



ECS Midwest, LLC

Geotechnical Engineering Report

Proposed Badger Farm Due Diligence

County Road K & I-94
Caledonia, Wisconsin

ECS Project Number 42:2185

December 21, 2021





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Mr. Jason Lueders
Director of Construction
Zilber Property Group
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Kenosha, WI, 53144
Email: Jason.Lueders@Zilber.com

ECS Project No. 42:2185

Reference: Geotechnical Engineering Report
Proposed Badger Farm Due Diligence
County Road K & I-94
Caledonia, Wisconsin

Dear Mr. Lueders:

ECS Midwest, LLC (ECS) has completed the subsurface exploration, field and laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed scope of services. This report presents our understanding of the geotechnical aspects of the project, 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 you on this project. We would like to continue our services during design and provide our services during construction to check the assumptions of subsurface conditions made for this report. Please contact us should you have questions about the information contained in this report, or if we can be of further assistance to you.

Respectfully submitted,

ECS Midwest, LLC



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TABLE OF CONTENTS

1.0 INTRODUCTION2

2.0 PROJECT INFORMATION.....3

 2.1 Project Location/Current Site Use/Past Site Use..... 3

 2.2 Proposed Construction 3

3.0 DESKTOP STUDY5

 3.1 Surficial Deposits..... 5

 3.2 Bedrock 6

4.0 FIELD EXPLORATION AND LABORATORY TESTING7

 4.1 Field Exploration 7

 4.1.1 Borings 7

 4.1.2 Test Pits..... 7

 4.1.3 Topsoil Hand Auger Probes..... 7

 4.2 Subsurface Characterization 8

 4.3 Groundwater Observations 8

 4.4 Laboratory Testing 9

5.0 DESIGN RECOMMENDATIONS10

 5.1 Foundations 10

 5.2 Slabs-on-Grade..... 12

 5.3 Site Retaining Walls 13

 5.4 Seismic Design Considerations 15

 5.5 Pavement Design Considerations 15

6.0 SITE CONSTRUCTION CONSIDERATIONS.....19

 6.1 Subgrade Preparation 19

 6.1.1 Stripping and Grubbing..... 19

 6.1.2 Proofrolling 19

 6.1.3 Site Temporary Dewatering..... 21

 6.2 Earthwork Operations..... 22

 6.2.1 Engineered Fill 22

 6.2.2 Compaction..... 23

 6.2.3 General Considerations 25

 6.3 Foundation and Slab Observations..... 26

 6.4 Utility Installations 27

7.0 CLOSING28

APPENDICES

Appendix A – Drawings & Reports

- Site Location Diagram
- Boring Location Diagram
- Generalized Subsurface Soil Profiles

Appendix B – Field and Laboratory Operations

- Reference Notes for Boring Logs
- Subsurface Exploration Procedures: SPT
- Boring Logs
- Test Pit Logs
- Topsoil Hand Auger Summary
- Laboratory Testing Procedures: Index Testing

Appendix C – Supplemental Report Documents

- Important Information about This Geotechnical-Engineering Report

EXECUTIVE SUMMARY

This Executive Summary is intended as a very brief overview of the primary geotechnical conditions 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 is in the due diligence phase. Therefore, the specific details of the future developments are not known so a limited number of test borings and test pits were performed within the 100-acre site for evaluation. This report contains preliminary geotechnical engineering information to evaluate the feasibility of developing the site. The recommendations herein are for preliminary development feasibility purposes only and are not intended to be used for the final design. A more comprehensive subsurface exploration and analysis is recommended to be performed for the development when building elevations, locations and structural details are known to provide more detailed recommendations for foundations, floor slabs, retaining walls and pavements including specific allowable soil bearing pressures and estimated settlements for development of the final design of the project.***
- A shallow foundation system bearing in competent native soils or bearing on engineered fill placed from a suitable bearing native soil subgrade may be preliminarily designed for a maximum, net, allowable bearing pressure of 4,000 psf. Undercut may be needed in areas due to crop tillage and a few areas of higher moisture/lower strength soil.
- In our opinion the site soils can be characterized as Site Class D for seismic design considerations.
- The building floor slab thicknesses may be determined based on an assumed modulus of subgrade reaction of 125 psi/in. Undercut may be needed in areas due to crop tillage and a few areas of higher moisture/lower strength soil.
- We recommend retaining walls be designed to withstand the lateral earth pressures exerted by the backfill, water, and surface or other surcharges. For rigid walls, restrained from rotation, the "at-rest" (k_o) soil condition should be used in the wall design and evaluation. For walls that are free to deflect at their tops, the "Active" (k_a) soil condition should be used in the wall design and evaluation. We recommend the walls be backfilled with a free-draining granular material.

1.0 INTRODUCTION

The purpose of this report is to provide geotechnical information for the design of foundations, floor slabs, retaining walls, and pavements for the proposed development. The recommendations developed for this report are based on project information supplied by you.

ECS provided its services in accordance with ECS Proposal No. 42:2918-GP, dated November 16, 2021, as authorized through the Purchase Order Number CM7010-000173 dated November 17, 2021 between ECS Midwest, LLC and Zilber Property Group, executed on November 22, 2021.

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

The report includes the following items.

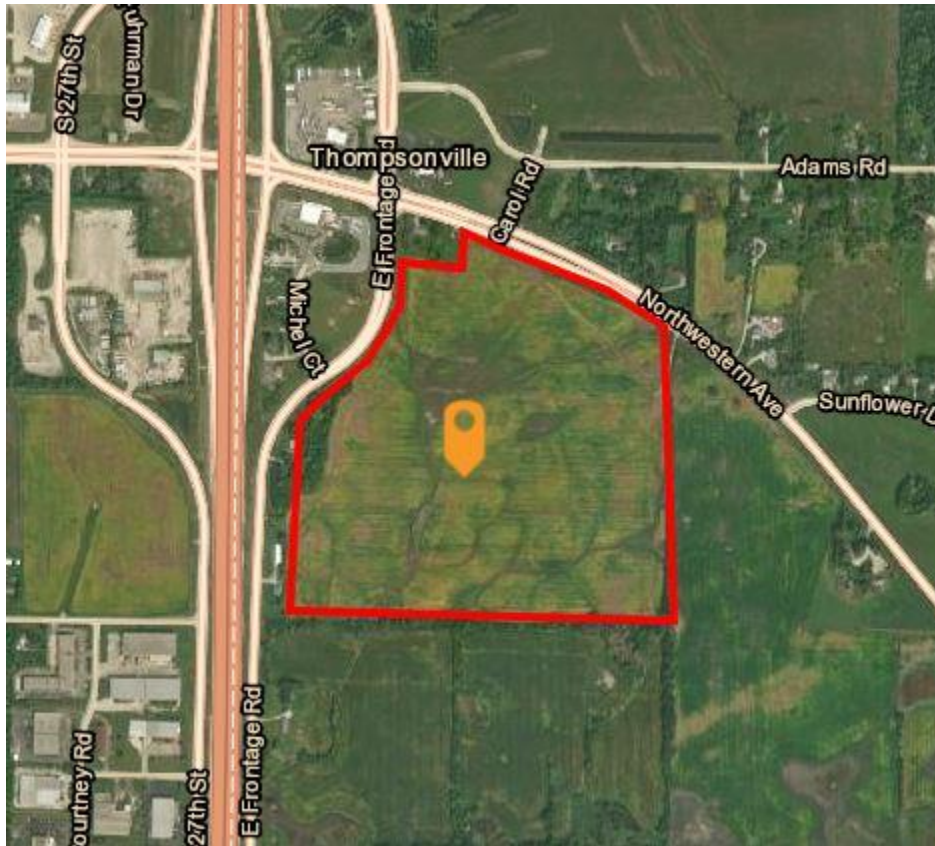
- A brief description of the field and laboratory test procedures and results.
- A description of the observed surface topographical features and site conditions.
- A description of area and site geologic conditions.
- A description of the interpreted subsurface soil stratigraphy with pertinent available physical properties.
- Records of the subsurface explorations (test boring/test pit logs).
- Foundation recommendations.
- General ground-supported floor slab design recommendations, including a recommended design subgrade modulus value.
- Recommended seismic Site Class.
- Recommendations for design of retaining walls.
- General pavement design recommendations, including a recommended design CBR value.
- Recommendations for site preparation and construction of engineered fills, including an evaluation of on-site soils for use as engineered fills, and delineation of potentially unsuitable soils and/or soils exhibiting excessive moisture at the time of sampling.
- General considerations relative to groundwater.

The scope of services for this project did not include an environmental assessment for determining the presence or absence of wetlands, or corrosive, hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE/PAST SITE USE

The project site is located on the south side of County Road K (Northwestern Avenue), just east of I-94 in Caledonia, Racine County, Wisconsin. The subject property is bounded to the north by County Road K, to the south and east by farmland, and to the west by residences and East Frontage Road. The site location is shown below, and on the Site Location Diagram in Appendix A.



Site Location (approximate site outlined in red)

The site is currently an undeveloped farmland. Based on the field map provided to us, dated October 22, 2021 by Heartland, the site has a rolling topography, and the approximate site surface elevations range from approximately EL. 748 to EL. 782 feet.

We performed a cursory review of aerial photographs of the subject site, dated 1937, 1963, 1967, 1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2015, and 2020 available on the Kenosha County Mapping website. The site appeared to be vacant farmland on the 1941 and 1950 aerials. The site appeared to historically be vacant farmland.

2.2 PROPOSED CONSTRUCTION

It is understood the proposed 100-acre development will include the construction of industrial-type buildings and pavement.

Buildings: The project is currently in the due diligence phase. Therefore, details such as the locations, loads and finished floor elevations (FFE) of the structures were not available. The information listed below summarizes our general assumptions of the structures and their loads.

BUILDING DESIGN INFORMATION/ASSUMPTIONS	
Subject	Expectation
Framing	Steel-frame
Levels	Single-story, slab-on-grade
Column Loads	80 to 250 kips
Wall Loads	2 to 5 kips per linear foot (klf)
Slab on Grade Floor Live Load	125 to 250 psf live load
Finished Floor Elevation	varies

The settlement tolerance of the proposed structures was not provided. Based on similar type construction we assume the maximum tolerable building settlement is 1 inch total and ½ inch differential.

Pavement: The development will also include paved parking and drive lanes. The project is currently in the due diligence phase. Therefore, the design traffic was not known. Therefore, it was necessary for us to arbitrarily select design traffic volumes to provide preliminary Pavement recommendations. The information below summarizes our assumptions of the traffic.

PAVEMENT DESIGN INFORMATION/ASSUMPTIONS	
Pavement Area	Maximum Daily Traffic
Light Duty	200 automobiles and 5 daily 18,000-pound ESALs
Medium Duty	1,000 automobiles and 50 daily 18,000-pound ESALs
Heavy Duty	1,000 automobiles and 100 daily 18,000-pound ESALs

Site Grading: It is assumed that up to approximately 4 feet of fill and cut will be needed to develop the site independent of subgrade preparation recommendations.

If ECS' understanding of the project is not correct or the design changes, especially if the structural loads or elevations are different, please contact ECS so that we may review these changes and revise our recommendations, as appropriate.

3.0 DESKTOP STUDY

Cursory review of readily available published geology and hydrogeology information was done to help evaluate the potential for geological factors that may not be captured by the subsurface exploration, and to evaluate the significance of these factors on the design and construction.

3.1 SURFICIAL DEPOSITS

Based on the USDA Natural Resources Conservation Service Web Soil Survey (<https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>), which provides soil information to a shallow (typically less than 5 feet) depth, the site soils as mapped are described below. Soil mapping of the site vicinity is also presented below.

- **(AtA) Ashkum silty clay loam:** Formed on end and ground moraines. Consists of clayey colluvium over till. These soils are considered to have a high potential for frost action, present a high risk of corrosion to uncoated steel, a low risk of corrosion to concrete, and a moderate shrink-swell potential.
- **(BcA) Beecher silt loam:** Formed on moraines. Consists of loess over calcareous, silty or loamy till. These soils are considered to have a high potential for frost action, present a high risk of corrosion to uncoated steel, a moderate risk of corrosion to concrete, and a moderate shrink-swell potential.
- **(MeB, MeB2) Markhm silt loam:** Formed on end and ground moraines. Consists of loess over silty clay loam till. These soils are considered to have a moderate potential for frost action, present a high risk of corrosion to uncoated steel, a moderate risk of corrosion to concrete, and a low shrink-swell potential.
- **(OzaB) Ozaukee silt loam:** Formed on ground and end moraines. Consists of loess over wisconsinan age silty and clayey till. These soils are considered to have a moderate potential for frost action, present a high risk of corrosion to uncoated steel, a moderate risk of corrosion to concrete, and a low shrink-swell potential.



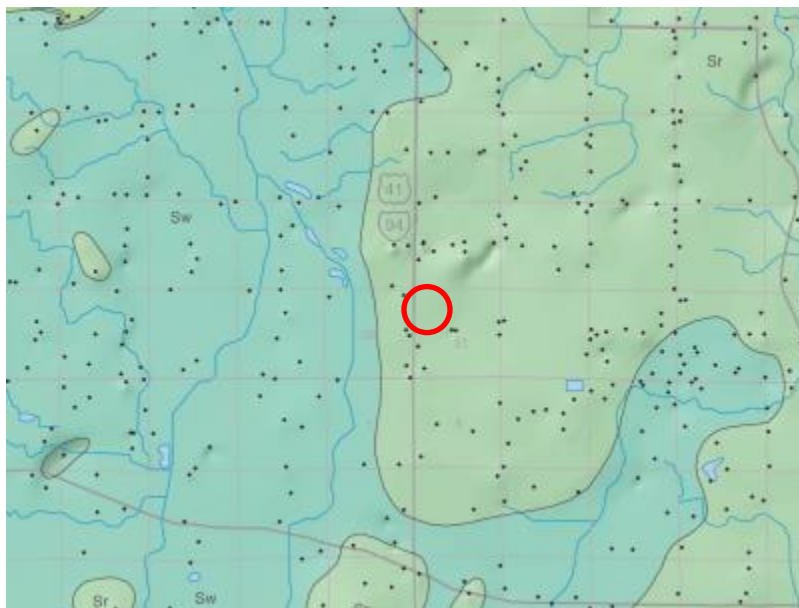
(Source: USDA - Natural Resources Conservation Service Web Soil Survey: websoilsurvey.nrcs.usda.gov)

Soil Survey Mapping

Glacial soils are often heterogeneous horizontally and vertically due to lack of sorting commonly associated with a glacial environment of deposition. Pre-glacial landforms unapparent from the surface may underlie glacial deposits. Cobbles or boulders may be present within or buried by glacial deposits. Local inclusions of water-deposited, laminated sands, silts and clays are sometimes encountered. Abrupt transitions common between varied glacial materials can impact design, construction and performance of new structures.

3.2 BEDROCK

The Wisconsin Geological and Natural History Survey Open-File Report (WOFR) 2004-12A *Preliminary Bedrock Geologic Map of Racine County, Wisconsin* indicates the Silurian aged Racine Formation (Sr) underlies the site. The bedrock is reported to consist of dolomite, which is medium to coarse grained, thin to thickly bedded, very light to light gray and fossiliferous. Open-File Report 2004-12C *Preliminary Depth to Bedrock Map of Racine County, Wisconsin* indicates bedrock may be at an approximate depth of 100 to 150 feet, and Open-File Report 2004-12B *Preliminary Elevation of Bedrock Map of Racine County, Wisconsin* indicates bedrock may be at an approximate elevation of EL. 600 to EL. 650 feet above mean sea level. An overview of the general site geology is illustrated below with the approximate site location outlined in red.



(Source: Wisconsin Geological and Natural History Survey Open-File Report 2004-15A)

Bedrock Mapping

4.0 FIELD EXPLORATION AND LABORATORY TESTING

4.1 FIELD EXPLORATION

The exploration procedures are described in greater detail in Appendix B in the insert titled Subsurface Exploration Procedures: SPT.

4.1.1 Borings

ECS used a measuring tape/wheel to field locate the borings relative to existing site features prior to mobilization of the drilling equipment. These locations were then referenced using a handheld GPS. The manufacturer states the typical expected accuracy for this GPS receiver, in an open sky, is 4 meters. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. Ground surface elevations at the boring locations were estimated from the topographic information on Google Earth. Ground surface elevations and boring locations determined without professional survey are approximate and may not be appropriate for final design.

Prior to drilling our subcontracted driller contacted the State of Wisconsin Utility One-Call Center, Digger's Hotline, to clear and mark underground utilities in the vicinity of the project site.

After utilities had been located and marked, 17 borings were advanced at the site on December 13, 14 and 16, 2021 by a subcontracted driller under the general guidance of ECS. Each boring was advanced to an approximate depth of 20 feet below existing site grade. The drill crew utilized a 7822DT Geoprobe track-mounted rotary drilling rig equipped with continuous flight, hollow stem augers to drill the borings.

The drill crew backfilled the boreholes at completion of drilling. Settlement or expansion of borehole backfill can occur over time resulting in a trip hazard. Monitoring the boreholes after initial drilling activities is not within our scope but should be done by the client or property owner.

4.1.2 Test Pits

Three test pits were dug by Reesman and observed by ECS on December 20, 2021. The test pits were dug to approximate depths of 12 to 17½ feet below existing site grade. After completion, the test pit excavations were backfilled by Reesman personnel with the excavated soils using nominal compaction effort consisting of tamping the soil with the excavator bucket.

These test pit locations were then referenced using a handheld GPS. The approximate test pit locations are indicated on the Boring Location Diagram in Appendix A.

4.1.3 Topsoil Hand Auger Probes

Forty-two hand auger probes were performed randomly within the site to estimate the depth of topsoil. The hand auger probes were performed utilizing an approximately 3¼-inch-diameter bucket-type hand auger. The approximate hand auger probe locations are indicated on the Boring Location Diagram in Appendix A. A summary of the estimated topsoil thicknesses encountered are included in Appendix B.

The boreholes were backfilled with soil cuttings after completion of the hand auger operations.

4.2 SUBSURFACE CHARACTERIZATION

The observed subsurface conditions were generally consistent with published geological mapping. Below is a generalized characterization of the subsurface materials encountered at the boring locations. Refer to the Boring Logs in Appendix B for information at a specific boring location.

GENERALIZED SUBSURFACE STRATIGRAPHY					
Approx. Depth to Stratum Bottom (feet)	Strata	Description	SPT ⁽¹⁾ N-value Range (bpf)	Calibrated Penetrometer Resistance (tsf)	Moisture Content (%)
Surface	--	Topsoil (0 to 33 inches ±)	N/A	N/A	N/A
20	I	(CL) LEAN CLAY, LEAN CLAY WITH SAND and SANDY LEAN CLAY, stiff to hard	2 - 29	1.25 - 4.5	11 - 25

1. Standard Penetration Test.

Generalized Subsurface Soil Profiles (cross-sections) of the borings through sections of the site are also included in Appendix A.

Because the split-spoon sampler 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. Material larger than the 1 $\frac{3}{8}$ -inch inside diameter of the split-spoon sampler cannot be collected and observed directly.

4.3 GROUNDWATER OBSERVATIONS

The drillers observed the boreholes for the presence of measurable free water during drilling and at the completion of drilling. However, no measurable water was encountered.

Because mostly poor draining soils were encountered at the boring locations, the static groundwater level may take days or weeks to stabilize. Therefore, the lack of observed water may not provide a reasonable indication of the static groundwater conditions at the time of drilling. Not a pocket of wet silty sand was encountered at Test Pit TP-1 at approximately 7 $\frac{1}{2}$ feet. Soils in the Midwest frequently oxidize from gray to brown above the level where the soil remains saturated. This zone of change, which may be an indication of the long-term water level, is frequently interpreted to be the ground water table. Gray soil was encountered at approximate depths of 5 $\frac{1}{2}$ to 17 feet at the boring locations, or approximately EL. 737 feet to EL. 758 feet, MSL.

Based on the boring data, we estimate the static groundwater level to be at a depth of approximately 5 $\frac{1}{2}$ to 17 feet at the boring locations, or approximately EL. 737 feet to EL. 758 feet, MSL.

Variations in the long-term water table elevation may result because of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors. Perched water conditions may also develop and/or exist at shallower or variable depths seasonally, particularly within more permeable soil underlain by less permeable soil and within fissured soil.

4.4 LABORATORY TESTING

The laboratory services performed by ECS for this project included classification and index property tests on select representative soil samples.

Each soil sample was visually classified based on texture and plasticity using ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) as a general guideline. After classification, the samples were grouped into the major zones noted on the boring logs in Appendix B. The USCS group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the boring logs are approximate; in-situ, the transitions may be gradual.

The results of the laboratory tests are included on the boring logs in Appendix B or separate test sheets in Appendix B. These tests included:

- Moisture content (ASTM D2216)
- Calibrated Penetrometer Resistance
- Organic content by Loss on Ignition (LOI) (ASTM D2974)

The laboratory procedures are described in greater detail in Appendix B including the insert titled Laboratory Procedures.

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.

5.0 DESIGN RECOMMENDATIONS

The project is in the due diligence phase. Therefore, the specific details of the future developments are not known so a limited number of test borings and test pits were performed within the 100-acre site for evaluation. This report contains preliminary geotechnical engineering information to evaluate the feasibility of developing the site. The recommendations herein are for preliminary development feasibility purposes only and are not intended to be used for the final design. A more comprehensive subsurface exploration and analysis is recommended to be performed for the development when building elevations, locations and structural details are known to provide more detailed recommendations for foundations, floor slabs, retaining walls and pavements including specific allowable soil bearing pressures and estimated settlements for development of the final design of the project.

5.1 FOUNDATIONS

Provided subgrades and engineered fills are prepared as discussed herein, the proposed structure may be supported by a conventional individual column (spread) footing and continuous wall (strip) footing shallow foundation system bearing on suitable native soil and/or engineered fill placed from a suitable bearing native soil subgrade. The existing undocumented fill should not be used for support. The following parameters are recommended for foundation design.

PRELIMINARY FOUNDATION DESIGN ⁽¹⁾		
Design Parameter		Value
Net Allowable Bearing Pressure ⁽²⁾		4,000 psf
Minimum Foundation Width	Wall (Strip)	18 inches
	Column (Spread)	30 inches
Post-Construction Estimated Settlement ⁽³⁾	Total	Approximately 1 inch
	Differential	Approximately ½ to ¾ inch

1. We recommend a structural engineer provide specific foundation details including footing dimensions, reinforcing, and other details.
2. The applied pressure in excess of the surrounding overburden soils above the base of the foundation and includes a factor of safety of 3.
3. Preliminary settlement estimates based on assumed range of structural loads and bearing elevations. Differential settlement is based on anticipated maximum column/wall loads and variability among the limited number of borings. Settlement is recommended to be re-evaluated once the foundation plans are available.

Estimates of settlement for foundations bearing on engineered fill are dependent on the quality of fill placed. Factors which may affect the quality of fill include maximum loose lift thickness of the fills placed and the amount of compaction effort placed on each lift.

Soils anticipated to be suitable for direct foundation support or as the subgrade for engineered fill and indirect foundation support should have parameters as noted in the following table or greater, unless otherwise recommended by ECS.

TARGET BEARING MATERIAL PROPERTIES				
Bearing Capacity (psf)	Cohesive Soil		Cohesionless Soil	
	Comparative Consistency	Unconfined Compressive Strength (tsf)	Relative Density	Corrected SPT N-value (blows per foot)
4,000	Very Stiff	2	Medium Dense	13

The soils encountered at the boring locations are predominately cohesive. Earth-formed footing construction techniques will likely be feasible. Where site grades are raised, earth-formed footing construction techniques are not expected to be feasible unless cohesive soil is used to raise site grades.

Potential Undercuts: Most of the soils at the foundation bearing elevation(s) are anticipated to be suitable for support of the proposed structure. ***Based on the anticipated foundation bearing elevations and anticipated elevations of suitable bearing soil at the boring locations, undercut or a lower bearing pressure may be needed within the area of Borings B-03, B-09 and B-13.*** Where soft or otherwise unsuitable soils are observed at the footing bearing elevations, the unsuitable soils should be undercut and removed. Existing fill soils are recommended to be removed from below foundations. We recommend ECS be retained to observe and test the foundation bearing grade as recommended in the **Foundation and Slab Observations** section. It is also recommended backfill of foundation undercuts be done as recommended in the **Earthwork Operations** section.

Frost Depth: Footings should be placed at a depth to provide adequate frost cover protection. We recommend the perimeter footings and footings in poorly heated areas be placed at a minimum depth of 4 feet below finished exterior grade. Interior footings in heated areas can be placed at a shallower depth provided suitable bearing soils are present and the foundations will not be subjected to freezing weather either during or after construction. Bear footings which will not have the benefit of building heat at least 5 feet below the finished ground grade.

Foundation Lateral Loading: Lateral load resistance will be developed by friction or cohesion acting at the base of foundations, and the passive earth pressure developed by the footings below-grade. Passive pressure and sliding resistance (friction or cohesion) may be used in combination in estimating the lateral resistance. The parameters in the following table are recommended for lateral foundation loading.

FOUNDATION LATERAL LOADING RESISTANCE PARAMETERS	
Soil Parameter	Estimated value
Coefficient of Passive Earth Pressure (K_p)	2.0
Soil Moist Unit Weight (γ)	125 pcf
Cohesion [<i>Foundations bearing on clay</i>] (C) ⁽¹⁾	1,500 psf
Interface Friction Angle [<i>Poured concrete on granular engineered fill</i>] (ϕ_i)	22°
Sliding Friction Coefficient [<i>Poured concrete on granular engineered fill</i>] (μ)	0.40
Passive Equivalent Fluid Pressure ⁽²⁾	250H (psf)

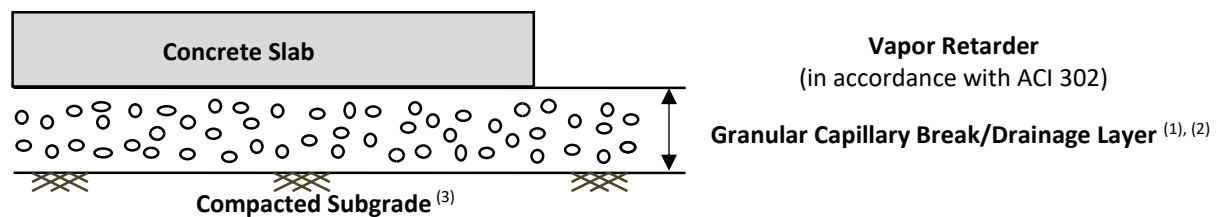
1. Cohesion may be used for lateral sliding resistance on the clay soil, but in no case should the lateral sliding resistance exceed half the dead load.
2. Neglect the passive earth pressure within the frost zone due to loss of strength seasonally and strain required to mobilize.

Design of the foundation for lateral loads should be based on a minimum factor of safety against sliding of 1.5 and overturning of 2. If the resultant force of the maximum vertical force does not act within the middle one-third (kern) of the footing, a smaller effective bearing area will occur and thereby result in a higher effective bearing pressure.

5.2 SLABS-ON-GRADE

The floor slab subgrade is expected to be lean clay and/or engineered fill used to raise site grades. Based on the borings and the expected subgrade soil undercut might be necessary to develop a suitable subgrade if the subgrade is subjected to wet weather and/or construction traffic disturbance.

Based on the assumed subgrade soils and slab loading, the following graphic depicts our general soil-supported slab recommendations.



1. **Drainage Layer:** Minimum 6 inches thick
2. **Drainage Layer Material:** Gravel (GP, GW) having a maximum aggregate size of 1 inch, no more than 10 percent passing the No. 200 sieve, and follow the recommendations of ACI 302.
3. **Compacted Subgrade:** Compacted to at least 95 percent of the maximum dry density per Modified Proctor (ASTM D1557).

The structural engineer should determine the slab thickness and other requirements. The design should include adequate construction joints, contraction joints and isolation joints in the slab to reduce the impacts of cracking and shrinkage. Refer to the ACI 302.1R04 *Guide for Concrete Floor and Slab Construction* for additional information regarding concrete slab joint design. Inclusion of welded wire fabric or an appropriate fiber mesh admixture is recommended to help control shrinkage cracking.

Slabs-on-grade should be underlain by a granular drainage layer placed on a properly prepared subgrade as recommended in the **Site Construction Considerations** section. The granular material will serve as a capillary break, which if properly designed and installed can assist in more uniform curing of concrete.

Inclusion of a vapor retarder should be considered if the building will contain moisture-sensitive floor coverings, equipment or materials. The vapor retarder will help reduce the potential of upward migration of water vapor from the soil into and through the concrete slab, which can contribute to excess humidity and microbial growth in the building. Where a vapor retarder is considered, special attention should be given to the surface curing of the slabs to reduce uneven drying of the slabs and associated cracking and/or slab curling. The designer should consider the moisture sensitivity of floor coverings and finishes, and the potential effects of slab curling and cracking when determining if the vapor retarder will be in direct contact with the slab or beneath a layer of granular fill. The use of a blotter or cushion layer above the vapor retarder may be considered for project specific reasons. Refer to ACI 302.1R04 *Guide for Concrete Floor and Slab Construction* and ASTM E 1643 *Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs* for additional guidance on these issues.

Positive drainage around the perimeter of the proposed structures should be used to reduce the potential for water accumulation under the structure elements. Slope exterior grades such that runoff is directed away from the structure. Direct downspouts away from the structure. Direct surface runoff to appropriate stormwater infrastructure.

Modulus of Subgrade Reaction: Provided the subgrade is prepared, and engineered fill and the granular drainage layer are placed as recommended in this report, design the slabs assuming an un-factored modulus of subgrade reaction, k_{v1} , of 125 psi/in (pounds per square inch per inch). This modulus of subgrade reaction value assumed is based on the recommended minimum drainage base thickness and correlation of index properties and soil type to historical 1 foot by 1 foot plate load tests. The modulus value used in design should be adjusted for areas larger than 1 foot by 1 foot.

Slab Isolation: We recommend ground-supported slabs be isolated from the foundations and foundation-supported elements of the structure to help reduce shear and bending stresses in the floor caused by differential movement between the foundations and slab. Where the structural configuration prevents the use of a free-floating slab, we recommend the slab be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab.

Frost Susceptible Areas: Frost susceptible soils were encountered. Exterior slabs and slabs in poorly or unheated areas, particularly in the areas of coolers and freezers, may be subject to frost heave. To help reduce frost heave potential, consider additional insulation, installation of subgrade drainage, and/or replacement to the frost depth with non-frost-susceptible backfill. Slope pavement and ground surface grades away from the building and flatwork, to help reduce water infiltration and potential frost heave problems.

5.3 SITE RETAINING WALLS

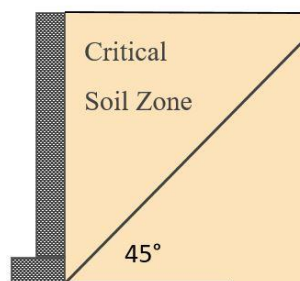
Retaining walls are expected at the loading docks. Site retaining walls are often constructed "bottom-up" and therefore the type of soil used to backfill the wall is chosen or specified by contract. The lateral earth pressures developed behind site retaining walls are commonly a function of the backfill and retained soil type, the zone of backfill behind the walls, and presence of water and surcharge loads.

Lateral Earth Pressures: We recommend the walls be designed to withstand the lateral earth pressures exerted by the backfill, water, and surface or other surcharges. The pressure diagram is triangular. It is anticipated that retaining walls associated with the building structure, such as for the unloading/loading dock situation, will be rigid walls restrained from rotation by the floor slab. For rigid walls, the "at-rest" (k_o) soil condition should be used in the wall design and evaluation. For walls that are free to deflect at their tops, the "Active" (k_a) soil condition should be used in the wall design and evaluation. The parameters below are recommended for retaining wall design.

RECOMMENDED LATERAL EARTH PRESSURE PARAMETERS		
Zone	Soil Parameter	Estimated value
Retained Soil (Lean Clay)	Unit Weight (γ)	125 pcf
	Angle of Internal Friction (ϕ)	28°
	Cohesion (C)	0 psf
	Coefficient of Earth Pressure at Rest (K_o)	0.53
	At-rest Equivalent Fluid Pressure	66H (psf)
	Coefficient of Active Earth Pressure (K_a)	0.36
	Active Equivalent Fluid Pressure	46H (psf)
Aggregate Backfill (in Critical Zone)	Unit Weight (γ)	120 pcf
	Angle of Internal Friction (ϕ)	32°
	Cohesion (C)	0 psf
	Coefficient of Earth Pressure at Rest (K_o)	0.47
	At-rest Equivalent Fluid Pressure	57H (psf)
	Coefficient of Active Earth Pressure (K_a)	0.31
	Active Equivalent Fluid Pressure	37H (psf)

The lateral pressure design parameters indicated above are based upon drained conditions assumed for the backfill materials behind the walls. If submerged or not drained higher nominal equivalent fluid pressures will result.

These parameters assume free-draining granular aggregate meeting the recommendations herein for retaining wall backfill will be placed throughout the “critical zone” and the backfill will be properly drained. The critical zone is defined as the area between the back of the retaining wall structure and an imaginary line projected upward and rearward from the bottom back edge of the wall footing at a 45-degree angle. The parameters provided assume the grade behind the wall and the grade in front of the wall is level. If the grade behind or in front of the wall will be sloped, contact us for revised parameters.



Refer to the **Foundations** section for lateral resistance due to cohesion/friction and passive pressure. Avoid the operation of heavy equipment to compact the wall backfill since it may overload and damage the wall. Such loads are often not considered in the design of retaining walls and are not considered for in our recommendations.

Wall Backfill: The backfill within the critical zone behind retaining walls is recommended to consist of crushed stone aggregate with a maximum of 15 percent fines (i.e., percentage of material passing a No. 200 Sieve), and minimum angle of internal friction of 32 degrees when compacted to a minimum of 95

percent of its maximum dry density per Modified Proctor (ASTM D1557). Remove material within the Critical Zone not meeting these criteria.

Wall Drainage: Retaining walls should be drained so that hydrostatic pressures do not build up behind the walls. Wall drains may consist of a 12-inch-wide zone of free draining gravel, such as AASHTO No. 57 Stone, placed directly behind the wall and separated from the soils beyond with a non-woven filter geotextile. Alternatively, the wall drain may consist of a suitable geocomposite drainage board material. The wall drain should be hydraulically connected to the foundation drain discussed below. Note recycled concrete often has cement dust and other fines content that will be higher than typical crushed limestone or other natural aggregates, which could clog drains, therefore recycled materials are NOT recommended as backfill in drainage layer/media applications.

A foundation drainage system is recommended to be included to help relieve hydrostatic pressures which may develop in the wall backfill. This system should consist of weep holes through the wall and/or a 4-inch perforated, closed joint drain line located along the backside of the walls above the top of the footing. The drain lines are recommended to be surrounded with a minimum of 8 inches of drainage aggregate, such as AASHTO Size No. 57 Stone, wrapped with an appropriate non-woven geotextile that meets the requirements of WisDOT Standard Specifications Section 645, Type DF, Schedule A or AASHTO M288, Class 3, nonwoven, separation geotextile.

5.4 SEISMIC DESIGN CONSIDERATIONS

Seismic Site Class: The International Building Code (IBC) requires the site be classified as Site Class A, B, C, D, E or F in accordance with Chapter 20 of ASCE 7 based on the site soil properties. The three parameters used to classify sites are shear wave velocity (v_s); undrained shear strength (s_u); and Standard Penetration Test (SPT) resistance (N-value). The seismic Site Class definitions for the weighted average of shear wave velocity, shear strength or SPT N-value in the upper 100 feet of the soil profile are listed below.

SEISMIC SITE CLASS				
Site Class	Soil Profile Name	Shear Wave Velocity, V_s , (ft./s)	N-Value (bpf)	S_u Value (psf)
A	Hard Rock	$V_s > 5,000$ fps	N/A	N/A
B	Rock	$2,500 < V_s \leq 5,000$ fps	N/A	N/A
C	Very dense soil and soft rock	$1,200 < V_s \leq 2,500$ fps	>50	$\geq 2,000$
D	Stiff Soil Profile	$600 \leq V_s \leq 1,200$ fps	15 to 60	1,000 to 2,000
E	Soft Soil Profile	$V_s < 600$ fps	<15	$\leq 1,000$

Chapter 20 of ASCE 7 requires the Site Class be based on the upper 100 feet of the soil profile. The borings performed for this project were drilled to a maximum depth of 20 feet. Therefore, the conditions below this depth were assumed based on our experience with the soils in the general site vicinity and engineering judgment. It is our opinion the site soils can be characterized as **Site Class D**. If a more favorable Site Class is beneficial to the project, ECS would be pleased to discuss our ReMi testing capabilities in this regard.

5.5 PAVEMENT DESIGN CONSIDERATIONS

The following sections provide recommendations for pavements.

Subgrade Characteristics: A California Bearing Ratio (CBR) test is commonly used to determine soil support parameters for pavement design. A CBR test or other appropriate test was not part of the scope for this project, so it was necessary to estimate the CBR design value. Based on the borings, it appears the pavement subgrade soils will mainly consist of lean clay existing fill. The clay soil at the borings was found to have a very stiff to hard consistency at the anticipated subgrade, but because it is frost susceptible and does not drain well, it is generally considered a poor subgrade material. We assumed a preliminary design CBR value of 3 for the flexible pavement and a preliminary design modulus of subgrade reaction, k_{v1} , of 125 psi/in for the rigid pavement. The pavement design recommendations assume the subgrade consists of suitable materials evaluated by ECS, and the subgrade is prepared as recommended in the **Subgrade Preparation** and **Earthwork Operations** sections of this report.

Pavement Sections: The recommended minimum pavement sections listed in the table below are based on the anticipated usage of the project site and a 20-year design service life, but were not developed based on specific traffic patterns, loading and resiliency factors, as those parameters were not provided by the design team. ***If the anticipated traffic will exceed that assumed in the Proposed Construction section, ECS should be contacted for revised pavement design recommendations; otherwise, increased pavement maintenance and a shortened pavement life should be expected.*** The preliminary pavement sections below are guidelines that may or may not comply with local jurisdictional minimums.

RECOMMENDED MINIMUM PAVEMENT SECTIONS						
Pavement Material	Compacted Material Thicknesses (Inches)					
	Flexible Pavement			Rigid Pavement		
	Light Duty	Medium Duty	Heavy Duty	Light Duty	Medium Duty	Heavy Duty
Portland Cement Concrete ⁽¹⁾	--	--	--	5	7½	8
Hot Mix Asphalt ⁽²⁾ Surface Course	1¾	2	2	--	--	--
Hot Mix Asphalt ⁽²⁾ Binder Course	1¾	3	3½	--	--	--
Dense Graded Crushed Stone Base ⁽³⁾	8	12	13	4	6	6
Total Pavement Section Thickness	11½	17	18½	9	13½	14

1. Section 415 of WisDOT Standard Specification for Highway and Structure Construction.
2. Section 460 of WisDOT Standard Specification for Highway and Structure Construction.
3. Section 305 of WisDOT Standard Specification for Highway and Structure Construction. We recommend dense graded crushed stone base. If crushed gravel or some other material is used in lieu of crushed stone, the material may have a lower structural coefficient and a thicker base may be required.

In frequent and higher stress traffic areas, such as where trucks frequently turn, drive through lanes, delivery areas, loading dock aprons, trash enclosure pads, and points of ingress or egress, heavy duty rigid (concrete) pavement is recommended.

Pavement materials and construction should be in accordance with the AASHTO Guide for Design of Pavement Structures, and the WisDOT Standard Specifications for Highway and Structure Construction.

If the pavements will be constructed early during site development to accommodate construction traffic, consideration should be given to the construction of designated haul roads, where thickened

pavement sections are provided to accommodate the construction traffic, as well as the future in-service traffic.

Rigid Pavements: We recommend an air-entrained concrete mix (compressive strength of at least 4,000 pounds per square inch at 28 days) for rigid pavement. We recommend adequate construction joints, contraction joints and isolation joints be provided in the areas of rigid pavement to reduce the impacts of cracking and shrinkage. Please refer to ACI 330R-92 *Guide for Design of Concrete Parking Lots* and ACI PRC-330.2-17 *Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities*. The ACI Guide recommends an appropriate spacing strategy for the anticipated loads and pavement thickness. It has been our experience that joint spacing closer to the recommended values in ACI results in a pavement with less cracks outside the joints and better long-term performance. Control joint spacing should be determined in accordance with the current ACI code. Separation joints should be provided where the pavement abuts fixed objects, such as the buildings and light poles.

Drainage: An important consideration with the design and construction of pavements is surface and subsurface drainage. Based on the estimated groundwater level, we consider surface water infiltration and seasonal perched water to be the main source of water for pavement design.

The pavement surface is recommended to be shaped or crowned to properly direct surface water to suitable on or off-site stormwater drainage infrastructure. The pavement subgrade should be properly sloped to avoid dips or pockets where water may become trapped. Dips in the subgrade can result in a “bathtub” effect, which may trap water. This trapped water can soften the subgrade and potentially heave the pavement during freezing weather. The subgrade in areas requiring undercut and backfill with granular soils are recommended to be graded to drain toward a drainpipe. The drainpipe should be sloped a minimum of ½ to 1 percent to discharge to nearby storm sewers, drainage ditches or other appropriate drainage facilities. Edge drains should be installed where site grades slope toward the pavement edge to reduce the potential for water to enter the base course layer. Edge drains should be sloped to the nearest appropriate drainage facility. Water that ponds on the subgrade surface can lead to deterioration of the subgrade soils, reduction of the base course support characteristics, and result in pavement heave during freezing conditions. Good drainage should help reduce the possibility of the subgrade materials being wet over a long period of time.

We recommend installation of “stub” or “finger” drains around catch basins and in other low-lying pavement areas to reduce the accumulation of water above and within the subgrade soils and aggregate base. As an alternative to stub or finger drains, existing manholes and storm sewer inlets could be perforated with 1-inch diameter holes at 2-foot centers at the subgrade level. The holes are recommended to be covered with a wire mesh and the manhole/inlet wrapped with a non-woven geotextile to reduce migration of material into the manhole/inlet. The excavation around the manhole is recommended to be backfilled with free draining granular materials. Consider installation of pavement edge drains or trench drains to reduce the accumulation of water within the base course and on the subgrade soils.

Maintenance: A sound maintenance program should be implemented to help maintain and enhance pavement performance and help attain the design service life. A preventative maintenance program should be started 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. Failure to perform preventative maintenance will reduce the service life of the pavement and increase the costs for corrective maintenance and full pavement rehabilitation. Seal

joints and cracks with elastomeric caulk in a timely manner to help reduce water infiltration thru the pavement section into the base course layer, which may result in softening of the subgrade and deterioration of the pavement. Pavements should be observed for distresses, such as cracks, depressions and poor drainage, at least twice a year, typically once in the spring and once in the fall.

6.0 SITE CONSTRUCTION CONSIDERATIONS

6.1 SUBGRADE PREPARATION

The method of site preparation will be influenced by factors unknown at the time this report was prepared, which may include weather before and during construction, the possibility of subsurface conditions not revealed by the borings, and the final details of the proposed development.

6.1.1 Stripping and Grubbing

The subgrade preparation should include stripping pavement, vegetation, rootmat, topsoil, and other soft or otherwise unsuitable materials from the 10-foot expanded building limits, 5-foot expanded pavement limits, and 5 feet beyond the toe of engineered fills, where feasible. ECS should be retained to observe and document that topsoil and other unsuitable surficial materials have been removed prior to the placement of engineered fill or construction of structures.

Topsoil deposits (approximately 0 to 33 inches thick) were observed at the exploration locations. The project team should be prepared to remove the topsoil in its entirety within the limits noted above. Because topsoil depths can vary greatly across a site the contractor should verify topsoil depths as part of their bidding process. Note topsoil removal should not be based on soil coloration alone. After removal of the rootmat, it may be possible to leave some darker soils in place provided the soil contains no more than 5 percent organic matter, by dry weight, as determined by Loss on Ignition ASTM D2974, has the recommended strength characteristics and is stable under proofroll. Note organic content tests were performed on a few samples of the topsoil material below the rootmat which was found to have an organic content of 5.3 to 8.3 percent.

ECS recommends the subgrade not be exposed to the elements or construction traffic for a prolonged time as the subgrade may become disturbed and/or softened. If pavement or other protective coverings are not placed within a few days after exposing the final design subgrade, consideration should be given to leaving the subgrade approximately 1 foot above the final design subgrade, where feasible, to help reduce softening of the design subgrade soil.

6.1.2 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be evaluated by ECS. The exposed subgrade is recommended to be thoroughly proofrolled with construction equipment having a minimum axle load of 10 tons (e.g., fully loaded tandem-axle dump truck for clayey soils or a large vibratory smooth drum roller for sandy soils). The subgrade should be traversed with the proofroll equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle. This procedure is intended to assist identification of yielding subgrade materials.

Unstable or pumping subgrade areas identified during the proofroll should be repaired prior to the placement of subsequent engineered fill or other construction materials. Unstable subgrade repair methods, such as undercutting, or moisture conditioning and recompaction, or chemical stabilization, should be discussed with ECS to determine the appropriate procedures regarding the existing conditions causing the instability. Test pits may be excavated in unstable areas to explore the shallow subsurface materials and to help determine the appropriate remedial action to stabilize the subgrade.

Seasonal reduction of the near surface soil strength can occur during wet times of the year (such as during the spring and fall months) or immediately following extended periods of rain. This may result in additional unstable or pumping subgrade areas. Some undercutting or repair of unstable subgrade soils should be anticipated during slab and pavement subgrade preparation, especially during unfavorable conditions. The method of subgrade repair or improvement chosen may be influenced by several factors such as weather and schedule, area, depth, and nature of the unstable subgrade soils. Depending on these and other factors, potential subgrade repair methods are described below, but the actual depth of subgrade undercut and/or stabilization method should be determined at the time of construction. Some common subgrade repair methods include:

Scarification and Compaction: Soils can be scarified, moisture conditioned (i.e., dried or wetted) to within a narrow range of the material's optimum moisture content and compacted. Scarification and compaction are generally most applicable where very shallow unstable conditions are encountered and at times when the soil can be properly dried or wetted to within a narrow range of the material's optimum moisture content.

Undercut and Replacement: We recommend soft or yielding soils be evaluated in approximately 6 to 12-inch intervals to help limit the volume of undercuts. If soft or yielding soils are identified, the contractor should remove only 6 to 12 inches of material at a time in the subject area and then proofroll/evaluate the undercut subgrade to determine if additional undercut is needed. This may take more time but could potentially reduce the removal of more soil than necessary. Use of a geogrid could also be considered to reduce undercut depths. A geogrid, if used, should be placed after underground work, such as utility construction, is complete. Do not operate equipment on the geogrid until after engineered fill is placed above it. Depending on the conditions at the time of repair, use of an aggregate engineered fill, such as crushed stone, crushed concrete or gravel, may be needed.

Chemical Modification: Alternatively, if these soils cannot be stabilized by conventional methods, chemical modification of the subgrade soils, such as with lime, lime kiln dust, cement, cement kiln dust, or other materials, may be utilized to reduce the moisture content and/or provide additional stabilization. An experienced pre-qualified contractor that has successfully chemically modified similar-sized projects with similar soil conditions is recommended to be used. The soil modification procedure, such as determination of the type and quantity of additive, and mixing and curing procedures, should be evaluated before implementation. This evaluation may include testing the soil to check if an adverse chemical reaction could occur. Chemical modification agents can have caustic effects to humans and property. The contractor should be required to minimize dusting or implement dust control measures, as required. For preliminary estimating purposes, the approximate incorporation rate (based on dry weight of soil) is typically in the range of 4 to 7 percent, by dry weight, for hydrated lime or lime by-products, and 4 to 10 percent, by dry weight, for Portland cement. Typically, the percentage needed is less for hydrated lime than other lime by-products because the available calcium oxide content of lime by-products tends to be lower. Note insufficient mellowing of modified soils could lead to heaving after placement. Subgrade modification can result in the creation of an 'aquiclude' layer which will allow water to pond above the stabilized surface within the base course. Such water, if not drained properly, can freeze in cold weather potentially resulting in significant heave of the pavement. Alterations to the pavement sections to include additional drainage, such as an open-graded drainage aggregate layer, may be needed if a chemically modified subgrade is used.

6.1.3 Site Temporary Dewatering

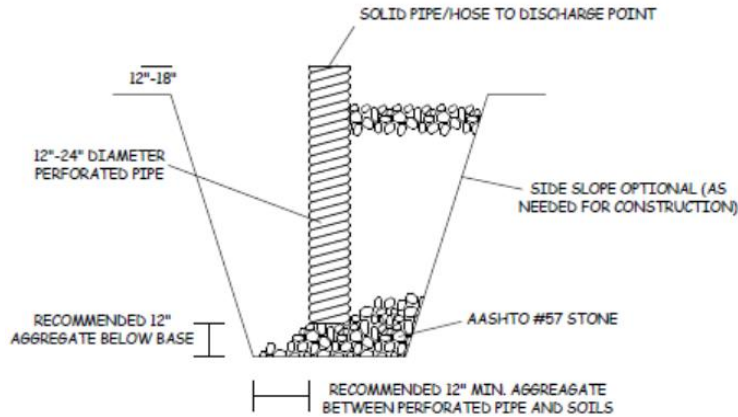
The contractor shall make their own assessment of temporary dewatering needs based upon the limited subsurface groundwater information presented in this report. Soil and groundwater conditions may vary between sampling intervals. If the contractor believes additional subsurface information is needed 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 (specialty or other) contractor familiar with the geotechnical and other aspects of the project. The failure to properly design and maintain a dewatering system for a given project can result in delayed construction, unnecessary undercuts, detrimental phenomena such as 'running sand' conditions, heaved subgrades, internal erosion (i.e., 'piping'), the migration of 'fines' down-gradient towards the dewatering system, localized settlement of nearby infrastructure, foundations, slabs-on-grade and pavements, etc. Water discharged from site dewatering systems are recommended to be discharged in accordance with all local, state and federal requirements.

Surface Water: The surface of the site should be kept properly graded to enhance drainage of the surface water to appropriate discharge or storage areas during construction. We recommend that an attempt be made to enhance the natural drainage without interrupting its pattern.

Subsurface Water: Groundwater observations are described in the **Groundwater Observations** section of this report. It appears the hydrostatic groundwater level at this site may be approximately 5½ to 17 feet below grade. Excavations for new conventional shallow foundations are not expected to extend below the groundwater level encountered at the boring locations. Based upon the results of the subsurface exploration and proposed construction, we believe construction dewatering at this site will be mainly to remove accumulated runoff water and perched water. Strategies for addressing perched groundwater are discussed below.

Strategies for Addressing Perched Groundwater: The typical strategy for addressing perched groundwater seepage into excavations and where excavations extend typically less than 1 to 2 feet below the water level, especially in areas containing primarily clay soils, is pumping from trench (or French) drains and sump pits with sump pumps which are backfilled with drainage aggregate such as AASHTO Size No. 57 Stone or open-graded bedding material. 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 Conceptual Sketch

A typical French drain consists of an 18 to 24-inch wide by 18- to 24-inch-deep bed of AASHTO No. 57 aggregate (or similar open graded aggregate) wrapped in a medium duty, non-woven geotextile and (sometimes) containing a 6-inch diameter, Schedule 40 PVC perforated or slotted pipe. Actual dimensions should be determined during construction. After installation, the geotextile should be wrapped over the top of the aggregate and pipe followed by placement of backfill. The top of the drain should be positioned at least 3½ feet below the design subgrade elevation. Drains should not be routed within the expanded building limits.

Pumping wells or a vacuum system could also be used to address perched groundwater. These techniques often are only effective during the initial depletion of the perched water quantity and may quickly be ineffective at addressing accumulation of water from rain, snow, etc.

6.2 EARTHWORK OPERATIONS

6.2.1 Engineered Fill

Product Submittals: Prior to placement of engineered fill, representative bulk samples (typically at least 50 to 100 pounds) of on-site and off-site borrow per material type should be submitted to ECS for laboratory testing, which may include natural moisture content, organic content, grain-size distribution, Atterberg limits, and moisture-density relationships for compaction. Import material should be tested prior to being hauled to the site to determine if it complies with project specifications. Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Satisfactory Engineered Fill Materials: Engineered fills should consist of materials free of debris with the following engineering properties.

ENGINEERED FILL INDEX PROPERTIES		
Subject	Property	
Plasticity	Upper 4 feet in Building Areas and Upper 2 feet in Pavement Areas	LL ≤ 40, PI ≤ 15
	Below 4 feet in Building Areas and Below 2 feet in Pavement Areas	LL ≤ 50, PI ≤ 20

ENGINEERED FILL INDEX PROPERTIES	
Subject	Property
Max. Particle Size	3 inches
Max. Organic Content	5 percent

Open-graded materials, such as coarser sands, and gravels (SP and GP), which contain increased void space in their mass may need to be encapsulated within a filter geotextile. If the fill is to provide low-frost susceptible characteristics, it must be classified as a clean GP or GW (or clean coarser SW or SP) per Unified Soil Classification System (ASTM D-2487) and must be properly drained.

Satisfactory Retaining Wall Backfill: Materials used as backfill within the critical zone behind retaining walls should have USCS classifications of sand or gravel with a maximum of 15 percent fines, and minimum angle of internal friction of 32 degrees when compacted to a minimum of 95 percent of its maximum dry density per Modified Proctor (ASTM D 1557). Material not meeting these criteria should be removed from the Critical Zone behind the walls.

Unsatisfactory Materials: Unsatisfactory fill materials, which do not satisfy the requirements for suitable materials, include topsoil and organic materials (PT, OH, OL), frost susceptible silt (ML), and high plasticity soils elastic silt (MH) and fat clay (CH).

Pea gravel is not recommended to be used as engineered fill. Pea gravel has round/smooth characteristics, no fines and does not interlock when compacted, which makes it more susceptible to future movement and instability resulting in excessive and variable settlement.

On-Site Borrow Suitability: On-site soil used as engineered fill must not contain more than 5 percent organic matter as determined by ASTM D2974, and must be free of frozen matter, deleterious materials, over-sized material (maximum 3-inch particle diameter), or chemicals that may result in the material being classified as "contaminated." The on-site soil may be feasible to use as engineered fill during favorable conditions but should be further evaluated by ECS prior to its use. A few of the soil samples had relatively high moisture contents so some drying of on-site soil prior to reuse as engineered fill may be needed during favorable conditions. Drying is expected to be needed during wet conditions. Some conditions at the time of construction, such as wet or freezing weather, may preclude the use of on-site soil, and use of an imported less moisture sensitive or less frost susceptible granular material may be needed.

6.2.2 Compaction

Subgrade Benching: Fill material should be placed in horizontal lifts. Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified, and the new fill benched and keyed into the existing material. Placement and compaction of fill is recommended to be on a 5 (H):1 (V) or flatter slope, or stepped or benched as required to flatten.

Engineered Fill Compaction: Engineered fill is recommended to be placed and compacted in appropriate thickness loose lifts as recommended below. Give as much importance to the moisture content requirements of the material as the density requirements during placement and compaction considering the moisture sensitivity of the soil.

ENGINEERED FILL COMPACTION RECOMMENDATIONS		
Subject		Recommendation
Compaction Standard		Modified Proctor, ASTM D1557
Recommended Compaction		≥ 95 percent of Maximum Dry Density
Moisture Content	Fine-grained	-1 to +3 % points of the material's optimum value
	Coarse-grained	-3 to +3 % points of the material's optimum value

Compaction equipment suitable to the material type being compacted should be used. Sheepsfoot compaction equipment is typically suitable for the fine-grained soils (clays). A vibratory steel drum roller is typically used for compaction of coarse-grained soils (sands and gravels) as well as to help seal compacted surfaces.

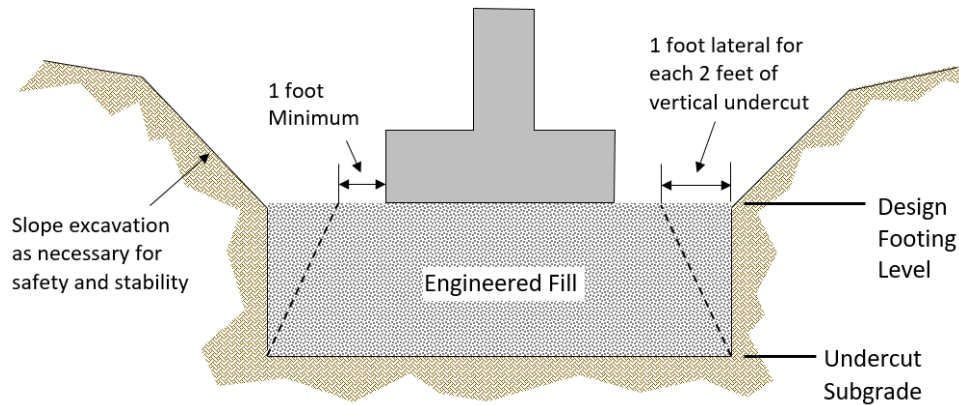
The maximum loose lift thickness depends upon the type of compaction equipment used and material being compacted. For isolated excavations around footing locations or within utility excavations, a hand tamper will likely be required. Listed below are generally recommended maximum loose lift thicknesses for compaction based on the utilized compaction equipment.

RECOMMENDED PRELIMINARY LOOSE LIFT THICKNESSES ⁽¹⁾	
Equipment	Maximum Loose Lift Thickness (inches)
Large/Heavy, Self-Propelled Equipment	8
Small, Self-Propelled or Remote Controlled (Rammax, etc.)	6 to 8
Hand Operated (Plate Tamps, Jumping Jacks, Wacker-Packers)	4 to 6

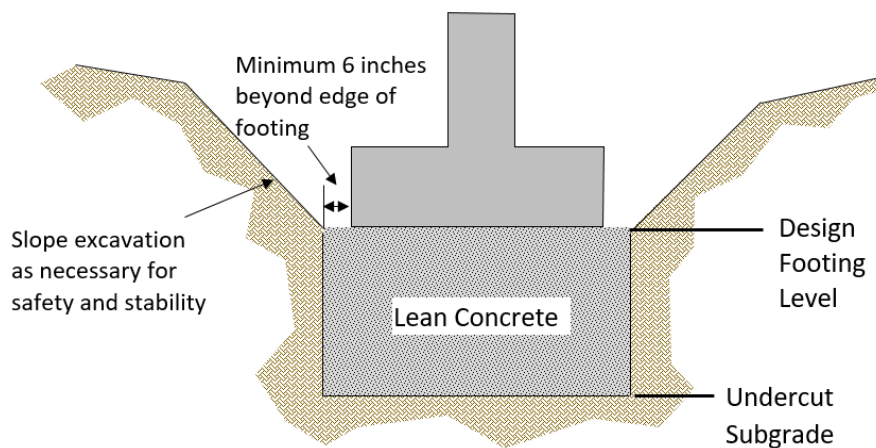
- Density testing during fill placement is important to check and document that the specified compaction is being achieved. In some cases, thinner lifts than noted above and/or more compaction energy may be needed to achieve the required degree of compaction.

In confined areas such as utility trenches, portable compaction equipment and thin lifts of 4 inches or less may be required to achieve specified degrees of compaction.

Engineered Fill Below Foundations: Unsuitable bearing material such as soft/very loose soils encountered at the proposed foundation bearing grade or within the foundation influence zone are recommended to be recompacted, if feasible, or removed to a suitable bearing subgrade and to a lateral extent, as conceptually illustrated below and replaced with engineered fill. The zone of the engineered fill placed below the foundations is recommended to extend 1 foot beyond the outside edges of the footings and from that point, outward laterally 1 foot for every 2 feet of fill thickness below the footing.



Alternatively, undercuts could be backfilled with lean concrete ($f'_c \geq 1,000$ psi at 28 days) up to the original design bottom of footing elevation. The original footing should be constructed on top of the hardened lean concrete. If lean concrete is utilized the excavation is recommended to be 1 foot wider than the footing (6 inches on each side), as conceptually illustrated below, and the lean concrete should be allowed to sufficiently harden prior to placement of the foundation concrete.



6.2.3 General Considerations

Fill Placement Considerations: Fill materials should not be placed on frozen soils, on frost-heaved soils, on excessively wet soils, or soils that are otherwise unstable. 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.

Excavation Safety: Excavations and slopes should be maintained in accordance with OSHA excavation safety standards. The Contractor is solely responsible for designing and constructing stable, temporary 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 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. In some cases, the use of shoring, bracing, or trench boxes may be required. 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; such responsibility is not being implied and should not be inferred.

Drain tile: Drain tile may exist at the site from past use of the property. Drain tile may drain large adjacent areas so care should be taken not to plug or damage any existing drain tile. Drain tiles that are damaged should be repaired and relocated away from the proposed building area, as needed. Drain tile are recommended to be relocated around the proposed development and discharged to suitable drainage facilities.

Test Pit Considerations: The test pit excavations were backfilled with the excavated soils using nominal compaction effort. Complete removal of the test pit backfill material and replacement under engineering controlled conditions is recommended during site preparation activities. If the materials are not removed and backfilled properly, settlement of the test pit backfill should be expected, along with the resultant movement, and potential distress to structures and pavements resting upon this material.

Bidding/Estimating Considerations: Contractors bidding or undertaking work at the site should examine the results of the subsurface exploration, satisfy themselves as to the adequacy of the information for bidding and construction, make their own interpretation of the data, and consider the effect it may have on their cost proposal, construction techniques, schedule, and equipment capabilities. Furthermore, contractors should complete additional fieldwork and exploration they deem necessary to properly prepare a cost proposal for the site work. Soil borings do not provide the same wide-scale view of the subsurface conditions that is obtained during site grading, excavation or other aspects of earthwork construction. Additional scope may be required to obtain more detailed subsurface information needed for earthwork bid preparation, which could include test pits to better understand the lateral and vertical extents of the subsurface materials of concern such as existing undocumented fill. Even with this additional information, budget contingencies should be carried in construction to help cover potential variations in subsurface conditions.

6.3 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the foundation concrete will not be placed soon after excavation and observation and testing of bearing grade, or if rainfall becomes imminent while the bearing soils are exposed, consider placement of a 2 to 3-inch thick "mud mat" of "lean" concrete on the bearing soils before the placement of reinforcing steel to help protect the bearing material otherwise a recheck of the bearing grade may be needed.

Footing Subgrade Observations: The recommendations of this report are predicated upon ECS checking the suitability of the in-situ foundation support soils during construction. The suitability of the actual bearing grade is recommended to be observed and tested to check that the soils are as indicated by the borings and are capable of supporting the recommended maximum net allowable bearing pressure.

Slab Subgrade Observation and Testing: ECS should be retained to observe and test the exposed subgrade within the expanded building limits prior to engineered fill placement and slab construction to check that adequate subgrade preparation has been achieved as recommended in the **Subgrade Preparation** section.

6.4 UTILITY INSTALLATIONS

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

Utility Subgrades: The soils encountered at the boring locations are expected to generally be suitable for support of utility pipes. It is recommended ECS be retained to observed and tested the suitability of the pipe subgrade materials encountered at the time of construction. Soft, loose, or otherwise unsuitable materials encountered at the utility pipe subgrade elevation should be removed and replaced with suitable 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. Granular bedding is recommended to consist of crushed stone chips in accordance with Table 32 and Chapter 8.43.0 of the *Standard Specifications for Sewer and Water 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. Cover material is recommended to consist of material in accordance with Table 36 and Chapter 8.43.3 of the *Standard Specifications for Sewer and Water Construction in Wisconsin*. Granular backfill material is recommended to consist of material in accordance with Table 37 and Chapter 8.43.4 of the *Standard Specifications for Sewer and Water Construction in Wisconsin*. Excavated material in accordance with Chapter 8.43.5 of the *Standard Specifications for Sewer and Water Construction in Wisconsin*, and as recommended in the **Earthwork Operations** section of this report could also be used as backfill.

7.0 CLOSING

ECS has prepared this report to guide 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, express 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. If this information is inaccurate, either because of our interpretation of the documents provided, or site or design changes that may occur later, ECS should be contacted so that we can review our recommendations and provide additional or alternate recommendations as may be required to reflect the proposed construction.

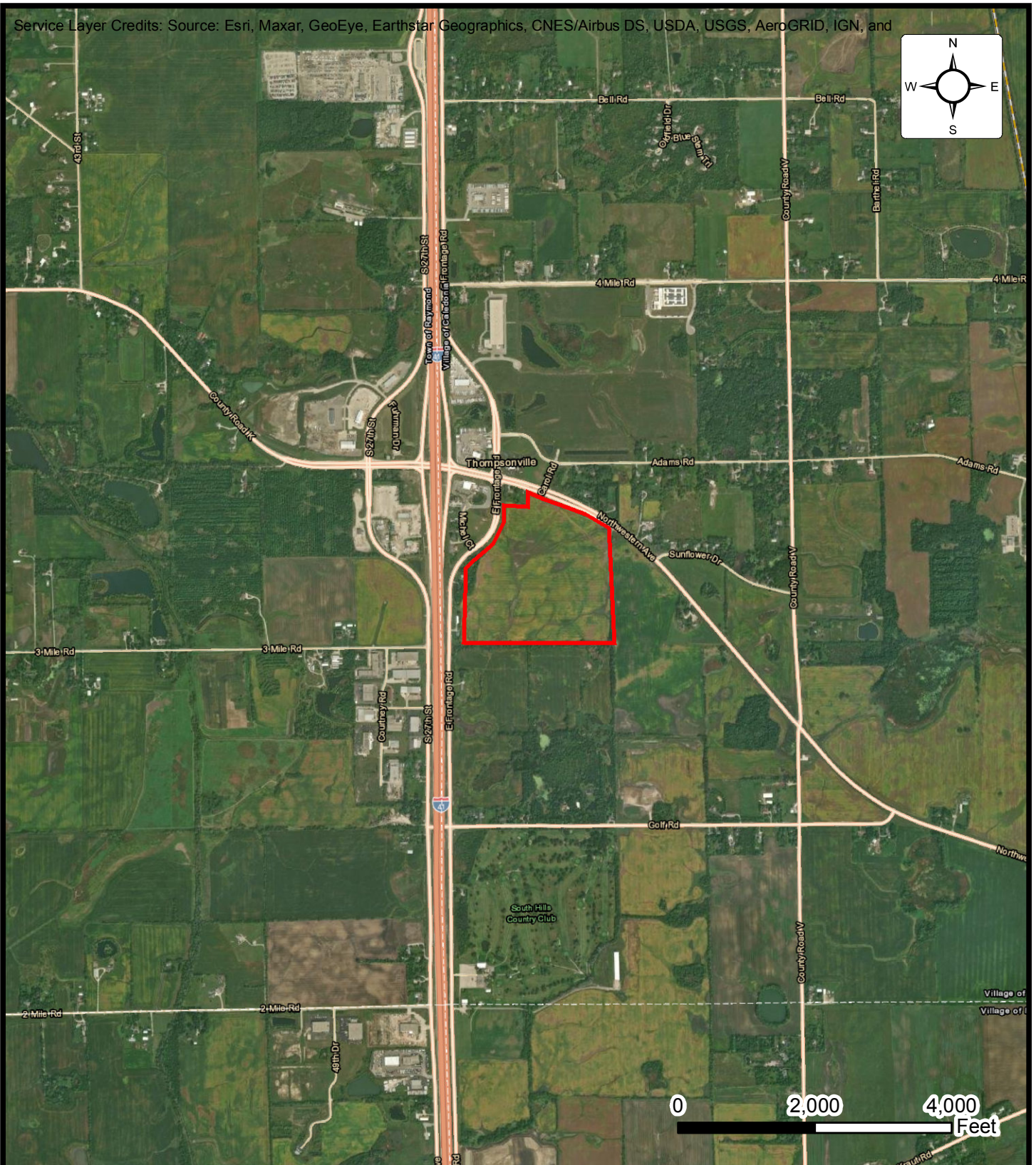
We recommend ECS review the project's plans and specifications so that we may evaluate consistency of those plans/specifications with the intent of the geotechnical report recommendations.

Field observations and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design recommendations. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendations should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

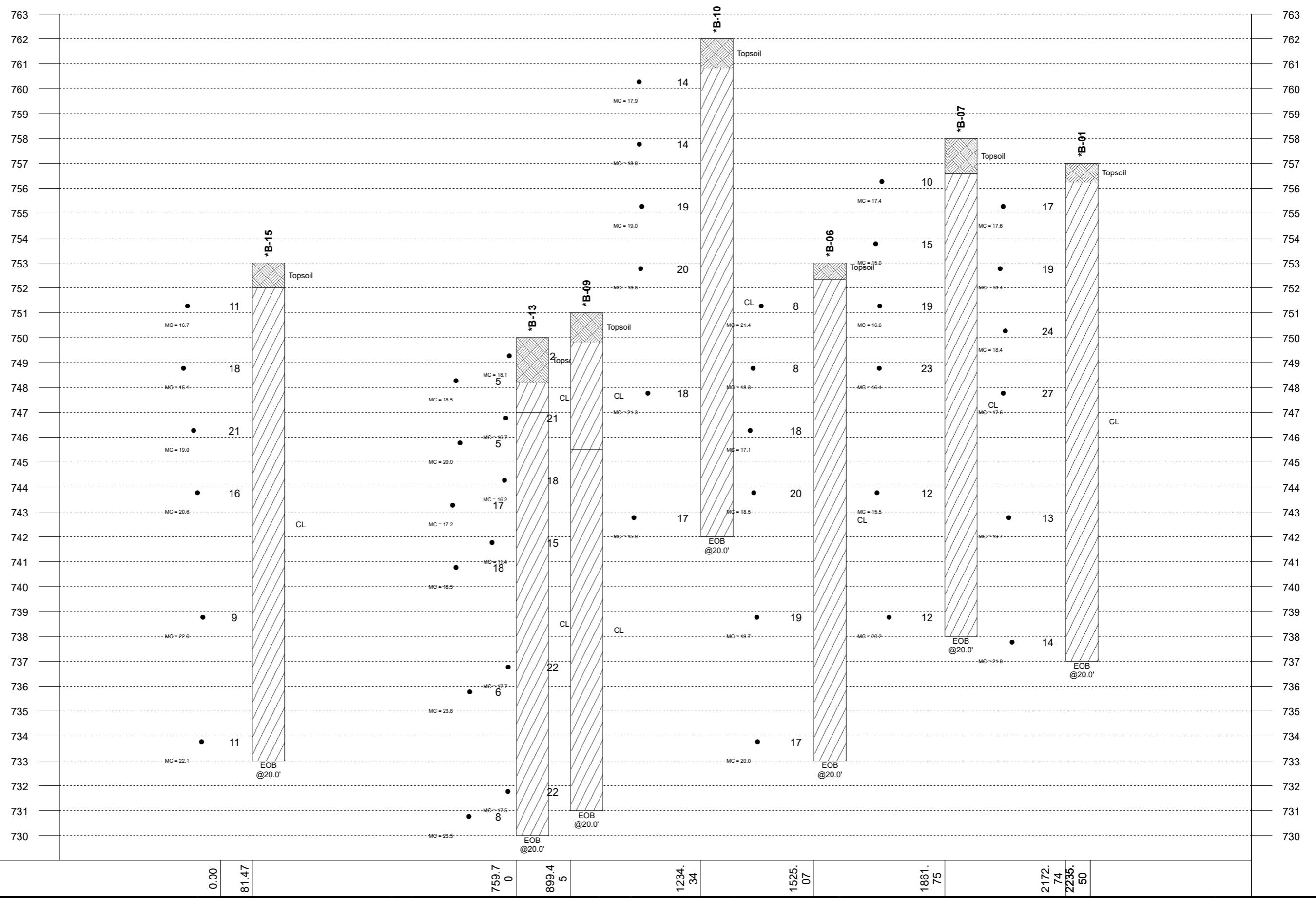
APPENDIX A - Drawings & Reports

Site Location Diagram
Boring Location Diagram
Generalized Subsurface Soil Profiles





Site Location Diagram
BADGER FARM DUE DILIGENCE
 COUNTY ROAD K & I-94, CALEDONIA, WISCONSIN
 ZILBER PROPERTY GROUP

ENGINEER DM1
SCALE AS NOTED
PROJECT NO. 42:2185
SHEET 1 OF 1
DATE 12/10/2021



Legend Key

 Topsoil

 Lean CLAY

729.00

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).

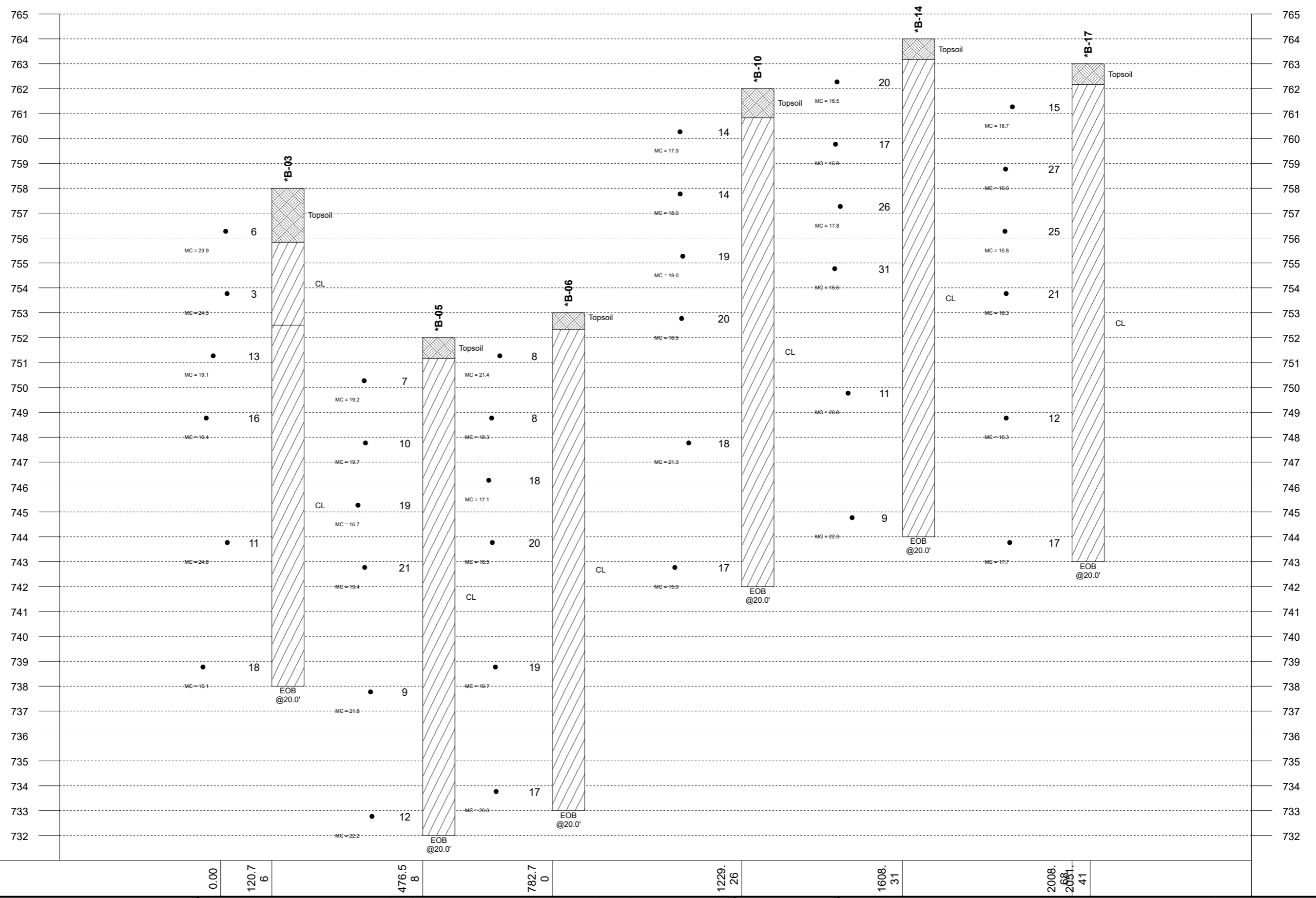
Plastic Limit	Water Content	Liquid Limit	WL (First Encountered)	Fill
X	●	△	▽	Red
[FINES CONTENT%]			▼	Possible Fill
BOTTOM OF CASING			▽	Probable Fill
LOSS OF CIRCULATION			▽	Rock



GENERALIZED SUBSURFACE SOIL PROFILE Section line 1

Badger Farm Due Diligence
Zilber Property Group
County Road K & I-94, Caledonia, Wisconsin 53126

Project No: 42:2185 Date: 12/20/2021



Legend Key

Topsoil

Lean CLAY

731.00

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	●	△	▽	Red
[FINES CONTENT%]			▼	Possible Fill
BOTTOM OF CASING			▽	Probable Fill
LOSS OF CIRCULATION			▽	Rock



GENERALIZED SUBSURFACE SOIL PROFILE Section line 2

Badger Farm Due Diligence
Zilber Property Group
County Road K & I-94, Caledonia, Wisconsin 53126

Project No: 42:2185 Date: 12/20/2021

APPENDIX B - Field and Laboratory Operations

Reference Notes for Boring Logs
Subsurface Exploration Procedures: SPT
Boring Logs
Test Pit Logs
Topsoil Hand Auger Summary
Laboratory Testing Procedures: Index Testing

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)
	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)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	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.



SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT)

ASTM D 1586

Split-Barrel (Split-Spoon) 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:

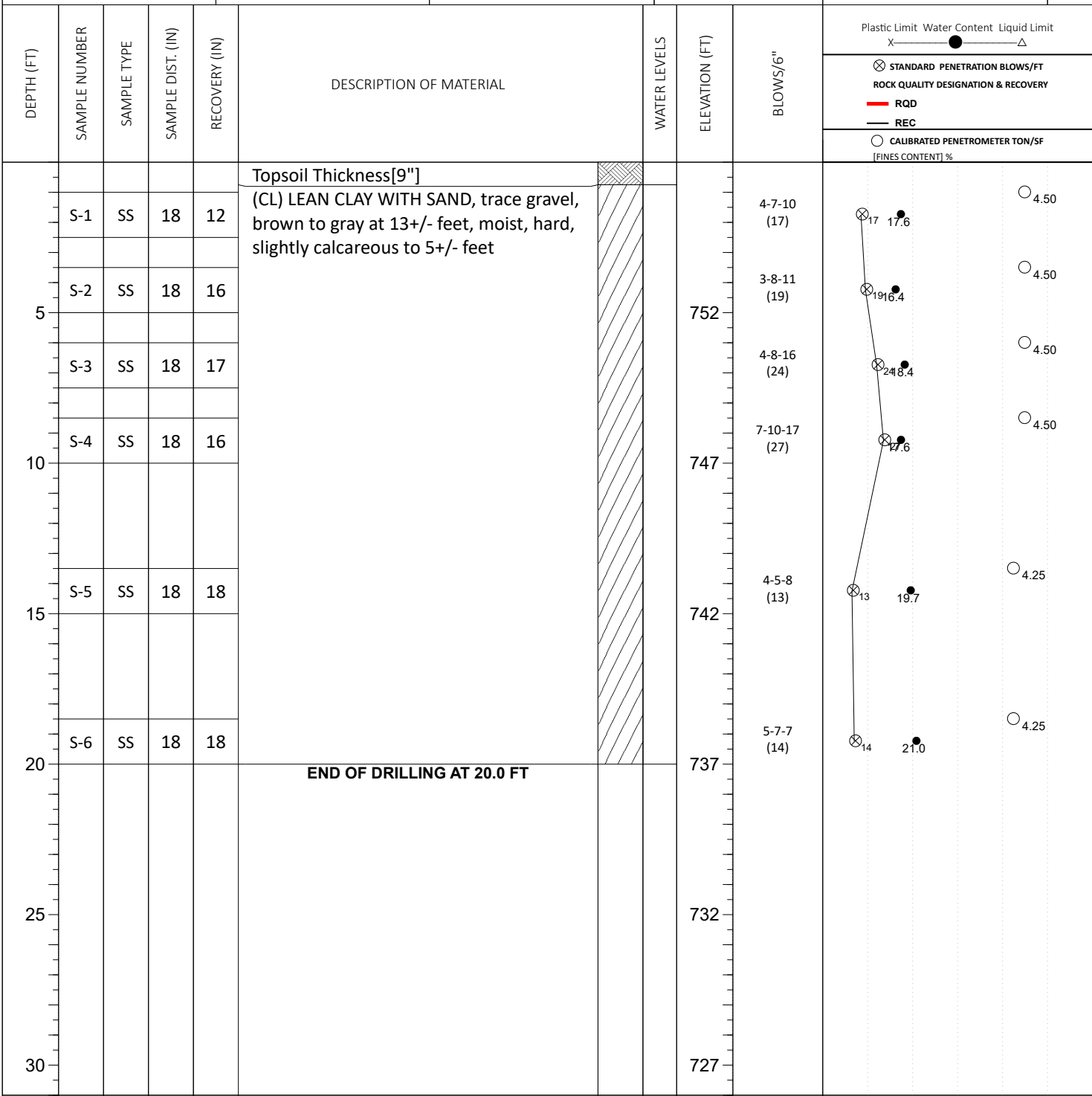
- Involves driving a 2-inch outside diameter hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30 inches at desired depth
- Recording the number of hammer blows required to drive the split-spoon a distance of 12 inches (in 3 or 4 Increments of 6 inches each)
- Auger is advanced* and an additional SPT is performed
- One SPT test is typically performed every 2½ to 5 feet.
- Obtain a 1⅜-inch diameter soil sample



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

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 289555.2	EASTING: 2520080.7	STATION:	SURFACE ELEVATION: 757.0	LOSS OF CIRCULATION
				BOTTOM OF CASING



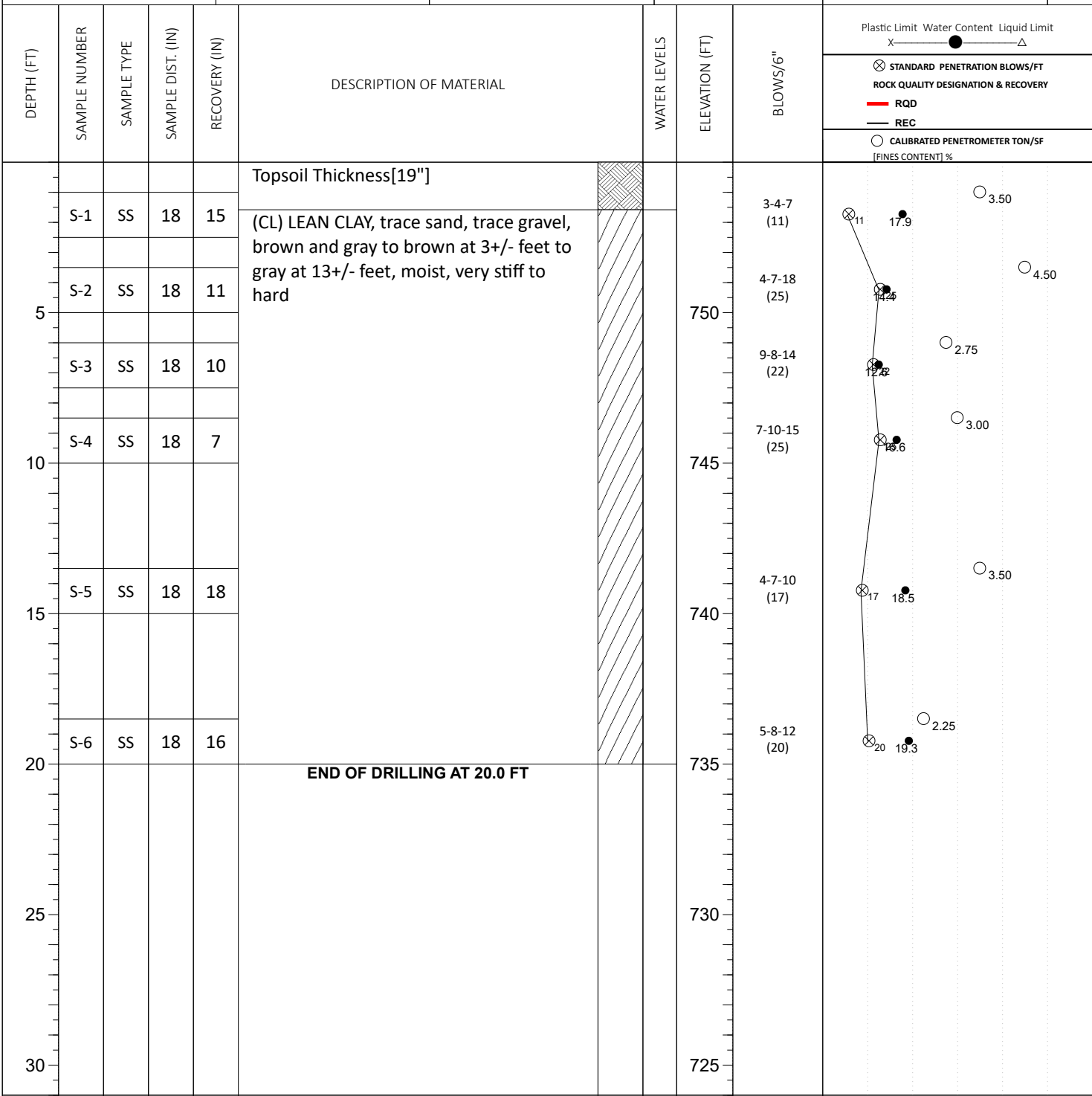
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>∇ WL (First Encountered)</td> <td style="text-align: center;">none</td> </tr> <tr> <td>▼ WL (Completion)</td> <td style="text-align: center;">dry</td> </tr> <tr> <td>∇ WL (Seasonal High Water)</td> <td></td> </tr> <tr> <td>∇ WL (Stabilized)</td> <td></td> </tr> </table>	∇ WL (First Encountered)	none	▼ WL (Completion)	dry	∇ WL (Seasonal High Water)		∇ WL (Stabilized)		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>BORING STARTED:</td> <td style="text-align: center;">Dec 13 2021</td> <td rowspan="2">CAVE IN DEPTH:</td> </tr> <tr> <td>BORING COMPLETED:</td> <td style="text-align: center;">Dec 13 2021</td> </tr> <tr> <td>EQUIPMENT:</td> <td style="text-align: center;">Track 7822 Geoprobe</td> <td rowspan="2">DRILLING METHOD: 2-1/4" HSA</td> </tr> <tr> <td>LOGGED BY:</td> <td style="text-align: center;">DM1</td> </tr> </table>	BORING STARTED:	Dec 13 2021	CAVE IN DEPTH:	BORING COMPLETED:	Dec 13 2021	EQUIPMENT:	Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA	LOGGED BY:	DM1	
∇ WL (First Encountered)	none																			
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BORING STARTED:	Dec 13 2021	CAVE IN DEPTH:																		
BORING COMPLETED:	Dec 13 2021																			
EQUIPMENT:	Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA																		
LOGGED BY:	DM1																			

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 289734.8	EASTING: 2519561.5	STATION:	SURFACE ELEVATION: 755.0	LOSS OF CIRCULATION 
				BOTTOM OF CASING 



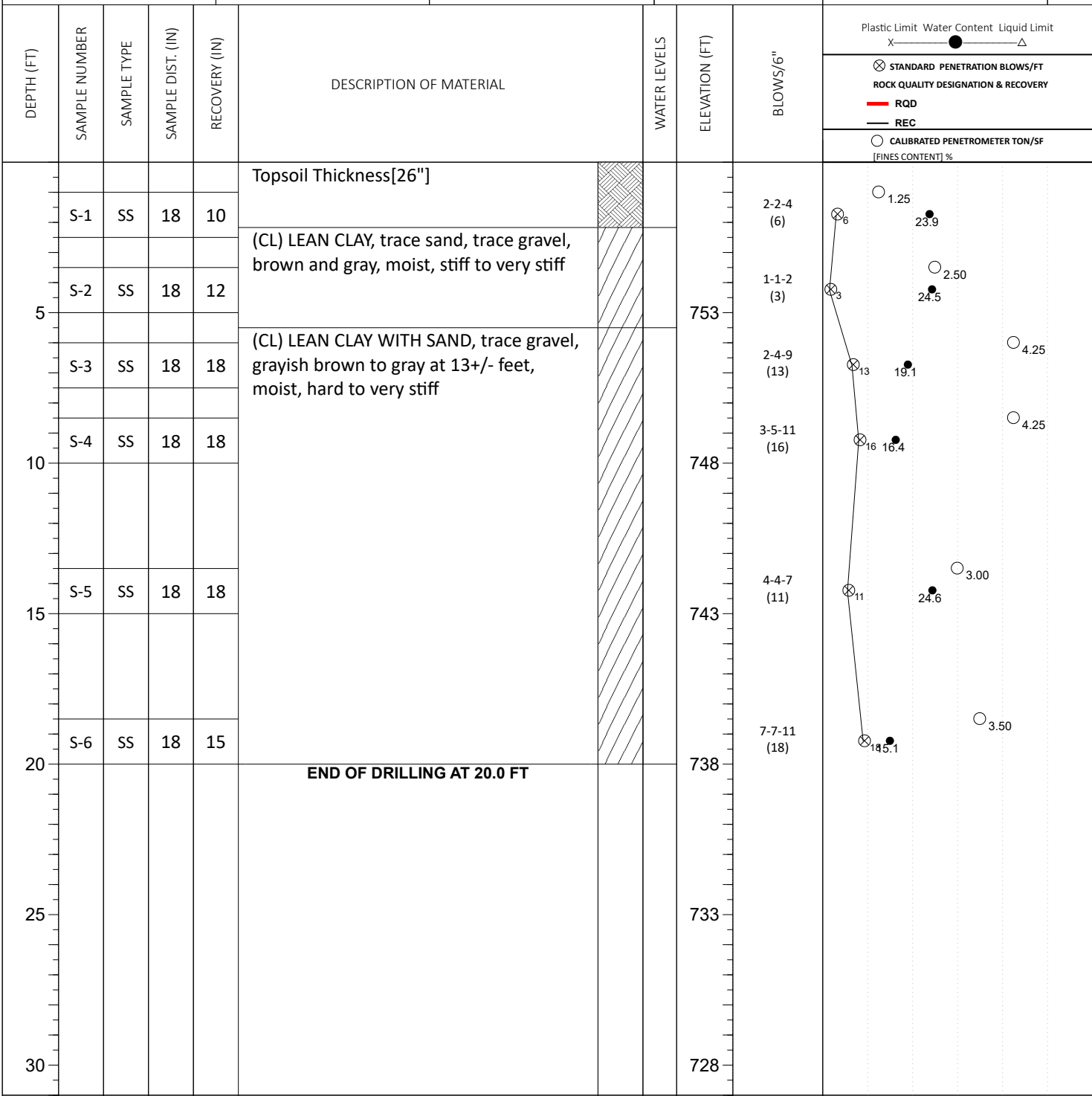
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▽ WL (First Encountered) none ▼ WL (Completion) dry ▽ WL (Seasonal High Water) ▽ WL (Stabilized)	BORING STARTED: Dec 13 2021 BORING COMPLETED: Dec 13 2021 EQUIPMENT: Track 7822 Geoprobe	CAVE IN DEPTH: HAMMER TYPE: Auto DRILLING METHOD: 2-1/4" HSA
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GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 289855.0	EASTING: 2519096.0	STATION:	SURFACE ELEVATION: 758.0	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 checked="" type="checkbox"/> WL (Completion) dry	BORING COMPLETED: Dec 13 2021	HAMMER TYPE: Auto
<input checked="" type="checkbox"/> WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA
<input checked="" type="checkbox"/> WL (Stabilized)	LOGGED BY: DM1	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

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				BOTTOM OF CASING



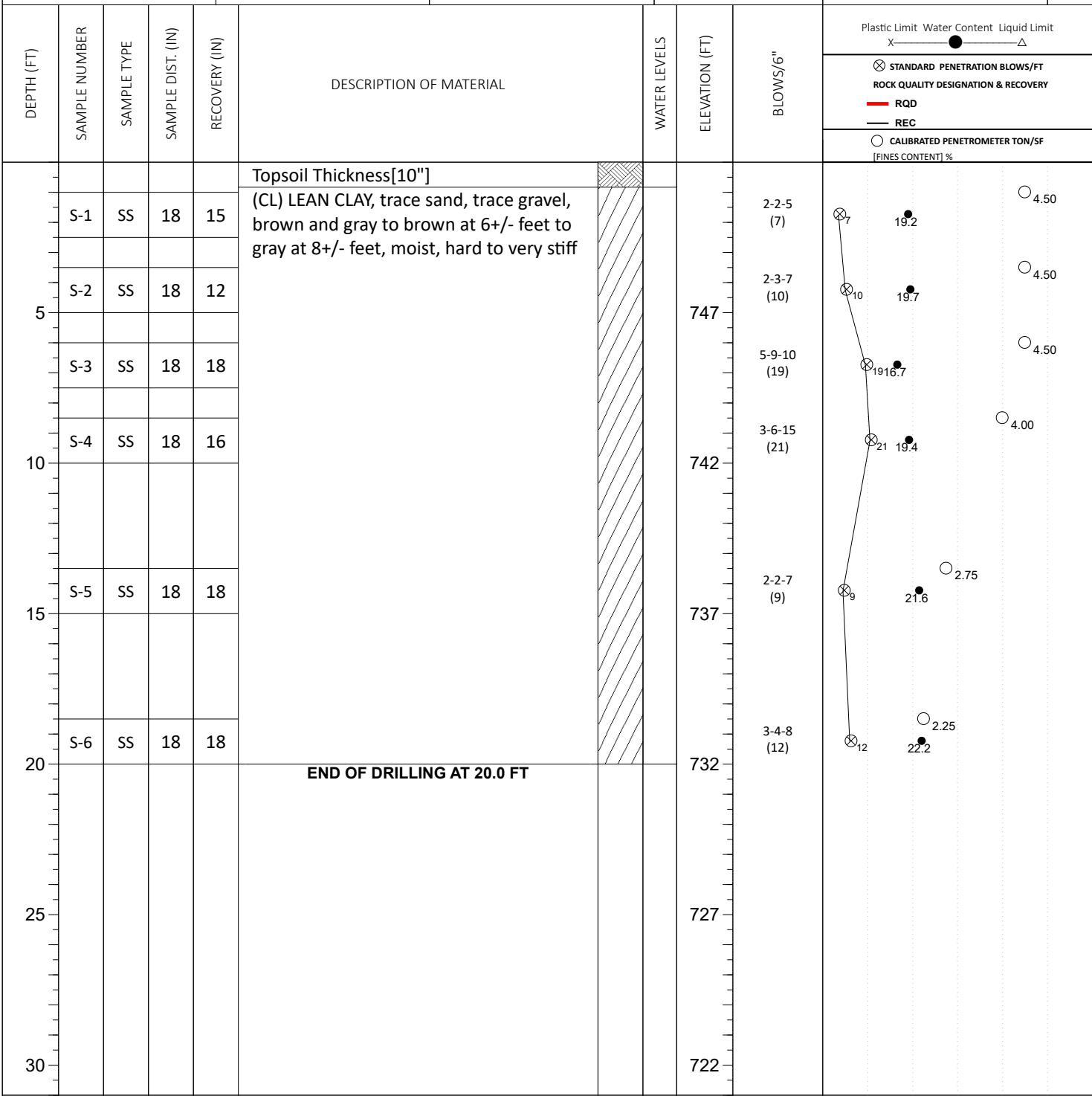
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▼ WL (Completion) dry	BORING COMPLETED: Dec 14 2021	HAMMER TYPE: Auto
▽ WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	LOGGED BY: DM1
▽ WL (Stabilized)		DRILLING METHOD: 2-1/4" HSA

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

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				BOTTOM OF CASING 



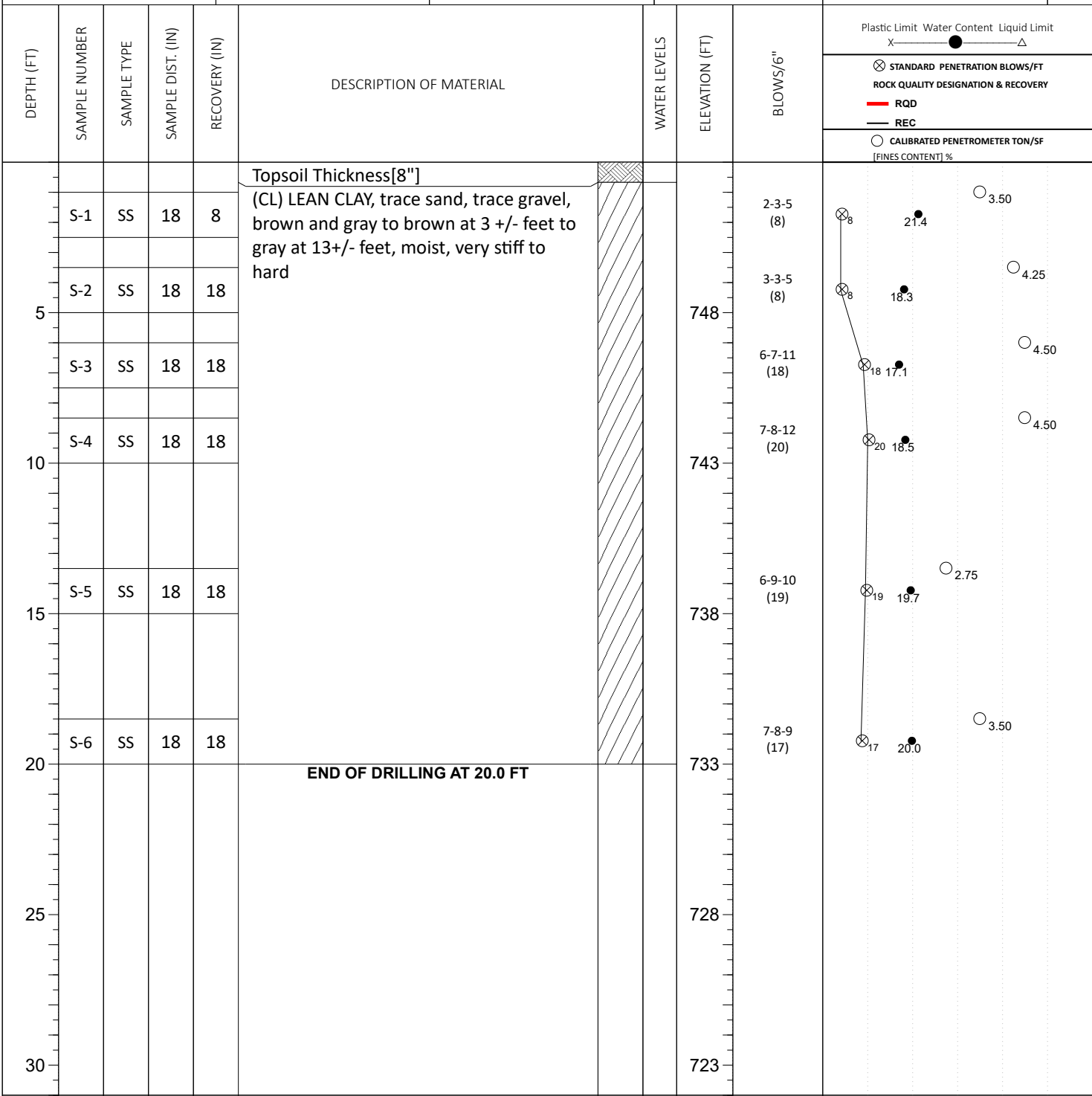
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▼ WL (Completion) dry	BORING COMPLETED: Dec 14 2021	HAMMER TYPE: Auto
▽ WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA
▽ WL (Stabilized)	LOGGED BY: DM1	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

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				BOTTOM OF CASING 



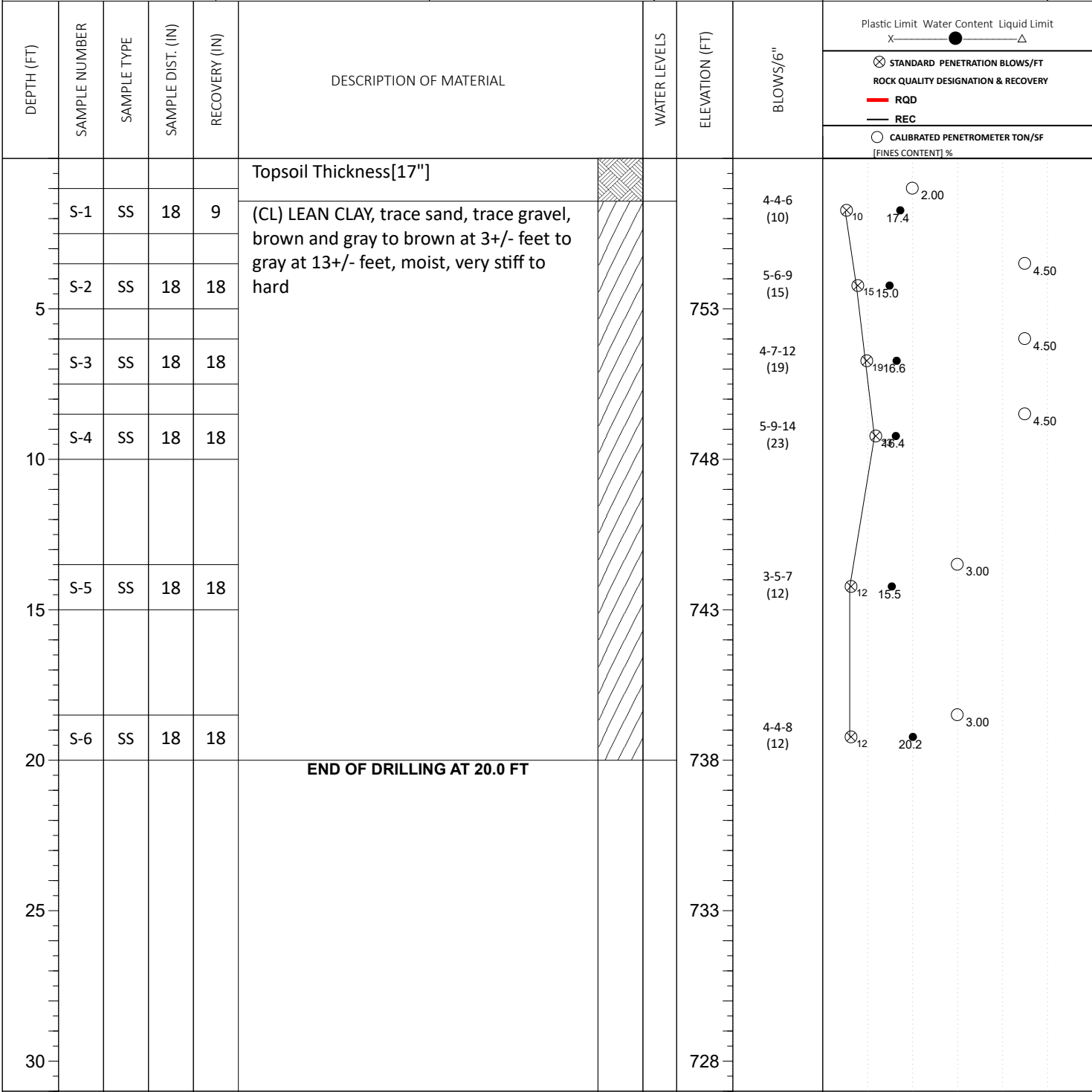
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▽ WL (First Encountered) none ▼ WL (Completion) dry ▽ WL (Seasonal High Water) ▽ WL (Stabilized)	BORING STARTED: Dec 16 2021 BORING COMPLETED: Dec 16 2021 EQUIPMENT: Track 7822 Geoprobe	CAVE IN DEPTH: HAMMER TYPE: Auto DRILLING METHOD: 2-1/4" HSA	LOGGED BY: DM1
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GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 289257.6	EASTING: 2519923.9	STATION:	SURFACE ELEVATION: 758.0	LOSS OF CIRCULATION 
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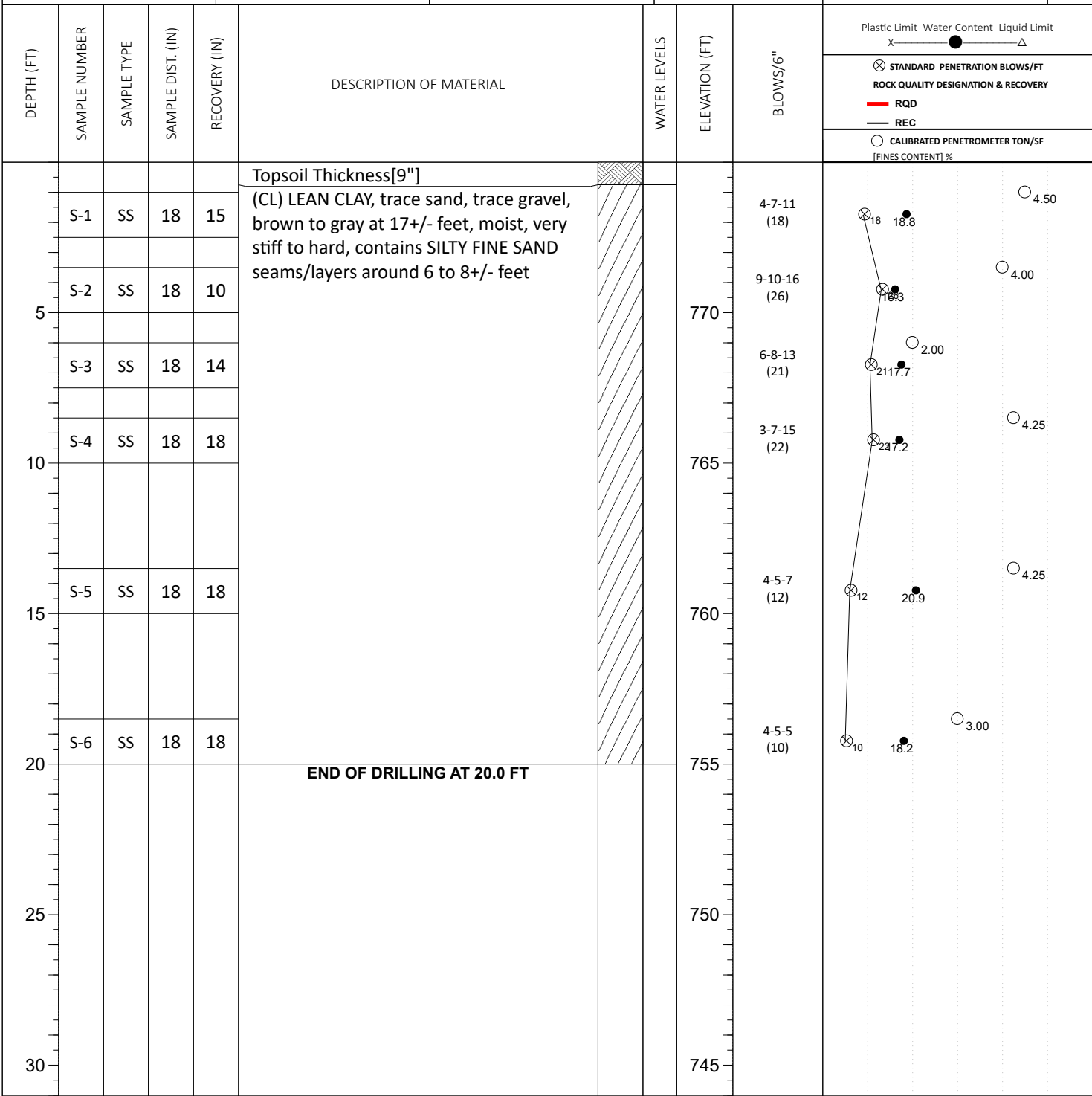
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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<input checked="" type="checkbox"/> WL (Completion) dry	BORING COMPLETED: Dec 16 2021	HAMMER TYPE: Auto
<input checked="" type="checkbox"/> WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	LOGGED BY: DM1
<input checked="" type="checkbox"/> WL (Stabilized)	DRILLING METHOD: 2-1/4" HSA	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 289041.1	EASTING: 2518534.1	STATION:	SURFACE ELEVATION: 775.0	LOSS OF CIRCULATION
				BOTTOM OF CASING



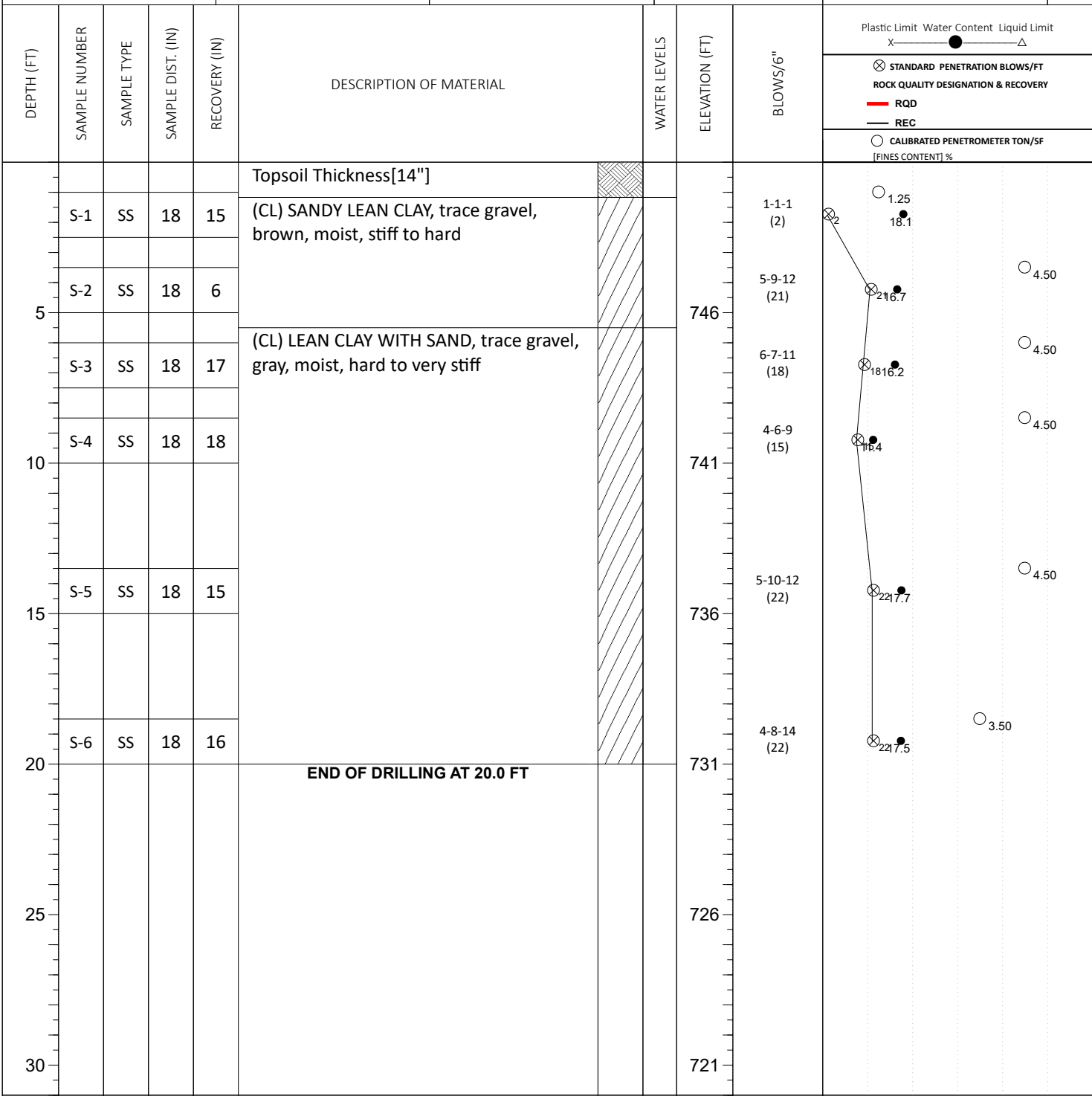
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BORING COMPLETED:	Dec 14 2021		HAMMER TYPE: Auto																		
EQUIPMENT:	Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA																			
LOGGED BY:	DM1																				

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

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				BOTTOM OF CASING



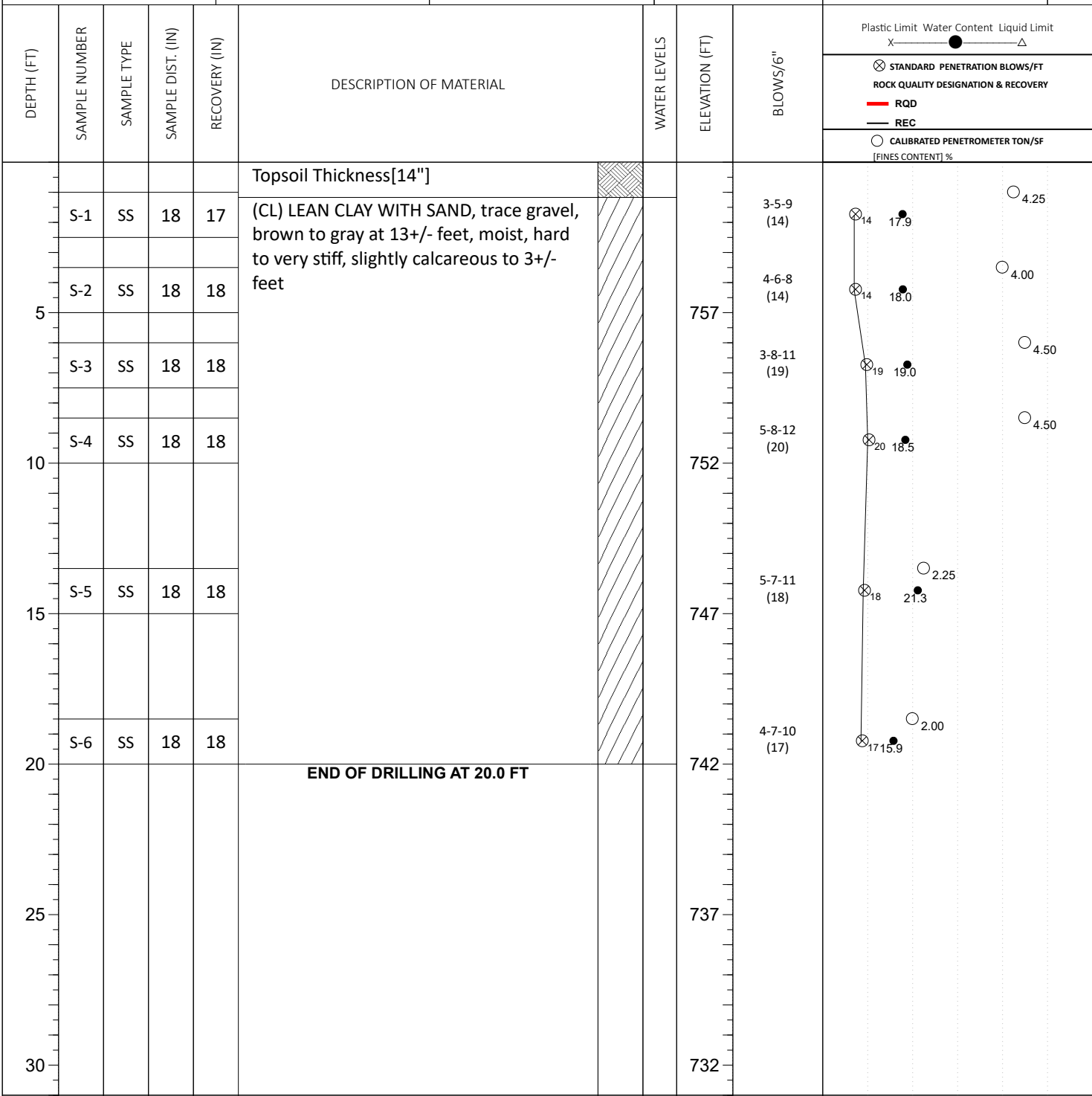
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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<input checked="" type="checkbox"/> WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	LOGGED BY: DM1
<input checked="" type="checkbox"/> WL (Stabilized)	DRILLING METHOD: 2-1/4" HSA	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

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				BOTTOM OF CASING 



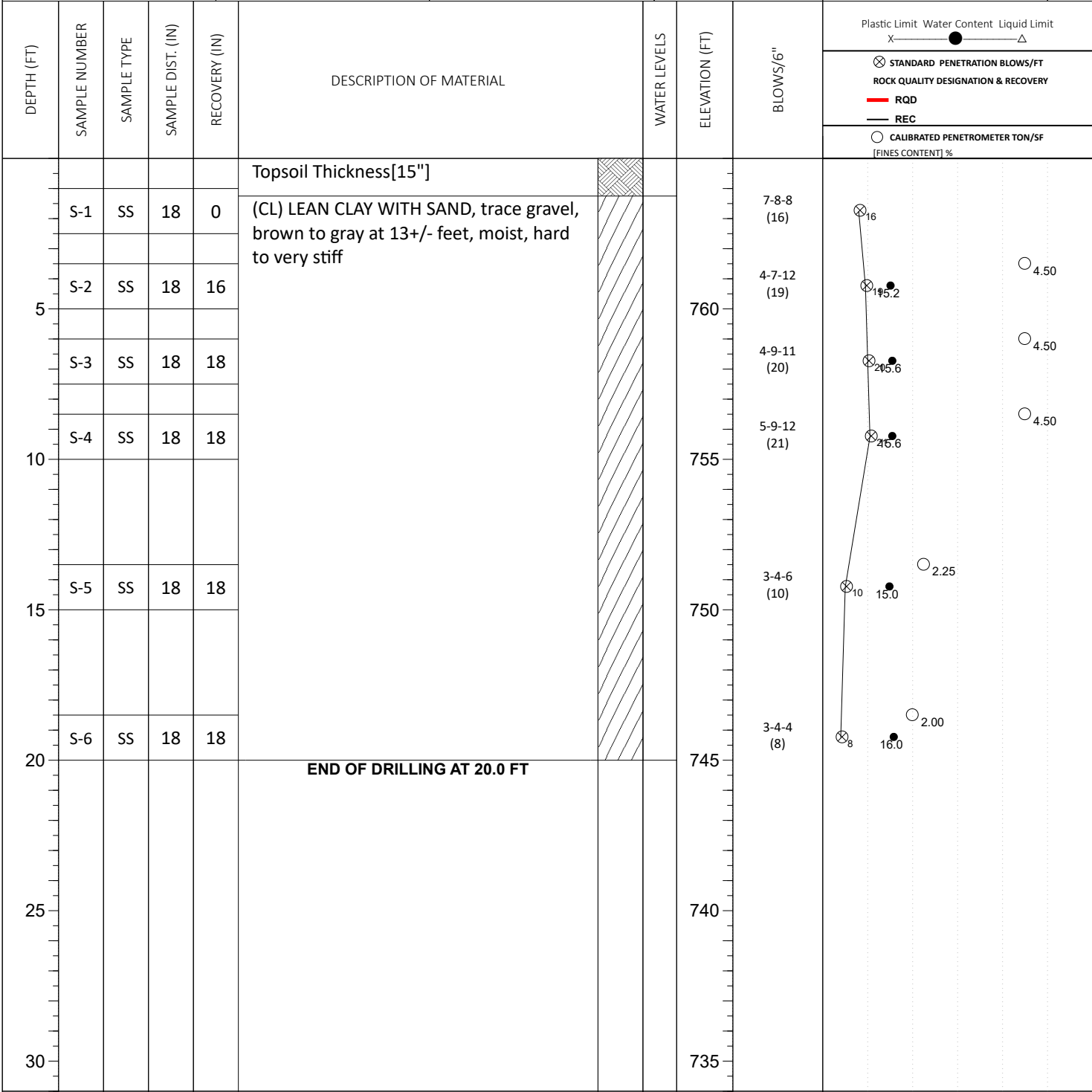
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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▼ WL (Completion) dry	BORING COMPLETED: Dec 16 2021	HAMMER TYPE: Auto
▽ WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA
▾ WL (Stabilized)	LOGGED BY: DM1	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

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				BOTTOM OF CASING 



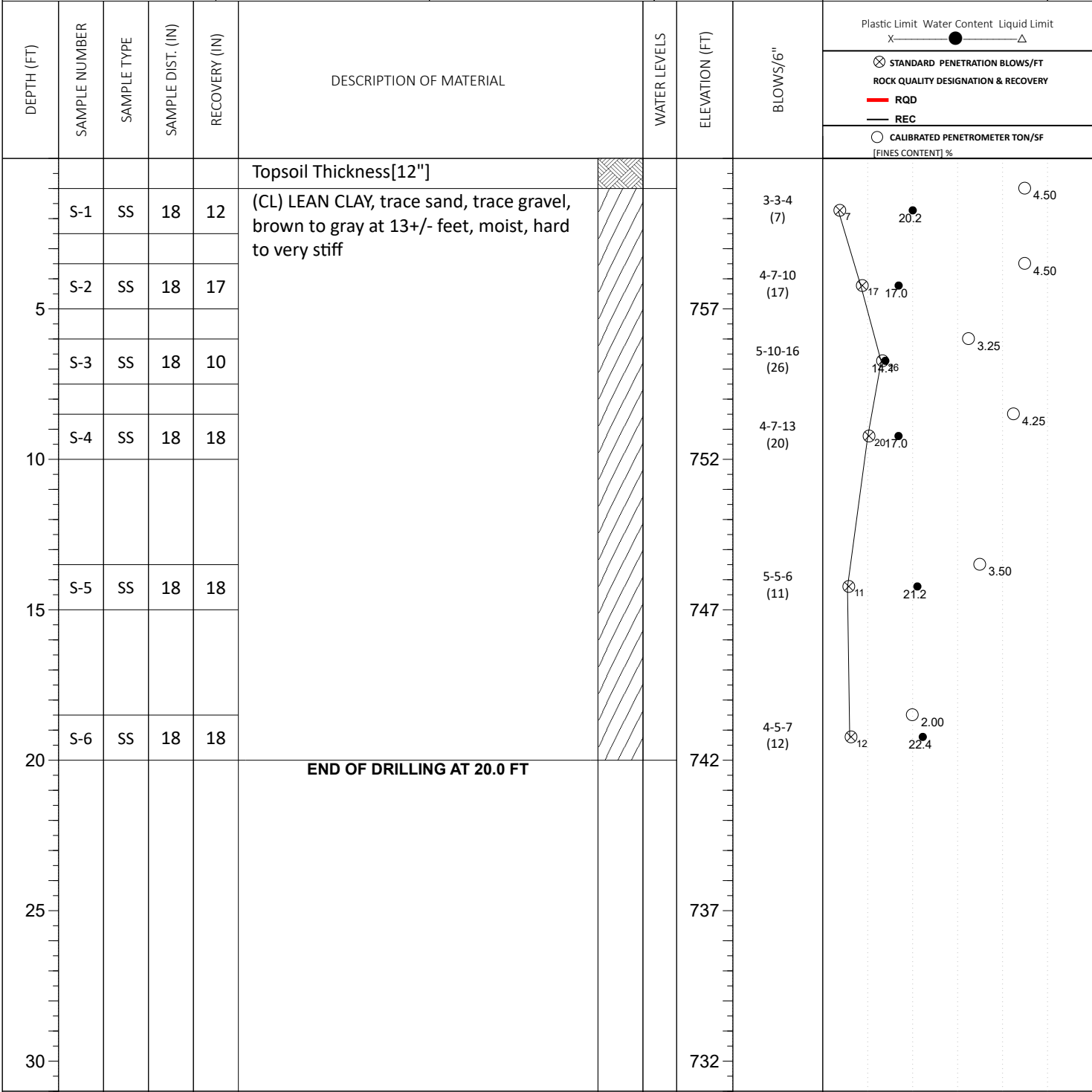
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▼ WL (Completion) dry	BORING COMPLETED: Dec 16 2021	HAMMER TYPE: Auto
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▽ WL (Stabilized)		DRILLING METHOD: 2-1/4" HSA

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 288678.8	EASTING: 2518625.1	STATION:	SURFACE ELEVATION: 762.0	LOSS OF CIRCULATION
				BOTTOM OF CASING



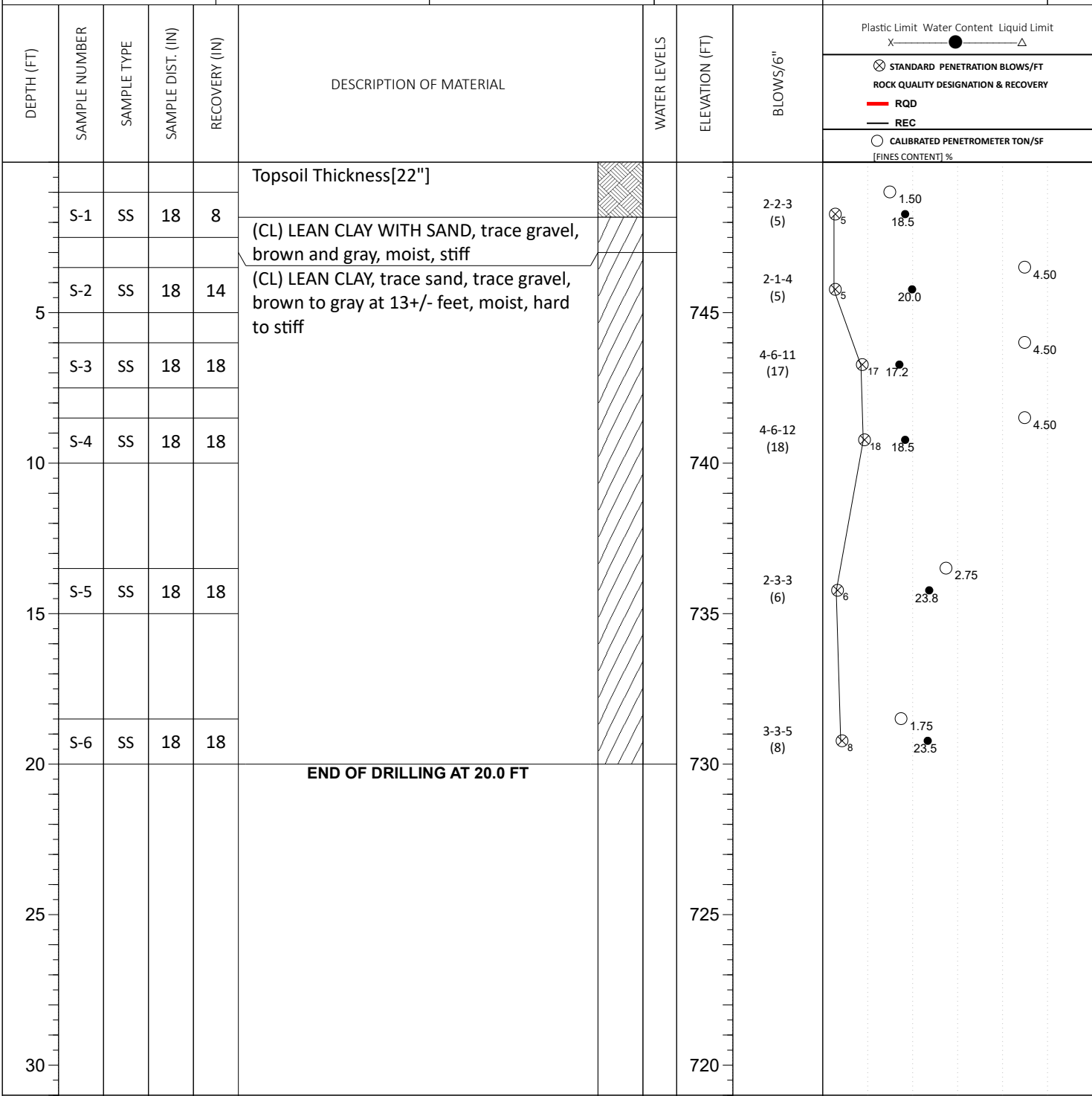
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) none ▼ WL (Completion) dry ▽ WL (Seasonal High Water) ▽ WL (Stabilized)	BORING STARTED: Dec 14 2021 BORING COMPLETED: Dec 14 2021 EQUIPMENT: Track	CAVE IN DEPTH: HAMMER TYPE: Auto DRILLING METHOD: 2-1/4" HSA	LOGGED BY: DM1
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GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 288627.6	EASTING: 2519014.3	STATION:	SURFACE ELEVATION: 750.0	LOSS OF CIRCULATION
				BOTTOM OF CASING



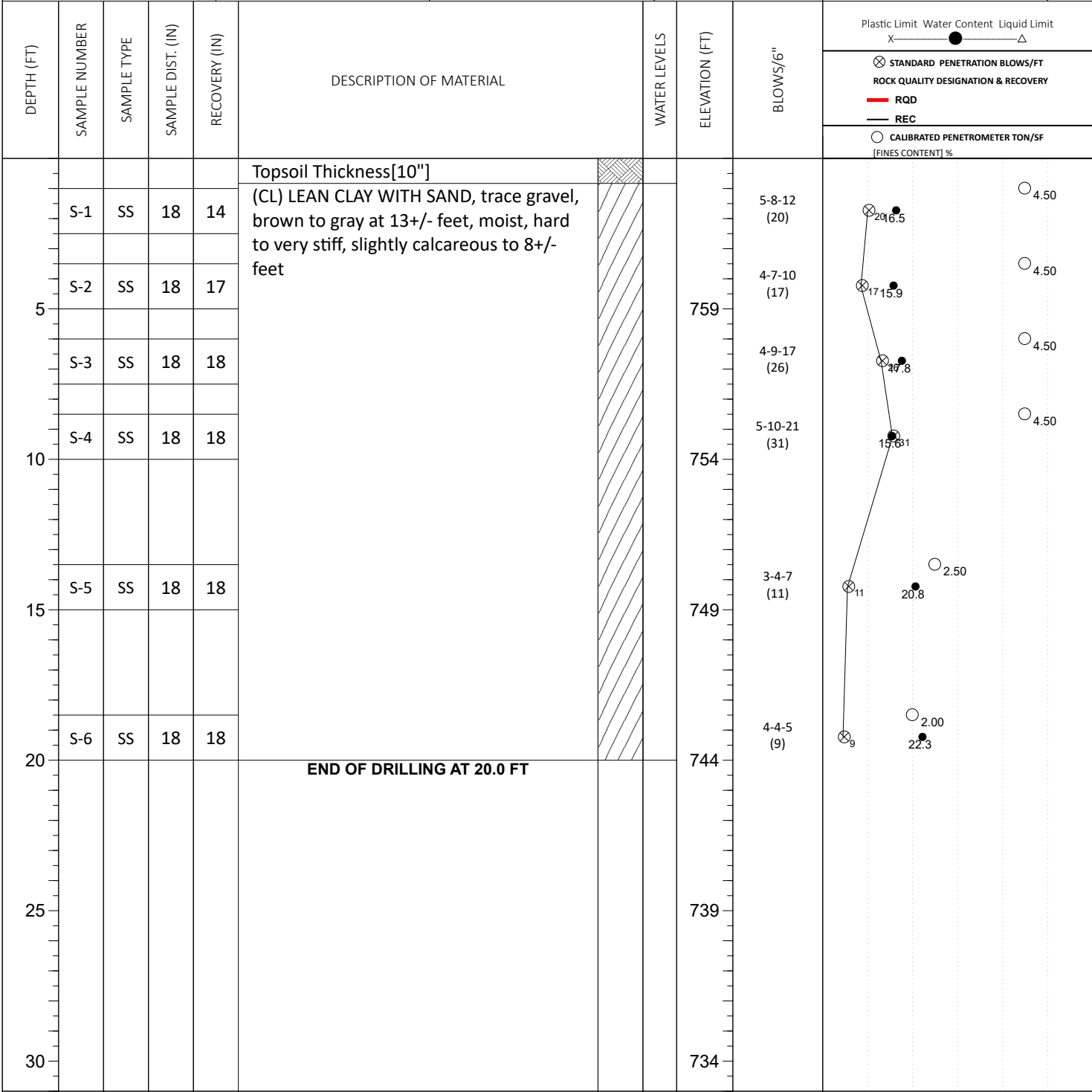
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) none	BORING STARTED: Dec 14 2021	CAVE IN DEPTH:
▼ WL (Completion) dry	BORING COMPLETED: Dec 14 2021	HAMMER TYPE: Auto
▽ WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	LOGGED BY: DM1
▽ WL (Stabilized)		DRILLING METHOD: 2-1/4" HSA

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

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				BOTTOM OF CASING



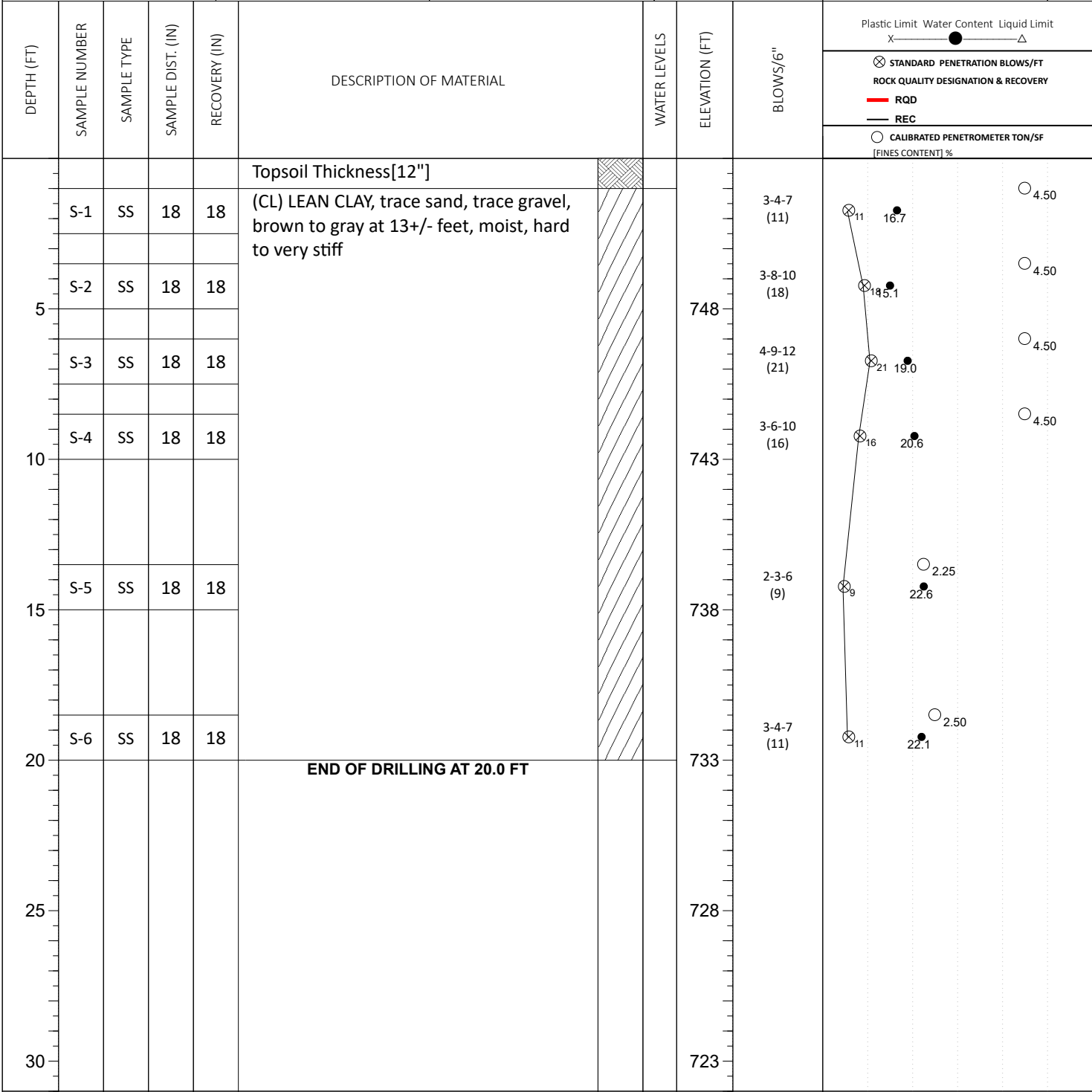
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

<input checked="" type="checkbox"/> WL (First Encountered) <input checked="" type="checkbox"/> WL (Completion) <input checked="" type="checkbox"/> WL (Seasonal High Water) <input checked="" type="checkbox"/> WL (Stabilized)	BORING STARTED: Dec 16 2021 BORING COMPLETED: Dec 16 2021 EQUIPMENT: Track 7822 Geoprobe	CAVE IN DEPTH: HAMMER TYPE: Auto DRILLING METHOD: 2-1/4" HSA
	LOGGED BY: DM1	

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 288209.4	EASTING: 2518479.9	STATION:	SURFACE ELEVATION: 753.0	LOSS OF CIRCULATION
				BOTTOM OF CASING



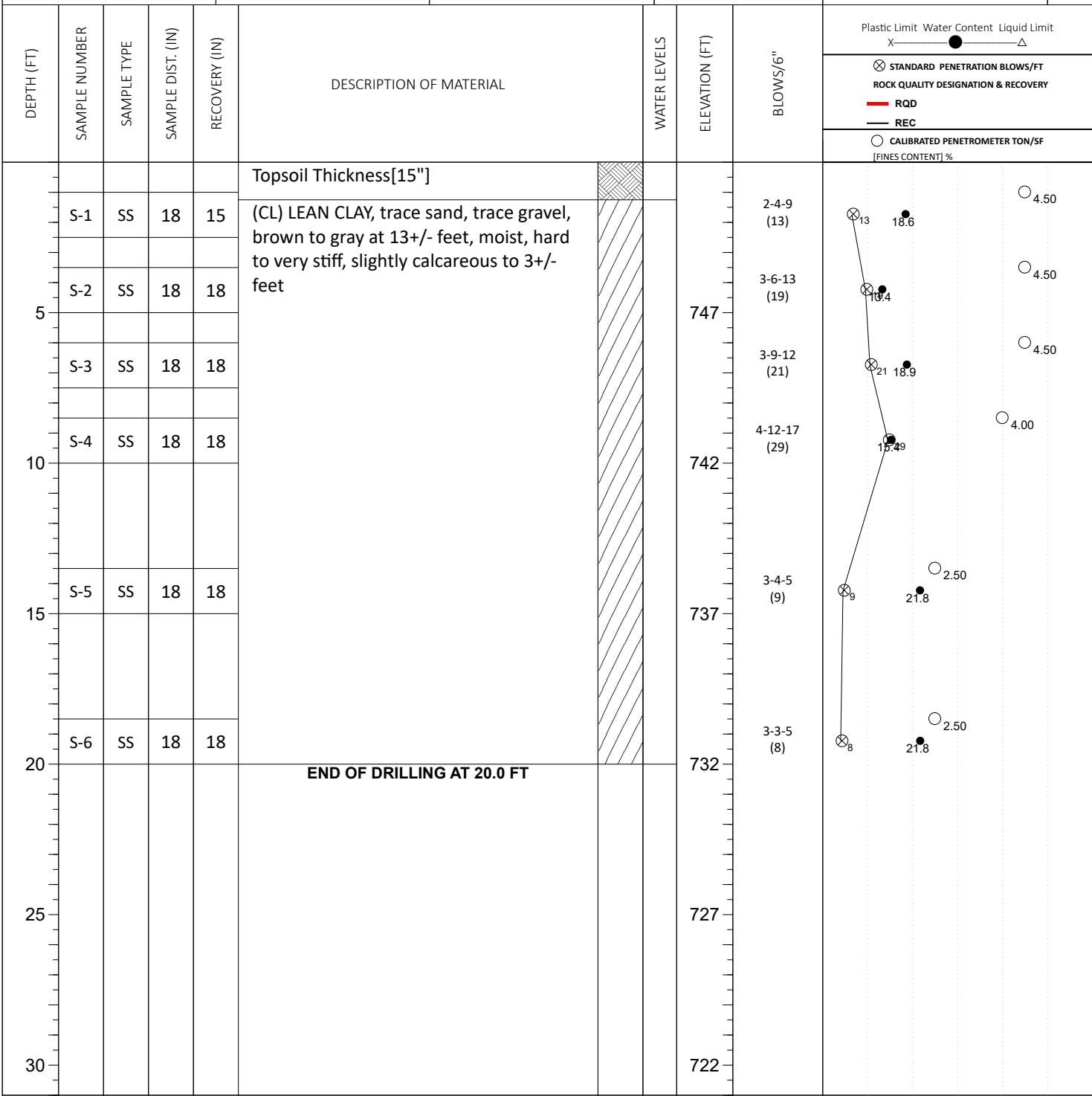
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

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<input checked="" type="checkbox"/> WL (Completion) dry	BORING COMPLETED: Dec 14 2021	HAMMER TYPE: Auto
<input checked="" type="checkbox"/> WL (Seasonal High Water)	EQUIPMENT: Track 7822 Geoprobe	LOGGED BY: DM1
<input checked="" type="checkbox"/> WL (Stabilized)		DRILLING METHOD: 2-1/4" HSA

GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 288218.4	EASTING: 2519255.6	STATION:	SURFACE ELEVATION: 752.0	LOSS OF CIRCULATION 
				BOTTOM OF CASING 



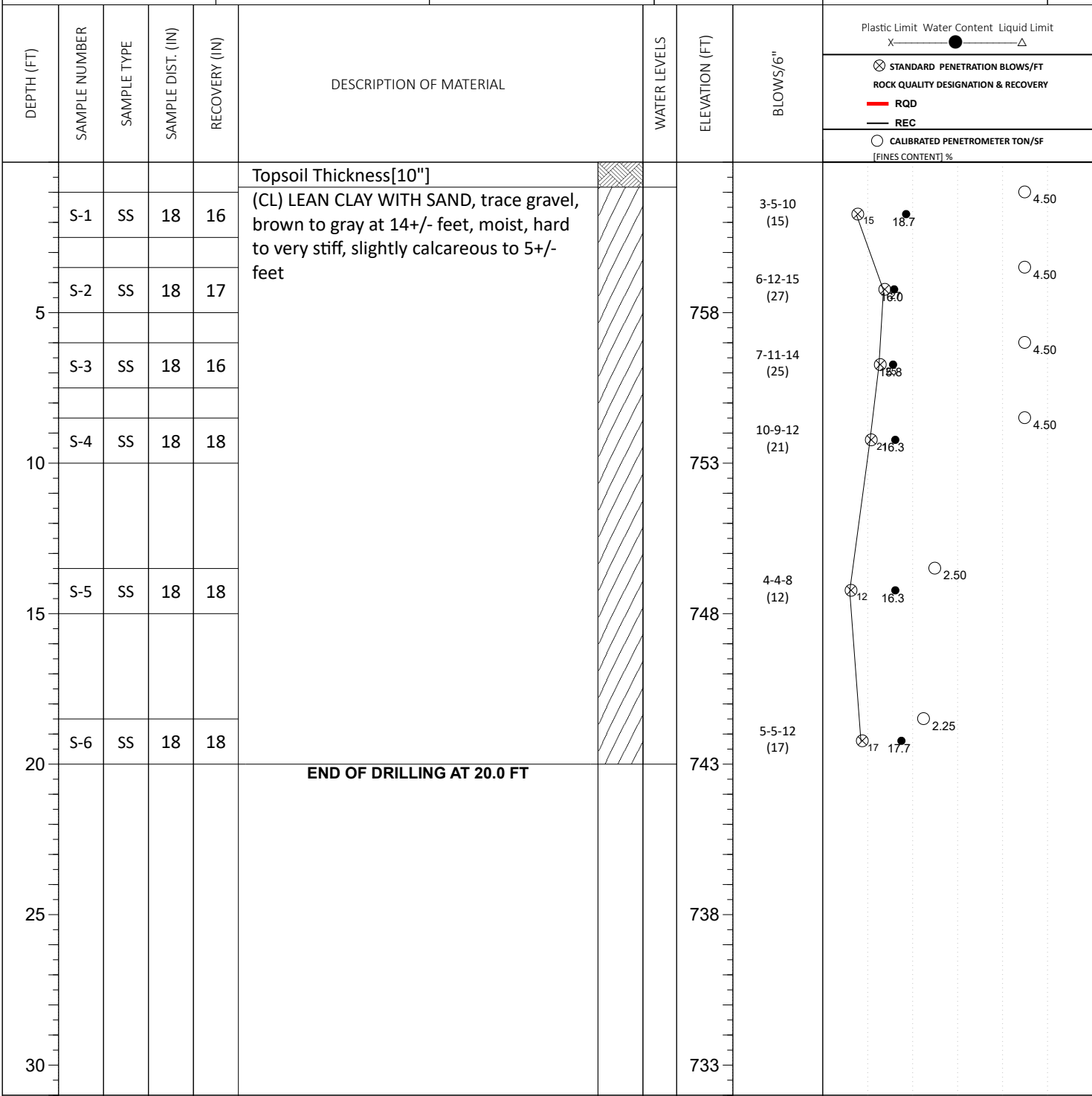
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) none ▼ WL (Completion) dry ▽ WL (Seasonal High Water) ▽ WL (Stabilized)	BORING STARTED: Dec 16 2021 BORING COMPLETED: Dec 16 2021 EQUIPMENT: Track 7822 Geoprobe	CAVE IN DEPTH: HAMMER TYPE: Auto DRILLING METHOD: 2-1/4" HSA	LOGGED BY: DM1
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GEOTECHNICAL BOREHOLE LOG

SITE LOCATION:
County Road K & I-94, Caledonia, Wisconsin 53126

NORTHING: 288185.6	EASTING: 2519980.1	STATION:	SURFACE ELEVATION: 763.0	LOSS OF CIRCULATION
				BOTTOM OF CASING



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

<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>∇ WL (First Encountered)</td> <td style="text-align: center;">none</td> </tr> <tr> <td>▼ WL (Completion)</td> <td style="text-align: center;">dry</td> </tr> <tr> <td>∇ WL (Seasonal High Water)</td> <td></td> </tr> <tr> <td>∇ WL (Stabilized)</td> <td></td> </tr> </table>	∇ WL (First Encountered)	none	▼ WL (Completion)	dry	∇ WL (Seasonal High Water)		∇ WL (Stabilized)		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>BORING STARTED:</td> <td style="text-align: center;">Dec 16 2021</td> <td rowspan="2">CAVE IN DEPTH:</td> </tr> <tr> <td>BORING COMPLETED:</td> <td style="text-align: center;">Dec 16 2021</td> <td>HAMMER TYPE: Auto</td> </tr> <tr> <td>EQUIPMENT:</td> <td style="text-align: center;">Track 7822 Geoprobe</td> <td>DRILLING METHOD: 2-1/4" HSA</td> </tr> <tr> <td>LOGGED BY:</td> <td style="text-align: center;">DM1</td> <td></td> </tr> </table>	BORING STARTED:	Dec 16 2021	CAVE IN DEPTH:	BORING COMPLETED:	Dec 16 2021	HAMMER TYPE: Auto	EQUIPMENT:	Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA	LOGGED BY:	DM1	
∇ WL (First Encountered)	none																				
▼ WL (Completion)	dry																				
∇ WL (Seasonal High Water)																					
∇ WL (Stabilized)																					
BORING STARTED:	Dec 16 2021	CAVE IN DEPTH:																			
BORING COMPLETED:	Dec 16 2021		HAMMER TYPE: Auto																		
EQUIPMENT:	Track 7822 Geoprobe	DRILLING METHOD: 2-1/4" HSA																			
LOGGED BY:	DM1																				

GEOTECHNICAL BOREHOLE LOG

TEST PIT SUMMARY
Badger Farm Due Diligence
Caledonia, Wisconsin
ECS Project No. 42:2185

Test Pit No.: TP-1

Ground Elevation: 755

Approximate Depth Below Existing Site Grade (Feet)	Soil Description	Excavation Effort
0 to 1½	TOPSOIL	Easy
1½ to 13½	LEAN CLAY, trace sand, trace gravel, brown to gray at 7½ ± feet, moist	Easy
Remarks	See Photograph below. Pocket of wet SILTY SAND encountered at 7½± feet. Soils slightly calcareous to 7½± feet.	



TEST PIT SUMMARY
Badger Farm Due Diligence
Caledonia, Wisconsin
ECS Project No. 42:2185

Test Pit No.: TP-2

Ground Elevation: 763

Approximate Depth Below Existing Site Grade (Feet)	Soil Description	Excavation Effort
0 to 1½	TOPSOIL	Easy
1½ to 17½	LEAN CLAY, trace sand, trace gravel, brown to gray at 7½ ± feet, moist	Easy
Remarks	See Photograph below. Approximately 1 to 2 inches of water accumulated at bottom after completion. Soils slightly calcareous to 4± feet.	



TEST PIT SUMMARY
Badger Farm Due Diligence
Caledonia, Wisconsin
ECS Project No. 42:2185

Test Pit No.: TP-3

Ground Elevation: 758

Approximate Depth Below Existing Site Grade (Feet)	Soil Description	Excavation Effort
0 to 2½	TOPSOIL	Easy
2½ to 6	SANDY LEAN CLAY, trace gravel, brown, moist	Easy
6 to 12	LEAN CLAY, trace sand, trace gravel, gray, moist	Easy
Remarks	See Photograph below. Soils slightly calcareous to 4± feet.	



TOPSOIL DATA

TOPSOIL THICKNESS	
Sample Location	Thickness (inches)
H-01	30
H-02	14
H-03	14
H-04	12
H-05	14
H-06	12
H-07	10
H-08	10
H-09	24
H-10	24
H-11	12
H-12	18
H-13	5
H-14	0
H-15	15
H-16	13
H-17	10
H-18	12
H-19	16
H-20	8
H-21	6
H-22	10
H-23	21
H-24	13
H-25	16
H-26	20
H-27	12
H-28	18
H-29	12
H-30	10
H-31	13
H-32	10
H-33	9
H-34	11
H-35	13
H-36	10
H-37	33
H-38	11
H-39	8
H-40	26
H-41	16
H-42	10

TOPSOIL THICKNESS	
Sample Location	Thickness (inches)
B-01	9
B-02	19
B-03	26
B-04	28
B-05	10
B-06	8
B-07	17
B-08	9
B-09	14
B-10	14
B-11	15
B-12	12
B-13	22
B-14	10
B-15	12
B-16	15
B-17	10
TP-1	18
TP-2	18
TP-3	30

ORGANIC CONTENT (ASTM D2974)		
Sample Location	Moisture Content (%)	Organic Content (%)
H-01 (NE)	20.6	5.3
H-15 (NW)	19.7	6.2
H-18 (SW)	24.4	8.3
H-27 (SE)	22.1	5.3



LABORATORY PROCEDURES:

Index Testing

Moisture content determination was performed on select fine-grained soil samples in accordance with ASTM D 2216.

Calibrated hand penetrometer tests (Qp) were performed on select cohesive soil samples. In the hand penetrometer test, the unconfined compressive strength of a soil sample is estimated, to a maximum of 4.5 or 6 tons per square foot (tsf), depending on the penetrometer model, by measuring the resistance of a soil sample to penetration by a small, calibrated, spring-loaded cylinder.

Atterberg limits determination was performed on select fine-grained soil samples in accordance with ASTM D 4319. The Atterberg limits are a basic measure of the critical water contents of a fine-grained soil: its **liquid limit**, **plastic limit**, and **shrinkage limit**. Depending on its water content, a soil may appear in one of four states: solid, semi-solid, plastic and liquid. In each state, the consistency and behavior of a soil is different and consequently so are its engineering properties. Atterberg limits can also be used to help distinguish between silt and clay, and to distinguish between different types of silts and clays.

Particle size distribution, also referred to as gradation or sieve analysis, refers to the proportions by dry mass of a soil particles distributed over specified particle-size ranges. The particle size distribution is used to help classify soils for engineering purposes. Particle size distribution determination was performed on select fine-grained soil samples in accordance with ASTM D 421, D 422 and/or D 1140.

A **loss on ignition (LOI)** test is used to estimate the organic content of the soil. In the LOI test a dry sample is heated to 440° C to burn off organic matter within the sample. The lost weight is compared to the initial dry weight to estimate the percentage of organics in the material. LOI determination was performed in accordance with ASTM D 2974.

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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e-mail: info@geoprofessional.org www.geoprofessional.org