater table based on the water table aquifer’s recharge ability, which may be limitless but can be lowered temporarily through adequate dewatering techniques such as deep wells and well points. Perched groundwater is often alleviated in excavations by pumping from sump pits and French drains.

The highest groundwater observations are normally encountered in late winter and early spring and our current groundwater observations likely differ from the seasonal maximum water table. In addition, variations in both groundwater types (perched and groundwater table aquifer) can occur because of seasonal variations in precipitation, evaporation, surface water runoff, lateral drainage conditions, construction activities, and other factors. The time of year and the weather history during the advancement of the borings should be considered when estimating groundwater levels at other points in time.

3.3 LABORATORY SERVICES

ECS performed classification and index property tests on representative soil samples obtained from the test borings to aid classification of the soils, and to help estimate engineering properties.

A geotechnical engineer visually classified each collected soil sample from the test borings based on texture and plasticity using ASTM D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)*, ASTM D2487, *Standard Practice for Classification for Engineering Purposes (Unified Soil Classification System (USCS))*, and the American Association of State Highway and Transportation Officials (AASHTO) Classification System as general guidelines. After classification, the geotechnical engineer grouped the various soil types into the major zones noted on the test boring logs in Appendix B of this report. The USCS group symbols for each soil type are indicated in parentheses along with the soil descriptions on the test boring logs. The bracketed text after the USCS group symbol indicates the AASHTO classification. The stratification lines designating the interfaces between earth materials on the logs are approximate; in-situ, the transitions may be gradual.

ECS performed calibrated hand penetrometer tests (Q_p) on select cohesive soil samples. In the hand penetrometer test, the unconfined compressive strength of a soil sample is estimated, to a maximum of 6.0 tons per square foot (tsf), by measuring the resistance of a soil sample to penetration by a small, calibrated, spring-loaded cylinder. The hand penetrometer test results can be found on the boring logs.

The laboratory testing program included tests performed in general accordance with relevant ASTM procedures for moisture content, organic content, Atterberg limits, and percent finer than the No. 200 sieve (P200) on select soil samples recovered from the borings. The test results can be found on the boring logs and in the following table:

LABORATORY TEST RESULTS								
Boring Number	Sample Number	Sample Depth (ft)	Moisture Content (%)	Organic Content (%)	P200 Content (%)	Atterberg Limits		
						LL (%)	PL (%)	PI
B-01	S-2A	2 – 4	25	---	74.7	---	---	---
B-02	S-2A	2 – 4	17	---	68.6	---	---	---
B-03	S-2A	2 – 4	16	---	64.6	---	---	---
B-04	S-2A	2 – 4	25	---	64.3	---	---	---
B-06	S-2A	2 – 4	14	---	67.5	---	---	---
B-07	S-1B	0 – 2	19	4.0	---	---	---	---
B-08	S-3A	4 – 6	16	---	---	34	15	19
B-09	S-1B	0 – 2	12	---	58.8	---	---	---

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposal.

4.0 DESIGN RECOMMENDATIONS

4.1 PAVEMENT DESIGN CONSIDERATIONS

Subgrade Characteristics: Our pavement design recommendations may be utilized provided the subgrade consists of generally adequate materials evaluated by ECS, and the subgrade is prepared as recommended in this report.

The following table provides values for the first adequate soil strata encountered in the borings. ECS obtained the values for the Soil Support Value and Design Group Index from the WisDOT Pavement Design Manual and Frost Index values from the frost susceptibility classifications according to the U.S. Army Corps of Engineer's criteria. We estimated the Subgrade and Resilient Modulus values based on historical testing of similar soil:

Recommended Design Values

Boring Number	Soil Classification		Subgrade Reaction Modulus, K (psi/in) ^(1,2)	Resilient Modulus, M _R (psi) ^(1,2)	Frost Index ^(1,2)	Soil Support Value ^(1,2)	Design Group Index ^(1,2)
	USCS	AASHTO					
B-01	CL	A-6	125	2,800	F-3	4.2	12
B-02	CL [possible FILL] ³	A-6	125	2,800	F-3	4.2	12
B-03	CL	A-6	125	2,800	F-3	4.2	12
B-04	CL	A-6	125	2,800	F-3	4.2	12
B-05	CL [possible FILL] ³	A-6	150	3,000	F-3	4.2	12
B-06	CL [FILL] ³	A-6	125	2,800	F-3	4.2	12
B-07	CL [possible FILL] ³	A-6	125	2,800	F-3	4.2	12
B-08	CL	A-6	125	2,800	F-3	4.2	12
B-09	CL	A-6	150	3,000	F-3	4.2	12

- Notes: (1) Design parameters are estimates only and are based on historical data for similar soil types. If more accurate values are required, additional testing should be performed.
- (2) Design parameters are for the first adequate soil strata below the proposed pavement elevation encountered in the borings. If more than 2 feet of sub-base fill material is placed, the characteristics of the fill will govern the pavement design.
- (3) Denotes existing or possible fill which, prepared in accordance with the **Subgrade Preparation** and **Earthwork Operations** sections of this report, is adequate to support the proposed pavement section.

Based on the results of our soil borings, ECS recommends the use of the pavement design parameters noted in the following table.

Recommended Pavement Design Parameters

Design Parameter	Recommended Value
Subgrade Reaction Modulus (psi/in)	125
Resilient Modulus (psi)	2,800
Frost Index	F-3
Soil Support Number	4.2
Design Group Index	12

Areas of subgrade stabilization and/or undercut may be required where exposed soils contain more than 5 percent organic content or where proof-rolling during construction indicates rutting or

deflection exceeds 1 inch, especially if the subgrade is subjected to construction traffic disturbance or if construction occurs during adverse weather conditions. In addition, we recommend providing Excavation Below Subgrade (EBS) for frost concerns in areas where the exposed subgrade contains highly frost susceptible soil having an "A-4" AASHTO designation. The ends of over-excavated areas should be sloped across a minimum length of 10 feet to reduce the potential abrupt changes in the pavement support characteristics that could lead to future pavement distress.

In areas requiring over-excavation for detrimental frost concerns and in trenches for utilities, ECS recommends constructing transition zones, which are wedges of backfilled soil used to mask the distinct difference between the native soils and the backfilled area. The transition zone should start at the trench walls, and at a depth of 3 feet below the finished pavement grade and rise at a slope of 1 vertical to 3 horizontal as it extends perpendicular to the trench. However, transition zones would not be necessary where EBS areas are backfilled with soils similar to the native soils, or where the native soils contain less than 30 percent material passing the #200 sieve.

For grading work and drainage design, soil volume shrinkage should be in the range of 25 to 35 percent for the encountered soils. These values correlate to expansion factors of 33 to 54 percent. For design purposes we recommend using an average shrinkage factor of 30 percent (43 percent expansion factor).

Prior to placing the aggregate base material, the pavement subgrade should be prepared as recommended within this report. Crushed aggregate base course utilized below pavements should meet Section 305 of the WisDOT Standard Specifications for Road and Bridge Construction and the gradation should meet the "1¼ inch" specification. The crushed aggregate base course should be compacted to at least 95 percent of the maximum dry density obtained in accordance with ASTM D1557, Modified Proctor method. As an alternative, a dense graded base meeting the "3 inch" specification can be used for the lower 8 inches of the base course layer to bridge over softer subgrade soils.

The aggregate used in the bituminous mixture should meet Section 460 of the WisDOT Standard Specifications for Road and Bridge Construction. The asphalt pavement should be compacted to a minimum of 93 percent of the theoretical density value.

Adequate construction joints, contraction joints and isolation joints should be provided in the areas of rigid pavement to reduce the impacts of cracking and shrinkage. Please refer to ACI 325.12R-02 *Guide for Design of Jointed Concrete Pavements for Streets and Local Roads*. The Guide recommends an appropriate spacing strategy for the anticipated loads and pavement thickness. It has been our experience that joint spacing closer to the minimum values results in a pavement with less cracking and better long-term performance.

Pavement Drainage: An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. The final pavement surface should be shaped or crowned to properly direct surface water to adequate on or off-site storm water drainage infrastructure. In addition, clayey pavement subgrade should be properly sloped to avoid dips or pockets where water may become trapped. Dips in the clayey subgrade could result in a "bathtub"

effect, which may trap water and potentially soften the subgrade. Good drainage should help reduce the possibility of the subgrade materials becoming saturated over a long period of time.

To reduce the potential for shallow perched water to develop in curb and gutter areas of the site, “stub” or “finger” drains should be considered around catch basins and in other low-lying areas where the exposed subgrade consists of silty or clayey soils to reduce the accumulation of water above and within the subgrade soils and aggregate base. As an alternative to the use of stub or finger drains, existing manholes and storm sewer inlets could be perforated with 1-inch diameter holes at 2-foot centers, and the manhole/inlet wrapped with a non-woven geotextile to reduce migration of material into the manhole/inlet. The holes could be placed at 90 degree intervals around the perimeter of the manhole, and the excavation around the manhole backfilled with free draining granular materials.

Pavement Maintenance: A sound maintenance program should be implemented to help maintain and enhance the performance of pavements and help attain the design service life. A preventative maintenance program should be implemented early in the pavement life to be effective. The “standard in the industry” supported by research indicates that preventative maintenance should typically begin within 2 to 5 years of the placement of pavement. However, maintenance of pavement on undocumented fill sites may require additional maintenance and earlier in the life cycle of the pavement. Failure to perform preventative maintenance will reduce the service life of the pavement and increase the costs for corrective maintenance and full pavement rehabilitation. To help reduce water infiltration through the pavement section into the base course layer, which may result in softening of the subgrade and deterioration of the pavement, we recommend timely sealing of pavement joints and cracks with elastomeric caulk. We recommend exterior pavements be observed for distresses, such as cracks, depressions, and poor drainage, at least twice a year, typically once in the spring and fall.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 SUBGRADE PREPARATION

5.1.1 Stripping and Initial Site Preparation

The subgrade preparation should consist of stripping pavement to be removed, vegetation, rootmat, topsoil, inadequate existing fill, and other soft/very loose or substandard materials from the 5-foot expanded pavement limits and 5 feet beyond the toe of engineered fills, where feasible. ECS should be retained to observe and document topsoil and other undesirable surficial materials have been removed prior to the placement of engineered fill or construction of pavements and structures. Existing utilities not reused should be capped-off and removed or properly abandoned in-place in accordance with local codes and ordinances.

5.1.2 Proof-rolling

After the removal of inadequate surface materials, cutting to the proposed subgrade, and prior to the placement of engineered fill or other construction materials, the exposed subgrade should be observed by ECS. The exposed subgrade should be thoroughly proof-rolled with construction equipment having a minimum axle load of 10 tons (e.g., fully loaded tandem-axle dump truck in clayey soils or large smooth drum roller in sandy soils). Proof-rolling should be traversed with overlapping passes of the vehicle under the observation of ECS. This procedure is intended to assist in identifying localized yielding materials.

Subgrade areas where proof-rolling identifies rutting or deflection exceeds 1 inch should be improved prior to the placement of subsequent engineered fill or other construction materials. Methods of stabilization, such as undercutting, moisture conditioning, or chemical stabilization should be discussed with ECS to identify possible solutions. Test pits may be excavated to explore the shallow subsurface materials to help in determining the cause of the observed poor materials, and to assist in the evaluation of appropriate remedial actions to stabilize the subgrade.

Near surface subgrade soils having a high moisture content and/or those having N-values less than 10 bpf may not pass a proof-roll and may need to be undercut or improved. Some undercutting or repair of unstable subgrade soils should be anticipated during slab and pavement subgrade preparation. If construction will occur during wet times of the year (such as during the spring or fall months), or immediately following extended periods of rain, then seasonal reduction of the near surface soil strength may occur. This may cause additional unstable or pumping subgrade areas for constructability concerns. The actual quantity of the subgrade undercut or stabilization should be determined by ECS at the time of construction.

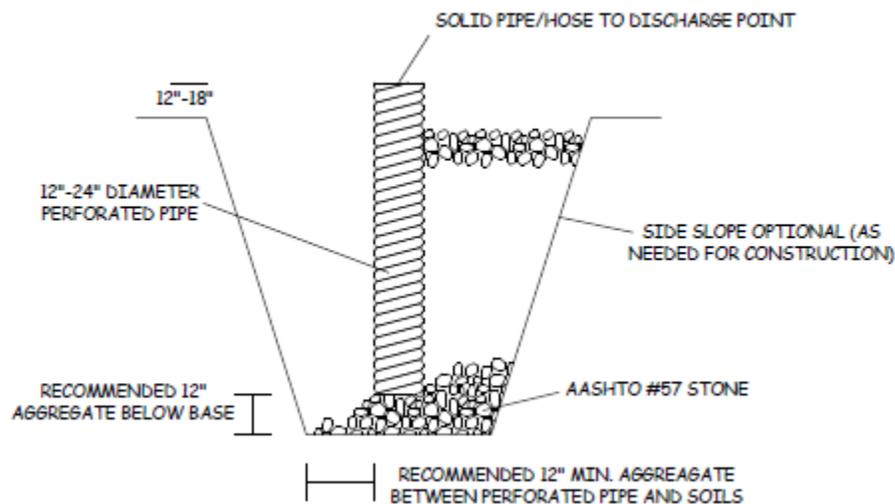
5.1.3 Site Temporary Dewatering

The contractor should make their own assessment of temporary dewatering needs based upon the limited subsurface groundwater information presented in this report. Soil sampling is not continuous, and thus soil and groundwater conditions may vary between sampling intervals (typically 5 feet). If the contractor believes additional subsurface information is needed to assess dewatering needs, they should obtain such information at their own expense. ECS makes no

warranties or guarantees regarding the adequacy of the provided information to determine dewatering requirements; such recommendations are beyond our scope of services.

Dewatering systems are a critical component of many construction projects. Dewatering systems must be selected, designed, and maintained by a qualified and experienced contractor familiar with the geotechnical and other aspects of the project. Failure to properly design and maintain a dewatering system for a given project can result in delayed construction, unnecessary foundation subgrade undercuts, detrimental soil conditions, and localized settlement of nearby infrastructure, foundations, slabs-on-grade and pavements, etc. Water discharged from site dewatering systems shall be discharged in accordance with all local, state and federal requirements.

Based on the subsurface exploration at this site, as well as our experience on other sites in nearby areas of similar geologic setting, ECS anticipates the construction dewatering at this site will be mainly to remove accumulated surface water and perched water. The typical primary strategy for addressing perched groundwater seeping into excavations is pumping from trench and sump pits with sump pumps. A typical sump pump drain (found in a sump pit or along a French drain) is depicted below. The inlet of the sump pump is placed at the bottom of the corrugated pipe and the discharge end of the sump is directed to an appropriate stormwater drain.



Sump Pit/Pump Diagram

Surface Drainage: The surface soils may be erodible. Therefore, the contractor should provide and maintain good site surface drainage during earthwork operations to maintain the integrity of the surface soils. Erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or steeper to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to reduce infiltration of surface water.

5.2 EARTHWORK OPERATIONS

5.2.1 Existing Man-Placed Fill

Fill Content: Boring B-02, B-05, B-06, and B-07 encountered existing fill and/or possible fill material that extended to depths between 2 and 6 feet below the existing grade. The existing fill material consisted of stiff LEAN CLAY (CL) and the possible fill materials consisted of stiff to very stiff LEAN CLAY, SANDY LEAN CLAY (CL) and medium dense SILTY GRAVEL (GM). For the possible fill, in the absence of deleterious material (such as recycled asphalt), it can be difficult to distinguish the difference between native soil and clean fill in the boring samples.

Existing fill has a risk for higher settlement because the soils were previously disturbed and potential variations in the density of this material may exist. The risk also increases where the material contains more than 5 percent organic content. An organic content test performed on a sample of the possible fill recovered from Boring B-07 indicated the material had a low to moderate organic content of 4.0 percent.

Based primarily on the standard penetration N-values and organic content test result, in our opinion, the risk for reduced pavement performance associated with the existing fill at this site is generally moderate. However, the risk could be reduced to low if the existing fill contains less than 5 percent organic content *and* proof-rolling observations do not indicate rutting or deflection greater than 1 inch.

Fill Removal from Pavement Areas: ECS recommends removing existing fill from within 2 feet of the finished pavement grade that contains greater than 5 percent organic content or does not meet the proof-rolling requirements outlined in this report. The removed material should then be replaced with a compacted engineered fill. ECS should be called on to observe and document undesirable existing fill materials have been removed prior to the placement of engineered fill or construction of pavement structures.

5.2.2 Frost Susceptible Soils

The frost susceptible clayey soils encountered in the borings provide a concern for the pavement system. A risk for reduced pavement performance exists with the construction of pavements on frost susceptible soil. The reduced pavement performance may occur because of potential detrimental frost heaving and spring thaw weakening. The risk associated with frost susceptible soils can be reduced by removal of the frost susceptible soils from within 3 feet of the finished pavement grade. In our opinion, the risk at this site related to the frost susceptible soils is generally moderate.

Based on our understanding of the owner's acceptable level of risk, ECS anticipates most of the moderately frost susceptible clayey soils will remain in place below pavements. However, if highly frost susceptible soils having an "A-4" AASHTO designation are encountered during construction, then we recommend consideration be given to removing these soils from within 3 feet of the finished pavement grade. The removed material should then be replaced with a properly compacted engineered fill.

5.2.3 Engineered Fill

Prior to placement of engineered fill, representative bulk samples (about 50 pounds) of on-site and off-site borrow should be submitted to ECS for laboratory testing, which will typically include natural moisture content, Atterberg limits, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Engineered Fill Materials: Engineered Fill is defined as inorganic soils with the following engineering properties and compaction requirements:

ENGINEERED FILL INDEX PROPERTIES	
Subject	Property
Liquid Limit (LL) and Plasticity Index (PI)	LL < 40, PI < 15
Maximum Particle Size	3 inches
Maximum Fines Content Passing #200 Sieve	20% by dry weight
Maximum Organic Content	5% by dry weight

ENGINEERED FILL COMPACTION REQUIREMENTS	
Subject	Requirement
Compaction Standard	Modified Proctor, ASTM D1557
Required Compaction	≥ 95% of Max. Dry Density
Moisture Content	-2 to +3 % points of the soil's optimum value
Loose Thickness	8 inches prior to compaction

On-Site Borrow Suitability: In our opinion, none of the encountered soils would likely meet the above requirements for engineered fill. Soils considered for use as engineered fill should be further evaluated and tested by ECS prior to use. On-site soil used as engineered fill should be free of frozen matter, deleterious materials, or chemicals that may result in the material being classified as "contaminated." Some conditions at the time of construction, such as wet or freezing weather, may preclude the use of on-site soil, and it may be necessary to use an imported less moisture sensitive or less frost susceptible granular material. The suitability of engineered fill materials should be checked by ECS prior to placement.

Fill Placement: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and frozen or frost-heaved soils should be removed prior to placement of engineered fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

5.3 UTILITY INSTALLATIONS

Utility construction should be in accordance with *The Standard Specifications for Sewer and Water Line Construction in Wisconsin*.

Utility Subgrades: ECS expects the soils encountered in our exploration to be generally adequate for support of utility pipes at typical utility depths. The pipe subgrade should be observed and probed for stability by ECS to confirm the encountered materials meet our recommendations. Existing fill, soft/very loose, organic, or otherwise substandard materials encountered at the utility pipe subgrade elevation should be removed and replaced with properly compacted engineered fill or pipe bedding material.

Utility Backfilling: The granular bedding material should be at least 4 inches thick, but not less than that specified by the project drawings and specifications and State requirements. ECS recommends granular bedding consist of crushed stone chips in accordance with Table 32 and Chapter 8.43.0 of *The Standard Specifications for Sewer and Water Line Construction in Wisconsin*.

Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the recommendations for engineered fill given in this report. We recommend cover material consist of material in accordance with Table 36 and Chapter 8.43.3 of *The Standard Specifications for Sewer and Water Line Construction in Wisconsin*.

Granular backfill material should consist of material in accordance with Table 37 and Chapter 8.43.4 of *The Standard Specifications for Sewer and Water Line Construction in Wisconsin*. Excavated material in accordance with Chapter 8.43.5 of *The Standard Specifications for Sewer and Water Line Construction in Wisconsin*, and as recommended in the **Earthwork Operations** section of this report could also be used as backfill.

We do not recommend flood compaction of the backfill, especially within a cohesive soil excavation, where cohesive soils are used as backfill, and/or where a shallow water table exists. Mechanical compaction is recommended and preferred since it generally provides more uniform compaction than flood compaction.

Excavation Safety: The contractor should make and maintain excavations and slopes in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing and constructing stable, excavations and slopes and should shore, slope, or bench the sides of the excavations and slopes as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in OSHA 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; ECS does not imply such responsibility, and the contractor, design team and owner should not infer it.

6.0 CLOSING

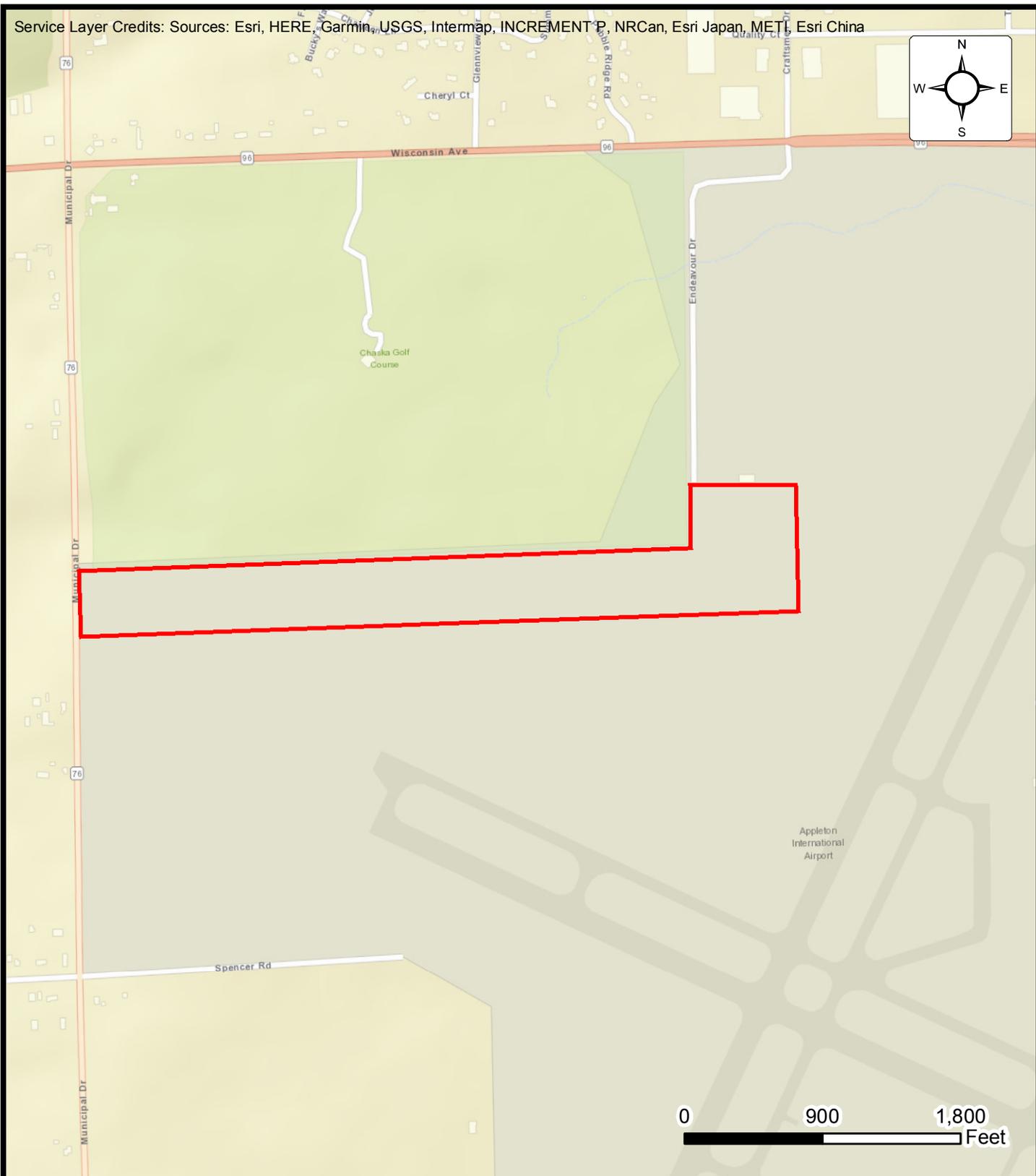
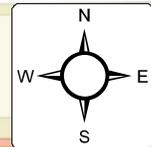
ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by McMahon Associates, Inc. If this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction. We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

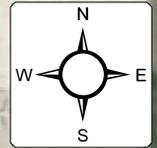
APPENDIX A – Diagrams and Reports

Site Location Diagram
Boring Location Diagram
Soil Survey Map
Subsurface Cross-Sections



**SITE LOCATION DIAGRAM
 PROPOSED ROADWAY EXTENSION
 AND APRON EXPANSION
 APPLETON INTERNATIONAL AIRPORT, APPLETON, WI
 MCMAHON ASSOCIATES, INC.**

ENGINEER ILM
SCALE AS NOTED
PROJECT NO. 59:3400
FIGURE 1 OF 1
DATE 2/28/2023



Legend



Approximate Boring Locations



Approximate Cross-Section Locations



BORING LOCATION DIAGRAM PROPOSED ROADWAY EXTENSION AND APRON EXPANSION

APPLETON INTERNATIONAL AIRPORT, APPLETON, WI
MCMAHON ASSOCIATES, INC.

ENGINEER
ILM

SCALE
AS NOTED

PROJECT NO.
59:3400

FIGURE
1 OF 1

DATE
2/28/2023



USDA Natural Resources Conservation Service

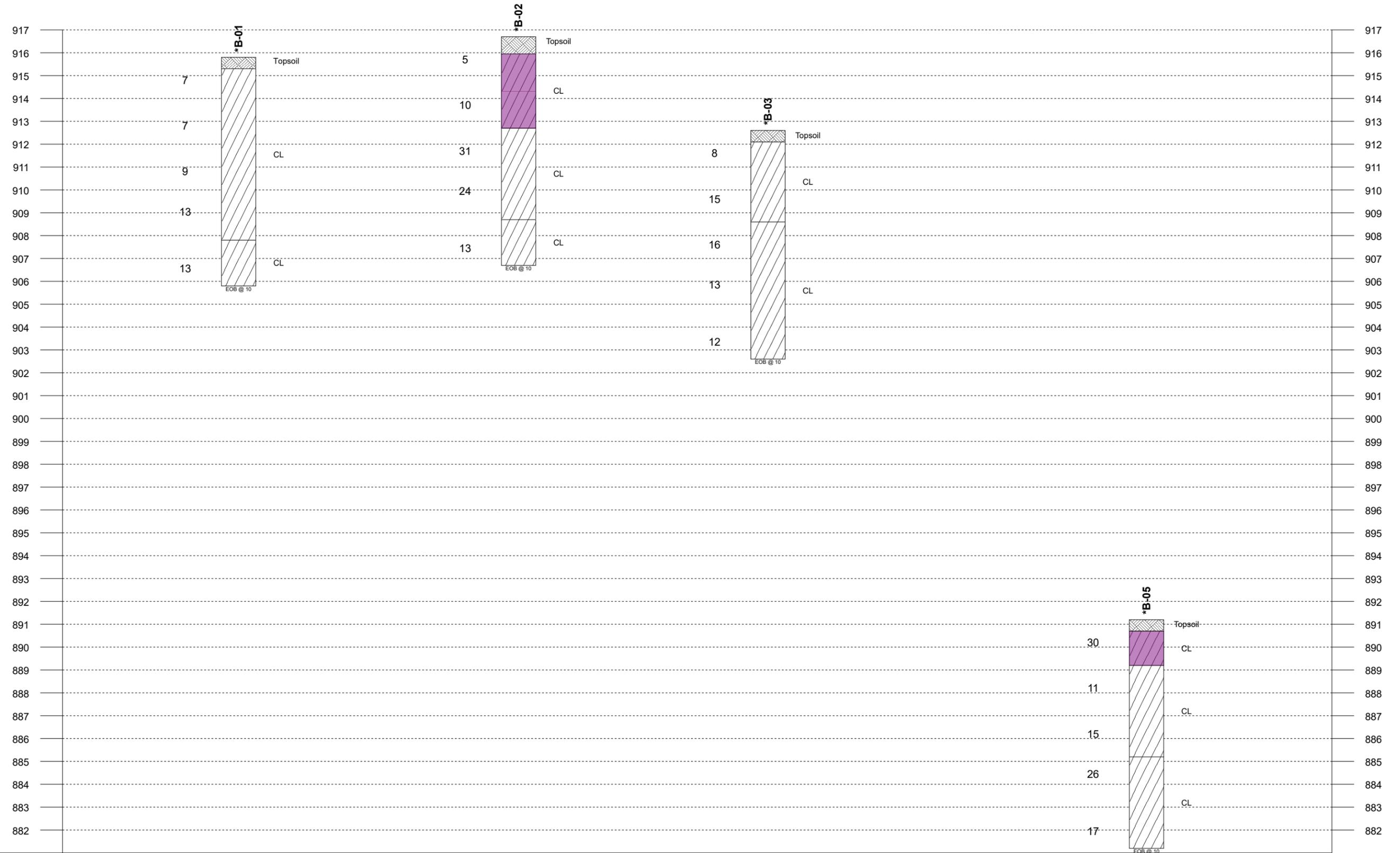
Web Soil Survey National Cooperative Soil Survey



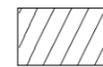
SOIL SURVEY MAP AIA ROADWAY EXTENSION AND APRON EXPANSION

W6390 CHALLENGER DRIVE, APPLETON, WISCONSIN
MCMAHON, INC.

ENGINEER JS
SCALE AS NOTED
PROJECT NO. 59:3400
FIGURE 1 OF 1
DATE 1/30/2023



Legend Key

-  Topsoil
-  Lean CLAY

Notes:
 1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
 2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
 3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
 4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

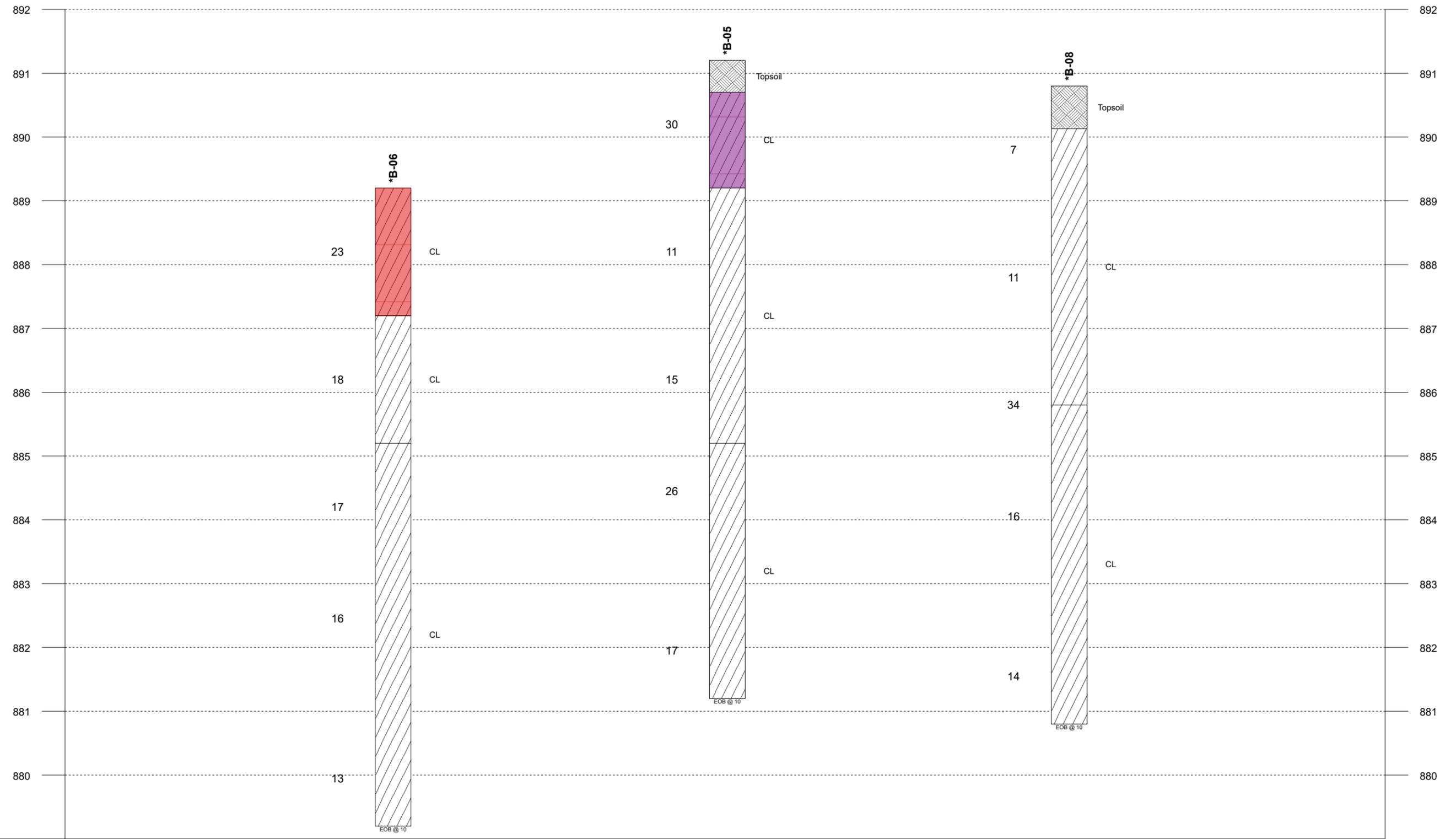
Plastic Limit	Water Content	Liquid Limit	▽	WL (First Encountered)		Fill
X	●	△	▼	WL (Completion)		Possible Fill
[FINES CONTENT %]			▽	WL (Estimated Seasonal High Water)		Probable Fill
	BOTTOM OF CASING		▽	WL (Stabilized)		Rock
	LOSS OF CIRCULATION		▽			



GENERALIZED SUBSURFACE SOIL PROFILE Section A-A'

AIA Roadway Extension and Apron Expansion
McMahon Associates, Inc.
W6390 Challenger Drive, Appleton, Wisconsin, 54914

Project No: 59:3400 Date: 03/02/2023



Legend Key

- Topsoil
- Lean CLAY

Notes:
 1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
 2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
 3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
 4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit	Water Content	Liquid Limit	▽	WL (First Encountered)
X	●	△	▼	WL (Completion)
[FINES CONTENT %]			▽	WL (Estimated Seasonal High Water)
	BOTTOM OF CASING		▽	WL (Stabilized)
	LOSS OF CIRCULATION			

	Fill
	Possible Fill
	Probable Fill
	Rock



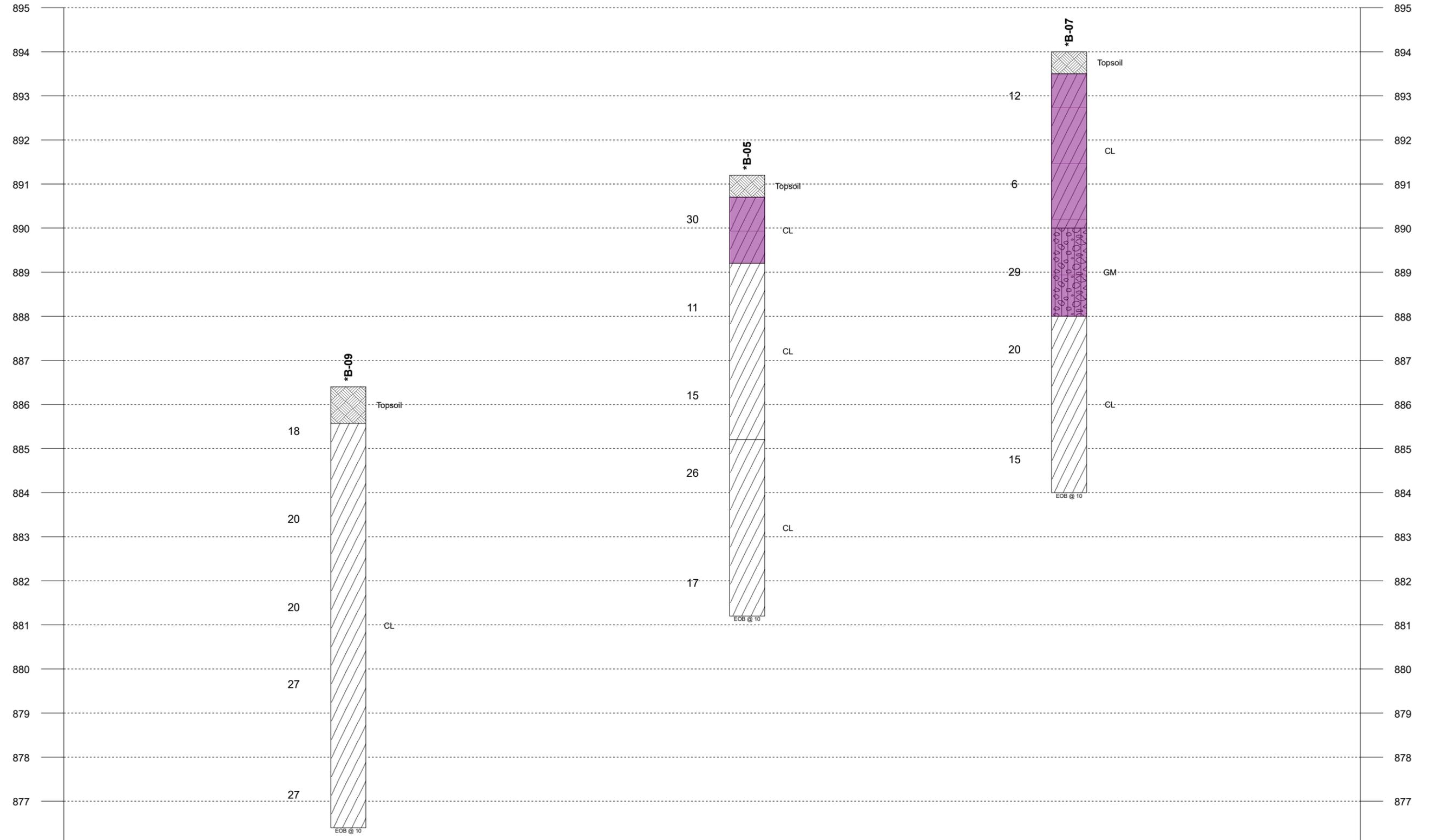
GENERALIZED SUBSURFACE SOIL PROFILE Section B-B'

AIA Roadway Extension and Apron Expansion

McMahon Associates, Inc.

W6390 Challenger Drive, Appleton, Wisconsin, 54914

Project No: 59:3400 Date: 03/02/2023



Legend Key

-  Topsoil
-  Lean CLAY
-  SILTY GRAVEL

Notes:
 1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
 2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
 3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
 4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit	Water Content	Liquid Limit	▽	WL (First Encountered)	■	Fill
X	●	△	▼	WL (Completion)	■	Possible Fill
[FINES CONTENT %]			▽	WL (Estimated Seasonal High Water)	■	Probable Fill
◀	BOTTOM OF CASING		▽	WL (Stabilized)	■	Rock
⊗	LOSS OF CIRCULATION					



GENERALIZED SUBSURFACE SOIL PROFILE Section C-C'

AIA Roadway Extension and Apron Expansion

McMahon Associates, Inc.

W6390 Challenger Drive, Appleton, Wisconsin, 54914

Project No: 59:3400 Date: 03/02/2023

APPENDIX B – Field Operations

Subsurface Exploration Procedure: Standard Penetration Testing (SPT)

Reference Notes for Boring Logs

AASHTO Soil Classification System

Boring Logs B-01 through B-09



SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT) ASTM D 1586 Split-Barrel Sampling

Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth
- Recording the number of hammer blows required to drive split-spoon a distance of 18-24 inches (in 3 or 4 Increments of 6 inches each)
- Auger is advanced* and an additional SPT is performed
- One SPT typically performed for every two to five feet. An approximate 1.5 inch diameter soil sample is recovered.



**Drilling Methods May Vary*— The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.



REFERENCE NOTES FOR BORING LOGS

MATERIAL ^{1,2}	
	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
	GW WELL-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GP POORLY-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GM SILTY GRAVEL gravel-sand-silt mixtures
	GC CLAYEY GRAVEL gravel-sand-clay mixtures
	SW WELL-GRADED SAND gravelly sand, little or no fines
	SP POORLY-GRADED SAND gravelly sand, little or no fines
	SM SILTY SAND sand-silt mixtures
	SC CLAYEY SAND sand-clay mixtures
	ML SILT non-plastic to medium plasticity
	MH ELASTIC SILT high plasticity
	CL LEAN CLAY low to medium plasticity
	CH FAT CLAY high plasticity
	OL ORGANIC SILT or CLAY non-plastic to low plasticity
	OH ORGANIC SILT or CLAY high plasticity
	PT PEAT highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS			
SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION	
DESIGNATION	PARTICLE SIZES
Boulders	12 inches (300 mm) or larger
Cobbles	3 inches to 12 inches (75 mm to 300 mm)
Gravel: Coarse	¾ inch to 3 inches (19 mm to 75 mm)
Gravel: Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand: Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
Sand: Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
Sand: Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")	<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS		
UNCONFINED COMPRESSIVE STRENGTH, QP ⁴	SPT ⁵ (BPF)	CONSISTENCY ⁷ (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	2 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT ⁷	COARSE GRAINED (%) ⁸	FINE GRAINED (%) ⁸
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective (ex: "Silty")	25 - 45	30 - 45

GRAVELS, SANDS & NON-COHESIVE SILTS	
SPT ⁵	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS ⁶	
	WL (First Encountered)
	WL (Completion)
	WL (Seasonal High Water)
	WL (Stabilized)

FILL AND ROCK			
FILL	POSSIBLE FILL	PROBABLE FILL	ROCK

¹Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

²To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

³Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

⁴Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

⁵Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

⁶The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

⁷Minor deviation from ASTM D 2488-17 Note 14.

⁸Percentages are estimated to the nearest 5% per ASTM D 2488-17.



**AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION
OFFICIALS (AASHTO)
SOIL CLASSIFICATION SYSTEM – AASHTO M145**

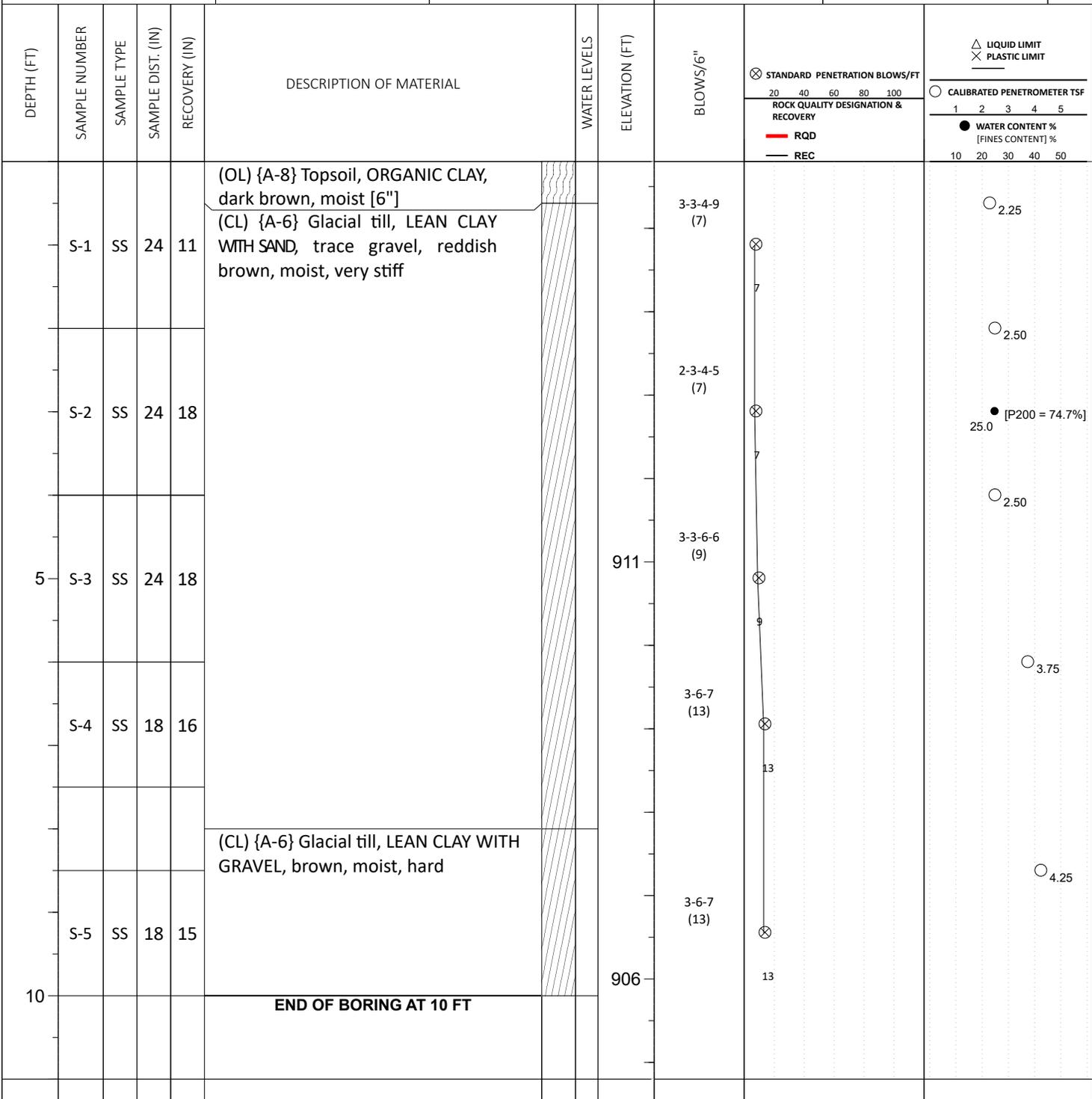
The AASHTO system of soil classification is based upon the observed field performance of subgrade soils under highway pavements and is widely used by highway engineers. According to this system, soils having approximately the same general load-carrying abilities are grouped together to form seven basic groups which are designated as A-1, A-2, A-3, A-4, A-5, A-6, and A-7. In general, A-1 soils would be the best soils for a highway subgrade and then each succeeding group being progressively poorer with A-7 soils being the poorest subgrade. The one exception is the A-3 group which is a better subgrade than the A-2 group. The classification system is shown in the table below:

AASHTO Soil Classification System

General Classification	Granular Materials (35% or less passing #200 Sieve)							Silt-Clay Materials (More than 35% passing #200 sieve)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
Group Classification	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis, Percent Passing											
#10	50 max	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
#40	30 max	50 max	51 min	-----	-----	-----	-----	-----	-----	-----	-----
#200	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of Fraction Passing #40											
Liquid Limit	-----	-----	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min	41 min
Plasticity Index	6 max	N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min ^{[1][2]}	
Usual Types of Significant Constituent Materials	Stone Fragments Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General Rating as Subgrade	Excellent to Good							Fair to Poor			

Notes: [1] – Plasticity Index of A-7-5 subgroup is equal to or less than Liquid Limit minus 30.
[2] – Plasticity Index of A-7-6 subgroup is greater than Liquid Limit minus 30.

SITE LOCATION: W6390 Challenger Drive, Appleton, Wisconsin, 54914	LOSS OF CIRCULATION 			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: 915.8	BOTTOM OF CASING

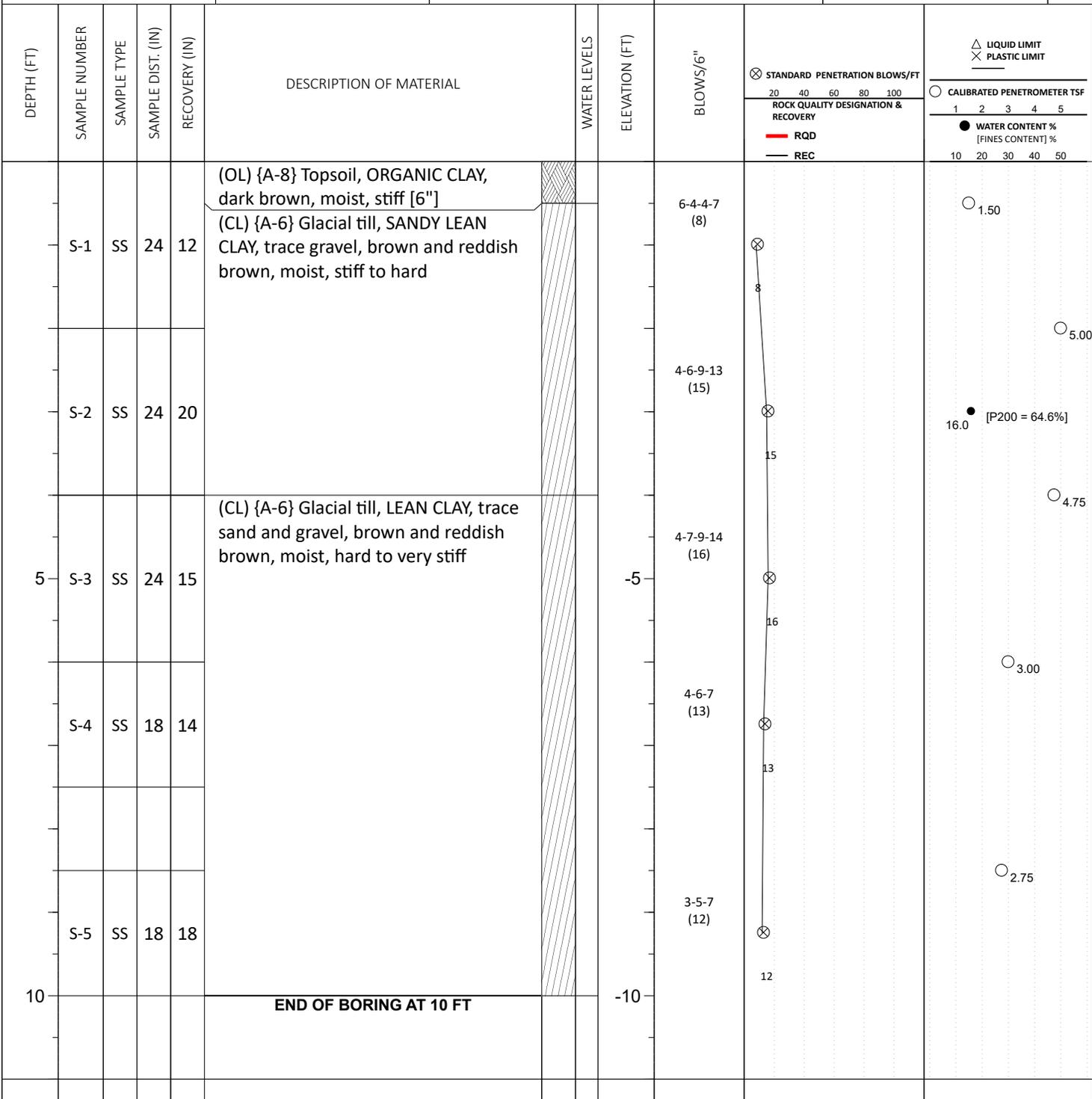


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

<input type="checkbox"/> WL (First Encountered) None	BORING STARTED: Feb 08 2023	CAVE IN DEPTH:
<input type="checkbox"/> WL (Completion) None	BORING COMPLETED: Feb 08 2023	HAMMER TYPE: Auto
<input type="checkbox"/> WL (Seasonal High Water)	EQUIPMENT: ATV	LOGGED BY: JS22
<input type="checkbox"/> WL (Stabilized)		DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION: W6390 Challenger Drive, Appleton, Wisconsin, 54914			LOSS OF CIRCULATION 	
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: 912.6	BOTTOM OF CASING

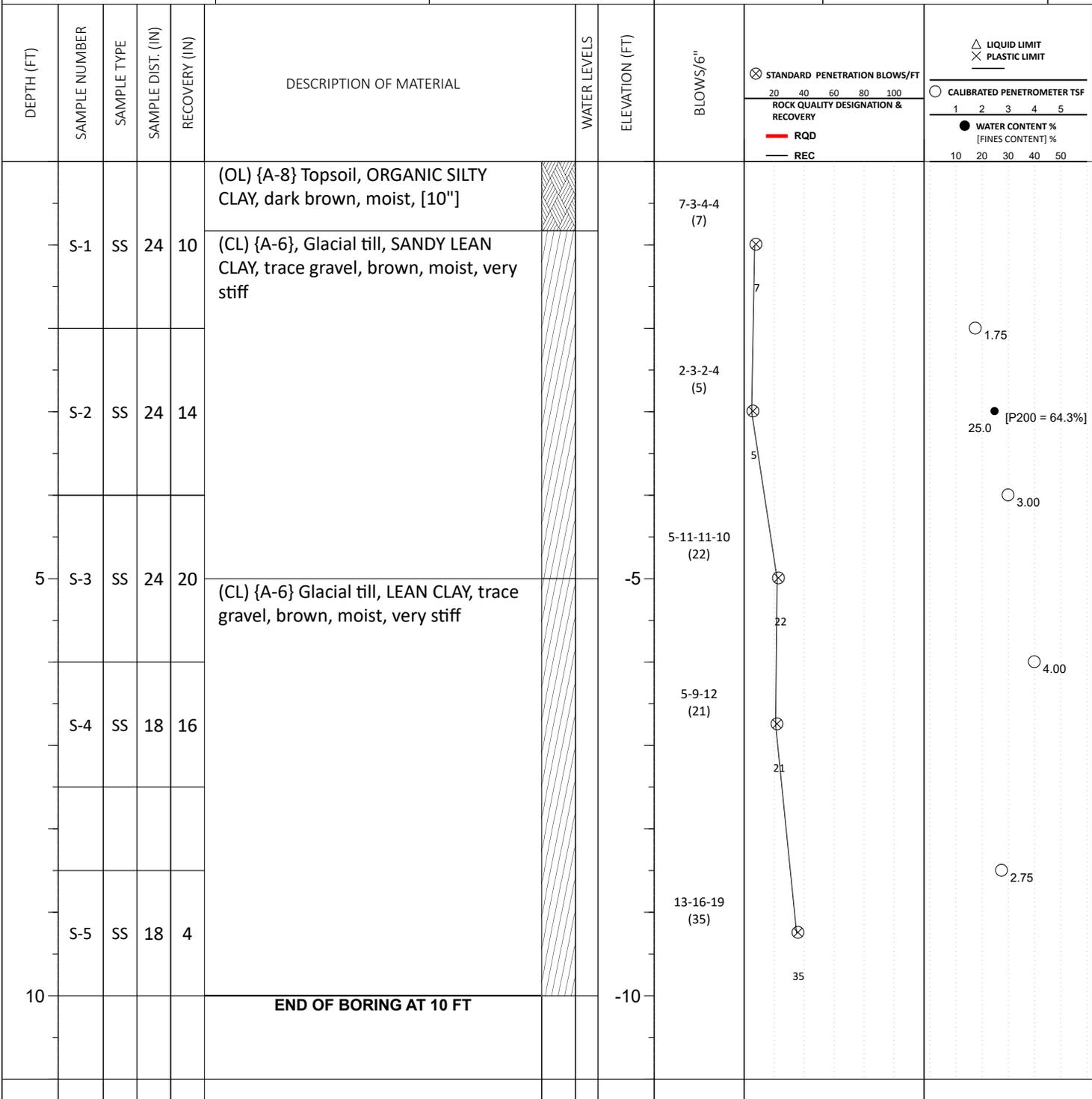


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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<input type="checkbox"/> WL (Completion)	none	BORING COMPLETED: Feb 08 2023	HAMMER TYPE: Auto
<input type="checkbox"/> WL (Seasonal High Water)		EQUIPMENT: ATV	DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)
<input type="checkbox"/> WL (Stabilized)		LOGGED BY: JS22	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION: W6390 Challenger Drive, Appleton, Wisconsin, 54914			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	BOTTOM OF CASING
			895.0



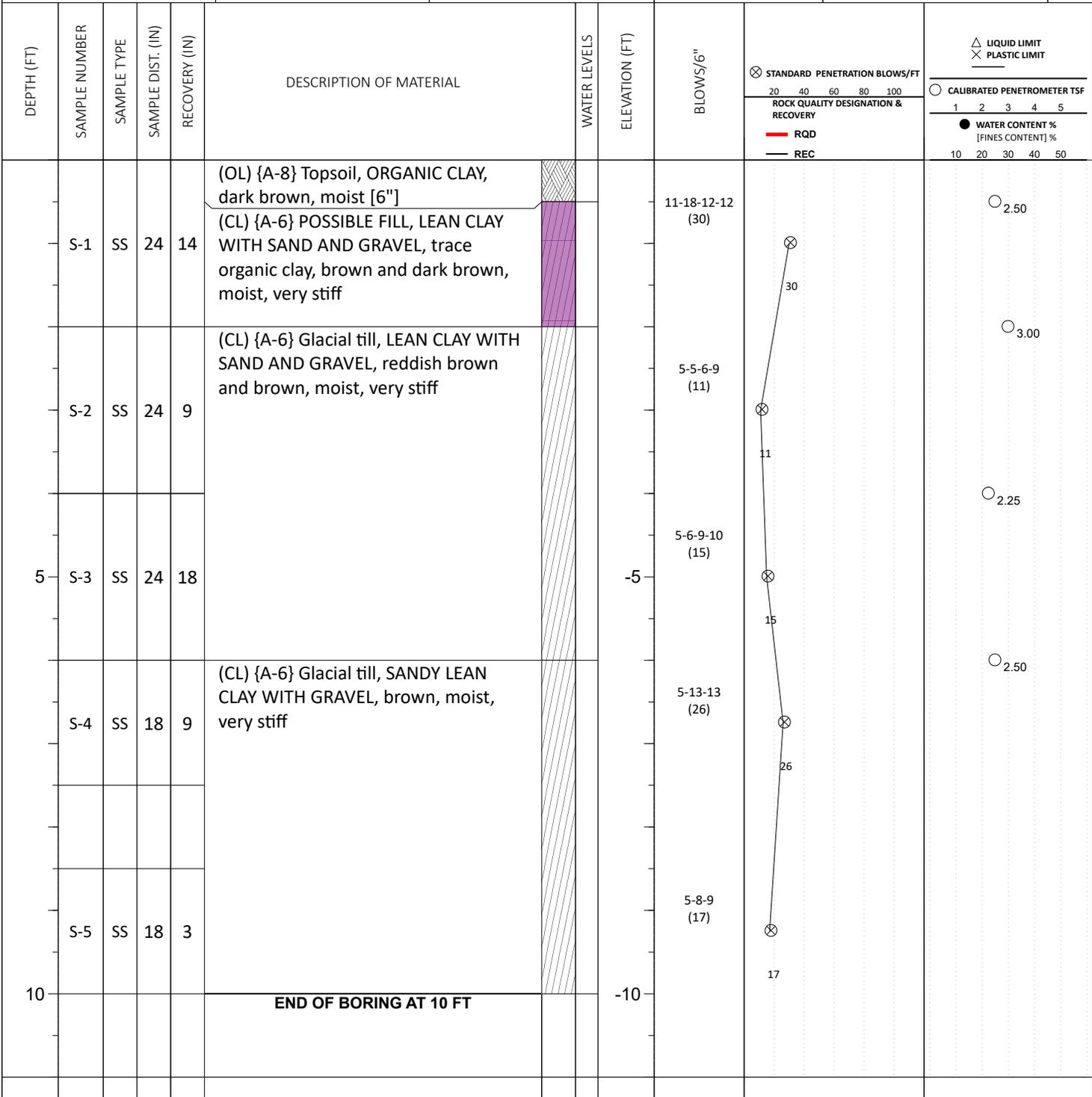
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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<input type="checkbox"/> WL (Seasonal High Water)		EQUIPMENT: ATV	DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)
<input type="checkbox"/> WL (Stabilized)		LOGGED BY: JS22	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
W6390 Challenger Drive, Appleton, Wisconsin, 54914

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: 891.2	LOSS OF CIRCULATION 
				BOTTOM OF CASING 

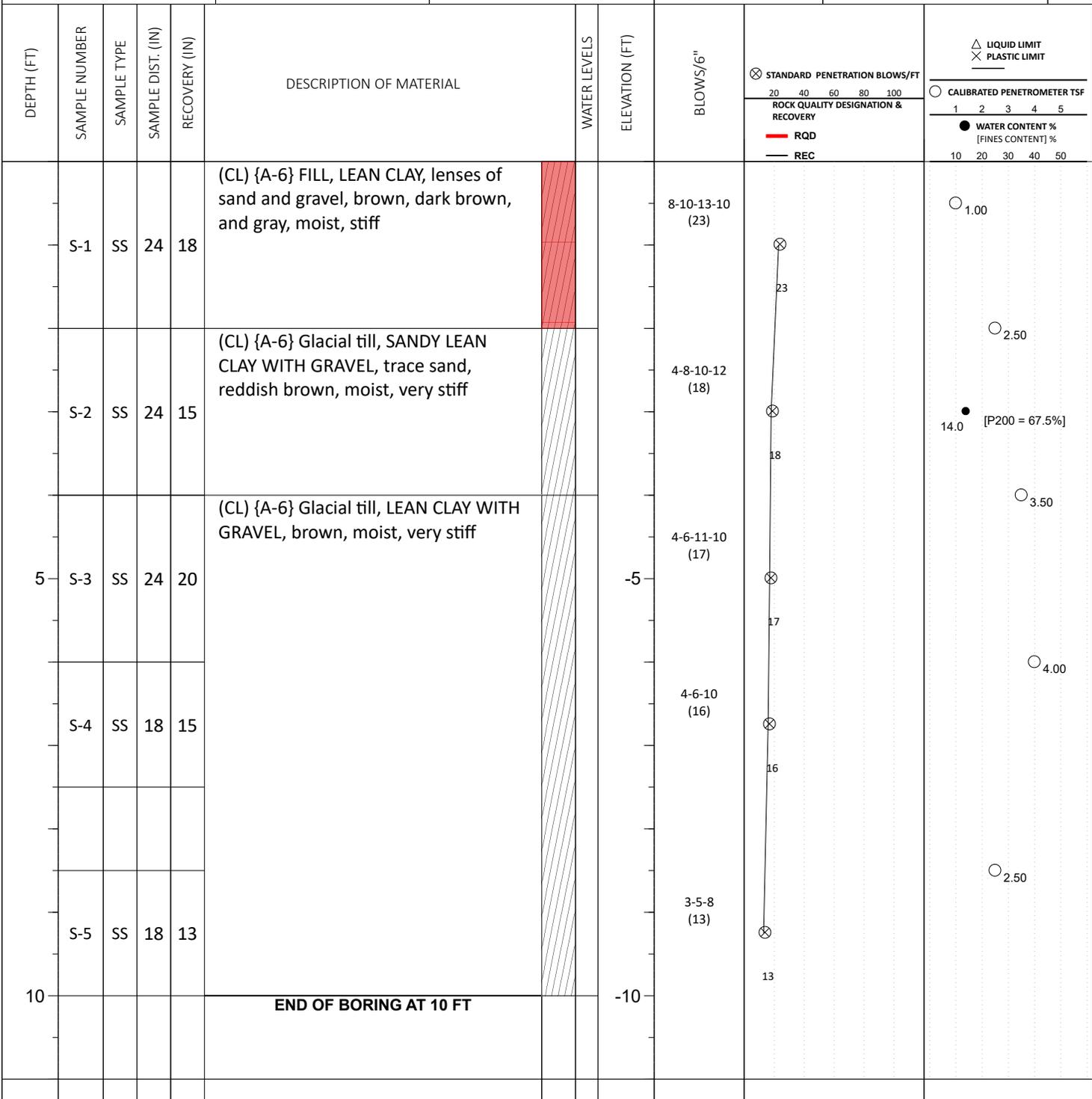


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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<input type="checkbox"/> WL (Stabilized)	DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION: W6390 Challenger Drive, Appleton, Wisconsin, 54914			LOSS OF CIRCULATION 	
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: 889.2	BOTTOM OF CASING

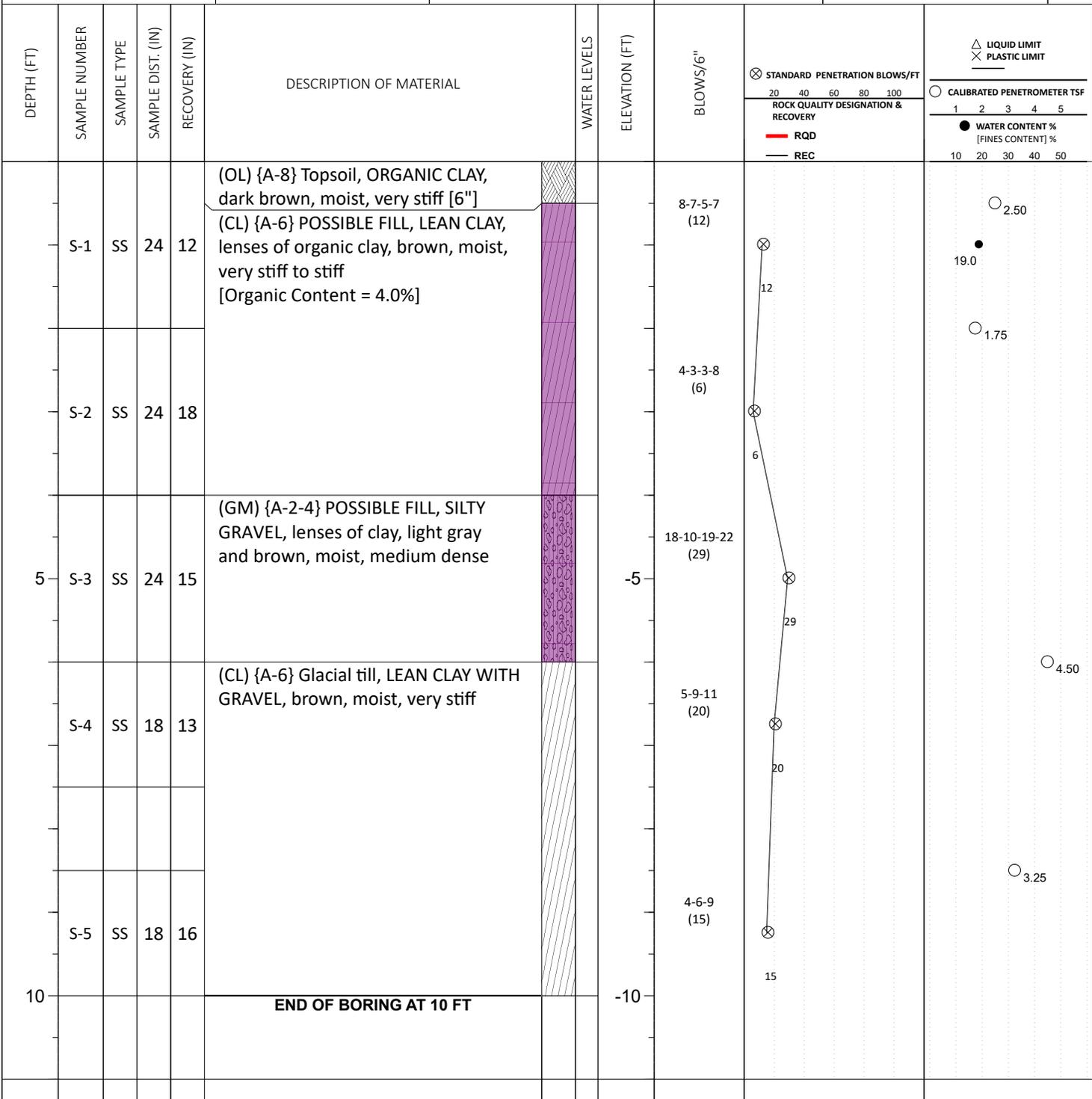


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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<input checked="" type="checkbox"/> WL (Completion) none	BORING COMPLETED: Feb 07 2023	HAMMER TYPE: Auto
<input checked="" type="checkbox"/> WL (Seasonal High Water)	EQUIPMENT: ATV	LOGGED BY: JS22
<input checked="" type="checkbox"/> WL (Stabilized)	DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION: W6390 Challenger Drive, Appleton, Wisconsin, 54914			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	BOTTOM OF CASING

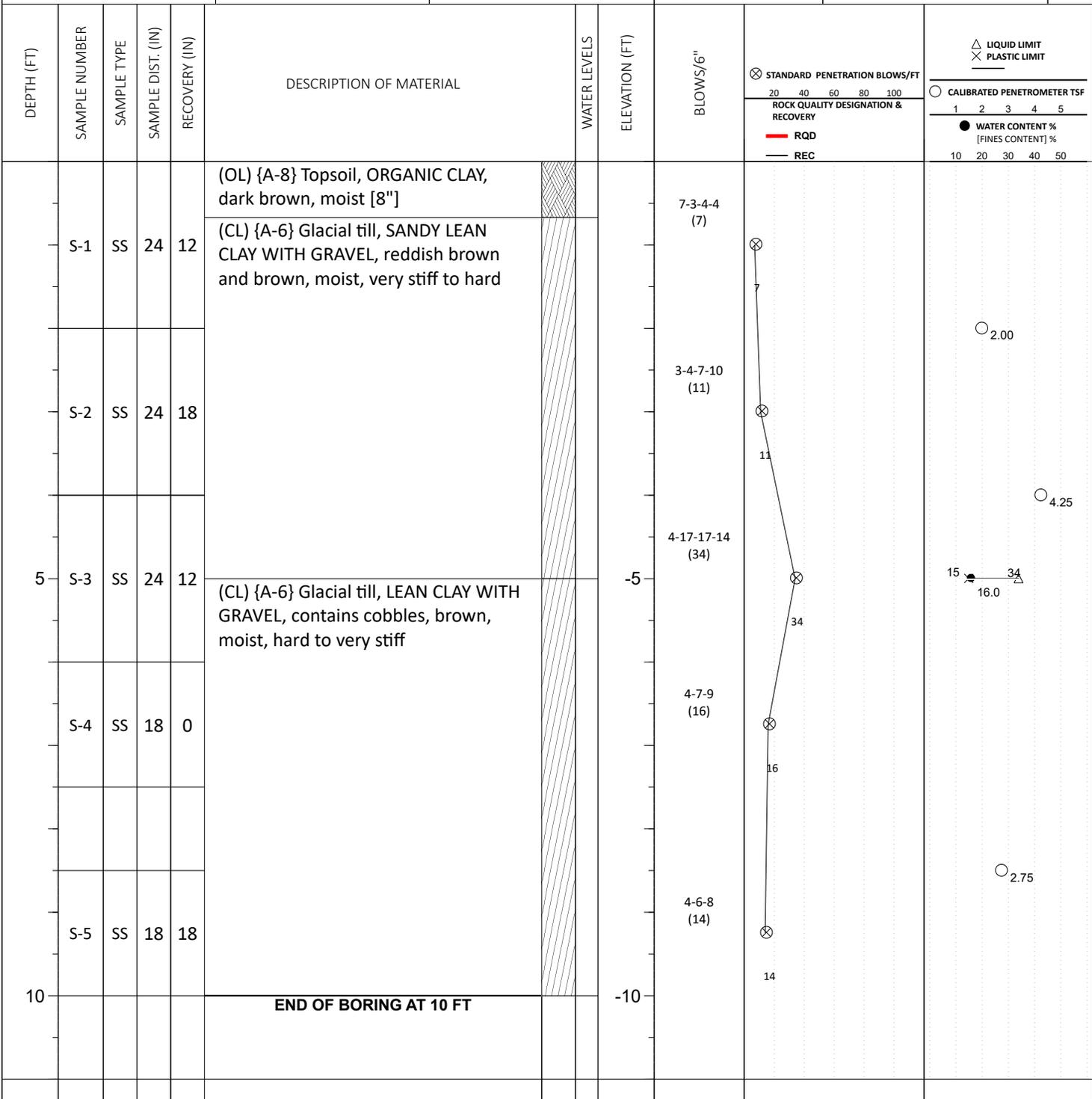


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

<input type="checkbox"/> WL (First Encountered) none	BORING STARTED: Feb 07 2023	CAVE IN DEPTH:
<input checked="" type="checkbox"/> WL (Completion) none	BORING COMPLETED: Feb 07 2023	HAMMER TYPE: Auto
<input checked="" type="checkbox"/> WL (Seasonal High Water)	EQUIPMENT: ATV	DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)
<input checked="" type="checkbox"/> WL (Stabilized)	LOGGED BY: JS22	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION: W6390 Challenger Drive, Appleton, Wisconsin, 54914			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	BOTTOM OF CASING

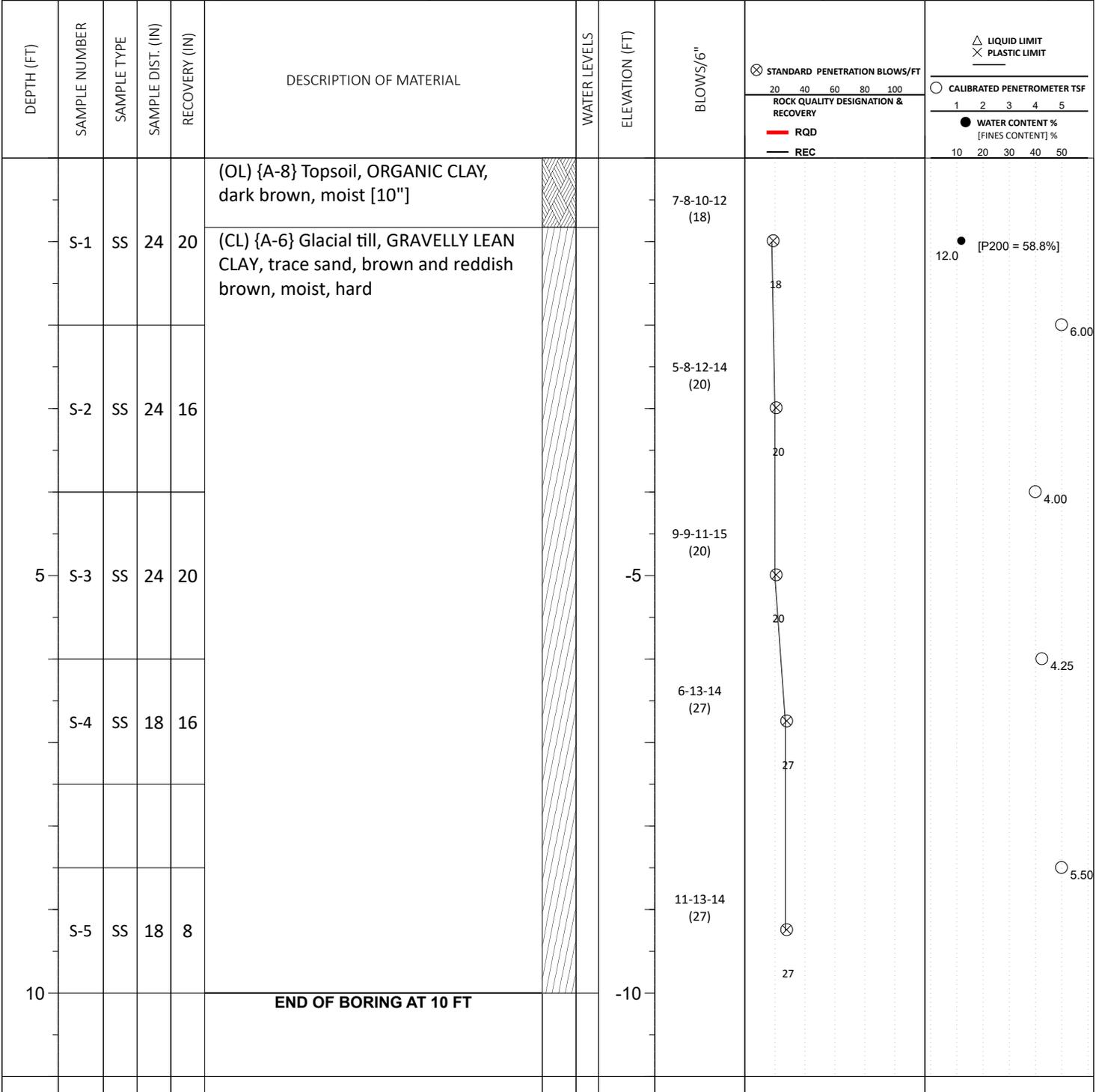


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

<input type="checkbox"/> WL (First Encountered)	None	BORING STARTED: Feb 06 2023	CAVE IN DEPTH:
<input checked="" type="checkbox"/> WL (Completion)	None	BORING COMPLETED: Feb 06 2023	HAMMER TYPE: Auto
<input checked="" type="checkbox"/> WL (Seasonal High Water)		EQUIPMENT: ATV	DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)
<input checked="" type="checkbox"/> WL (Stabilized)		LOGGED BY: JS22	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION: W6390 Challenger Drive, Appleton, Wisconsin, 54914			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	BOTTOM OF CASING



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

<input type="checkbox"/> WL (First Encountered)	None	BORING STARTED: Feb 06 2023	CAVE IN DEPTH:
<input type="checkbox"/> WL (Completion)	None	BORING COMPLETED: Feb 06 2023	HAMMER TYPE: Auto
<input type="checkbox"/> WL (Seasonal High Water)		EQUIPMENT: ATV	DRILLING METHOD: 3 1/4" HSA 0' to 8.5' (AH)
<input type="checkbox"/> WL (Stabilized)		LOGGED BY: JS22	

GEOTECHNICAL BOREHOLE LOG

APPENDIX C – Supplemental Report Documents

Important Information about This Geotechnical-Engineering Report

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* **Confront the risk of moisture infiltration** by including building-envelope or mold specialists on the design team. **Geotechnical engineers are not building-envelope or mold specialists.**



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