APPENDIX F

PRELIMINARY GEOTECHNICAL REPORT

April 11, 2018

Stantec Consulting Services, Inc.
209 Commerce Parkway, PO Box 128
Cottage Grove, WI 53527-8955

Attn: Mr. Brian J. Karczewski, M.S., PSS
Senior Project Manager, Senior Associate

SUBJECT: Preliminary Geotechnical Exploration Report
Badger State Solar Project
Jefferson County, Wisconsin
PSI Project No. 00522223-R2

Dear Mr. Karczewski,

Professional Service Industries, Inc. (PSI), an Intertek Company, is pleased to submit our Preliminary Geotechnical Exploration Report for the Badger State Solar Project in Jefferson County, Wisconsin. This report includes the results of field and laboratory testing; preliminary recommendations for foundations; as well as general site development recommendations. An electronic copy of this report is being provided via email. Hard copies can be issued upon request.

PSI appreciates the opportunity to perform this geotechnical study and we look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Colin T. Henderson, P.E.
Project Engineer
Geotechnical Services

COLIN T. HENDERSON
E-44652-6
BIG BEND, WI

Ted A. Cera, P.E.
Department Manager
Geotechnical Services

TED A. CERA
34991-006
WAUKESHA, WI

PRELIMINARY GEOTECHNICAL EXPLORATION REPORT

Badger State Solar Project

Jefferson County, Wisconsin

Prepared for

Stantec Consulting Services, Inc.

209 Commerce Parkway, PO Box 128

Cottage Grove, WI 53527-8955

PSI Project No. 00522223-R2

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TABLE OF CONTENTS (Page 1 of 2)

INTRODUCTION

General

This report presents the results of the preliminary geotechnical exploration for the proposed Badger State Solar Project, in Jefferson County, Wisconsin. The work was performed for Stantec Consulting Services, Inc., at the request of Mr. Brian Karczewski.

Purpose

The purpose of this study was to provide a preliminary evaluation of the subsurface conditions at various proposed solar panel locations throughout the project limits, as directed by Stantec Consulting Services, Inc. A comprehensive foundation evaluation for all possible locations was beyond the scope of this preliminary subsurface exploration, but is recommended prior to design and construction when specific design details of the solar farm are known.

Scope

The scope of services for this geotechnical study included a site reconnaissance, the preliminary subsurface exploration, a determination of soil characteristics by field and laboratory testing, and an engineering evaluation of the data obtained.

Authorization

The description of services and authorization to perform this preliminary subsurface exploration and evaluation was in the form of a signed contract agreement between Stantec Consulting Services, Inc. and Professional Service Industries, Inc. (PSI), dated July 24, 2018. The scope of services are referenced in PSI Proposal No. 232297, dated July 17, 2018. This report has been prepared on behalf of, and exclusively for the use of Stantec Consulting Services, Inc. The information contained in this report may not be relied upon by any other parties without the express written consent of PSI, and acceptance by such parties of PSI’s General Conditions.

SITE AND PROJECT DESCRIPTION

The project sites will be located on parcels that exist on the southwest side of the Crawfish River, in Jefferson County, Wisconsin. The parcels generally exist within a 2.8 mile by 2.5 mile area north and south of Highway 18, west of Highway 89, south of Hope Lake Road, and north of County Highway J. In general, the parcels were predominantly being used as agricultural fields at the time of exploration. The topography varied significantly across the overall proposed project area described above, and also between the various locations of the borings performed. Hilly terrain, grass covered paths, and wooded areas were also present across portions of the overall project area.

The proposed Badger State Solar Project is understood to include the construction of multiple new solar racks, and associated service buildings and transformers. PSI was informed by the client that common foundations for the proposed solar farm structures will consist of driven piles or helical piers. Spread footings are proposed for support of the service buildings. It must be recognized that evaluation of deep foundations is limited to the relatively shallow depth of the borings requested/performed for this preliminary exploration. Additional deeper borings would generally be required prior to design and construction for final evaluation of deep foundations, to provide higher load carrying capacities of the foundation elements, and to provide design level recommendations. It is understood that site grades will remain the same as what currently exists with only minimal cutting or filling performed at the individual sites.

FIELD EXPLORATION/TESTING AND LABORATORY PROCEDURES

Scope Summary

The field and laboratory data utilized in the evaluation and analysis of the subsurface soils was obtained by drilling a total of 17 exploratory test borings, securing soil samples by the split-spoon sampling method, and subjecting the collected samples to laboratory testing. In addition, test pits were excavated and observed adjacent to 6 select boring locations after the borings were performed.

Field Exploration

Seventeen (17) soil test borings have been performed for this project at locations selected by the client, and were planned to extend to a depth of 20 feet below the existing ground surface. However, auger refusal on possible cobbles, boulders, or bedrock was experienced at B-17 at a depth of about 13 feet. In addition, borings B-4, B-6, and B-8 were extended beyond the planned depths, to depths of 25 to 40 feet due to the presence of organic and/or low strength soils. Subsequent to the borings being performed, test pits were performed to a depth of 10 feet adjacent to 6 select boring locations, including B-3, B-6, B-11, B-13, B-15, and B-17.

The borings were staked in the field by Stantec Consulting Services, Inc. and PSI in the general areas of the planned solar farm sites and were generally within agricultural fields. The general areas where the borings and test pits were performed are indicated on the Boring and Test Pit Location Plan enclosed in Appendix A. The borings were backfilled with bentonite chips immediately upon completion of drilling and removal of the augers from the ground. The test pits were backfilled immediately upon completion of excavation with the same soil spoils that were excavated from the pits. No special compaction of the test pit backfill was provided, other than some limited tamping with the backhoe bucket during backfilling. Offset locations, if any, are indicated on the bottom of the Soil Boring Logs. The ground surface elevations shown on the logs were estimated by interpolation of a 10-foot USGS contour map of the project area, provided to PSI by Stantec and Google Earth Pro. Based on the relatively large contour intervals, the accuracy of the elevations cannot be verified. If accurate elevations of the borings are desired, surveying of the boring locations by a qualified surveyor will be required.

The soil test borings were performed with an all-terrain vehicle (ATV) mounted rotary drilling rig utilizing continuous flight hollow stem augers to advance the holes. The ATV drill rig was required for access to the proposed borings due to soft surface conditions in areas, varied topography, and the off-road nature of the proposed boring locations. Representative samples were obtained by the Standard Penetration Test (SPT) method using split-spoon sampling procedures in general accordance with ASTM D-1586 procedures. Samples were collected at 2.5-foot intervals to 10 feet, and then at 5 foot intervals thereafter to the end of the borings. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling thirty (30) inches, required to advance the split-spoon sampler one (1) foot into the soil. The sampler is lowered to the bottom of the drill hole and the number of blows recorded for each of the three (3) successive increments of six (6) inches of penetration. The “N” value is obtained by adding the second and third incremental numbers. The SPT provides a means of estimating the relative density of granular soils and comparative consistency of cohesive soils, thereby providing a method of evaluating the relative strength and compressibility characteristics of the subsoils.

The SPT soil samples were transferred to clean glass jars immediately after retrieval, and returned to the laboratory upon completion of the field operations. Samples will be stored for a period of 60 days, at which time they will be discarded unless other instructions are received. All soil samples were visually classified by a soils engineer in general accordance with the Unified Soil Classification System (ASTM D-2488-75).

A copy of the Boring and Test Pit Location Plan (Figure 1) and Soil Boring and Test Pit Logs are enclosed as Appendices A and B, respectively. The soil stratification shown on the logs represents the soil conditions in the actual boring and test pit locations at the time of the exploration. The terms and symbols used on the logs are described in the General Notes found in Appendix B. Upon completion, the boreholes were backfilled to the ground surface with bentonite chips.

Laboratory Testing

Additional characteristics of the materials were evaluated in the PSI laboratory to provide data on which to classify and quantitatively assess the engineering properties of the soil samples obtained. The types of soils encountered were identified and logged on the boring records. The results of the field and laboratory tests are presented on the Soil Boring Logs and Table 1 (Soil Data) included in Appendix C.

Laboratory Tests and Measurements

Visual Classification: All samples were visually classified by a soils engineer in accordance with the Unified Soil Classification System (ASTM D-2488). An explanation of the symbols used in this system is included on the General Notes found in Appendix B.

Moisture Content Tests: The moisture content was determined by ASTM method D-2216 and is recorded on the Soil Boring Logs in Appendix B as a percentage of the dry weight of soil.

Unconfined Compression Test – SPT Samples: The approximate undrained shear strength of selected cohesive soils was estimated from unconfined compression tests performed with a Rimac compression machine on specimens obtained from the split-barrel sampler. The strength values of soil samples obtained by the Standard Penetration Test Method must be considered approximate, recognizing that this sampling technique provides a representative, but somewhat disturbed sample. The results are listed on the Soil Boring Logs in Appendix B beneath the column labeled “Q_r”.

Organic Content Tests: Loss-on-ignition (LOI) testing was performed on samples obtained at B-7, B-8, and B-10, to determine the organic contents of selected samples at various depths, in accordance with ASTM D-2974. The results are summarized in the Soil Conditions section below and are also listed on the Soil Boring Logs enclosed in Appendix B.

Density Determination: Density estimates were made utilizing extrapolation of lab data, the SPT samples, or were based on published correlations between “N” values, unconfined compressive strengths, and wet unit weights.

Hand Penetrometer Tests: Cohesive samples extracted from the split-barrel sampler were tested with a soil penetrometer. This device provides an approximation of the unconfined compressive strength of the soils, and is useful, along with other soil parameters, in evaluating the soil strength characteristics. The results are listed on the Soil Boring Logs enclosed in Appendix B beneath the column labeled “Q_p”.

The laboratory testing was performed in general accordance with the respective ASTM methods, as applicable. The results are included on the Soil Boring Logs included in Appendix B. In addition, a summary of the results of the test data is included on Table 1 in Appendix C.

The following table summarizes the quantity of each aforementioned lab test that was performed for this project.

LAB TESTS	TOTAL TESTS PERFORMED
Moisture Content	124
Unconfined Compression Test (Rimac - Q_r)	1
Hand Penetrometer Test (Q_p)	11
Organic Content Tests (LOI)	4

DESCRIPTION OF SUBSURFACE CONDITIONS

General

A description of the subsurface conditions encountered at the test boring and test pit locations are shown on the Soil Boring and Test Pit Logs enclosed in Appendix B. The lines of demarcation shown on the logs represent approximate boundaries between the various soil classifications. It must be recognized that the soil descriptions are considered representative for the specific test hole locations, and that variations may occur between the sampling intervals and between the widely spaced boring locations. Soil depths, topsoil and layer thicknesses, and demarcation lines can be utilized for preliminary construction calculations, but should not be expected to yield exact and final quantities. A summary of the major soil profile components is described in the following paragraphs.

Soil Conditions

About 5 to 24 inches of topsoil comprised of dark brown or black organic silt, were encountered on the surface at the test borings and test pits, with the exceptions of B-8, TP-2 (B-6) and TP-4 (B-13). The surface materials at B-8 consisted of about 8 inches of aggregate base comprised of brown crushed sand and gravel. Extending from the surface of TP-4 (B-11), natural brown clayey sand soils were present to a depth of about 3 feet. Extending from the surface of TP-2 (B-6) were fill soils comprised brown silty fine sand with gravel, to a depth of about 1 foot. Below the fill at TP-2 (B-6), was a deposit of buried topsoil comprised of black organic silt, extending to a depth of about 2.5 feet.

The surface materials at B-4 and B-8 were underlain by organic soils consisting of peaty topsoil comprised of black organic silt, or gray, dark brown, or dark gray organic silt with shell matter (lake marl), extending to depths of about 22 and 6 feet, respectively. Moisture contents of these soils ranged from about 46% to 233%, indicating a very moist to wet condition. These moisture contents are generally indicative of materials which contain moderate to high organic contents.

Below the organic soils at B-8, and the surficial topsoil at B-7, were gray, bluish gray, or brownish/greenish gray silt soils with trace organics, extending to depths of about 8 to 27 feet. Moisture contents of these soils ranged from about 34% to 55%, indicating a very moist to wet condition. These moisture contents are generally indicative of materials which contain trace to moderate organic contents. Standard Penetration Tests (SPTs) on these soils indicated a very loose relative density, with Standard Penetration Resistances (N-values) generally ranging from about 1 to 2 blows per foot (bpf). However, in some instances this soil was penetrated by the split spoon sampler for the entire sampling interval under the static weight of the sampling hammer.

The surface materials at B-1, B-2, B-9, B-10, B-12, B-13, B-16, B-17, TP-3, and TP-5 were underlain by cohesive soils comprised of brown, grayish brown, or gray silty clay or sandy clay; extending to depths of about 1.5 to 7 feet. It should be noted that silty clay soils were present below the organic soils at B-8, extending to the boring termination depth of 40 feet. Traces of organics were present within the clay soils at B-10. Moisture contents of the clay soils ranged from about 15% to 25%, indicating a moist to very moist condition. The clay soils were very soft to very stiff in consistency, with estimated unconfined compressive strengths ranging from about 0.25 to 3.0 tons per square foot (tsf). The lower strength, very soft to medium stiff clay soils were present within B-10 and B-12 to depths of about 1.5 to 6 feet.

Below the clay soils at B-1, B-2, B-9, B-10, B-12, B-13, B-16, B-17, TP-3, and TP-5 (B-13); the fill and buried topsoil at TP-2 (B-6); the organic soils at B-4, the silt with trace organics at B-7; and the surface materials at the rest of the boring and test pit locations; were natural granular soils that extended to the boring termination depths. The granular soils generally consisted of light brown, brown, or gray silty fine sand, sandy silt, clayey sand, or medium to coarse sand; with varying gravel content and areas of possible cobbles and boulders. Difficult drilling due to very dense soils and the possible presence of cobbles and boulders was encountered at B-17, beginning at a depth of about 8 feet. In addition, auger refusal on possible cobbles, boulders, or bedrock was experienced at B-17, at a depth of about 13 feet.

Moisture contents of the granular soils ranged from about 3% to 29%, indicating a damp to wet condition. Standard Penetration Tests (SPTs) on these soils indicated a very loose to very dense relative density, with Standard Penetration Resistances (N-values) ranging from about 2 blows per foot (bpf) to 50 blows for 1 inch of split-spoon sampler penetration. However, N-values in the range of about 6 to 37 blows per foot, indicating a loose to dense relative density, were more typically encountered in the borings.

Loss-on-ignition (LOI) organic content testing was performed on samples of the silt with trace organics at B-7 and B-8, and the silty clay with trace organics at B-10, at various depths between 1 to 17.5 feet. The moisture contents of these soils ranged from about 25% to 53%, indicating a very moist to wet condition. The results of the LOI testing indicated organic contents ranging from approximately 1.7% to 2.7%. Soils with organic contents greater than about 5 percent are typically considered to be organic. As such, the aforementioned soils are considered to be of low organic content. The following Table depicts the soil types and individual organic content results of the samples at each location tested, and are also shown in the Soil Boring Logs in the Appendix B.

BORING NO.	SOIL TYPE	SAMPLE INTERVAL (FT)	ORGANIC CONTENT (%)
B-7	Silt, Trace Organics	3½ to 5	1.7
B-8	Silt, Trace Organics	8½ to 10	2.7
B-8	Silt, Trace Organics	16 to 17½	2.5
B-10	Silty Clay, Trace Organics	1 to 2½	2.0

The foregoing discussion of soil conditions on this site represents a generalized soil profile as determined at the test boring locations. A more detailed description and supporting data for each test location can be found on the individual Soil Boring and Test Pit Logs enclosed in Appendix B and on Table 1 – Soil Data and Table 2, enclosed in Appendix C.

Groundwater Observations

Groundwater observations were made during the drilling and excavation operations at the borings and test pits, and in the open boreholes and pits upon completion. Groundwater was encountered during auger advancement at B-2 through B-10, B-12, B-16; and during test pit excavation operations at TP-1 (B-3); at depths ranging from about 3 to 21 feet. Upon completion and removal of the augers, groundwater was present above the caved soils at borings B-2, B-3, B-5, B-9, B-10, B-12, and B-16, at depths ranging from about 5 to 8 feet. The groundwater was generally observed within natural granular soils.

Estimated groundwater depths at the specific boring locations at the time of drilling are presented in Table 1 (Soil Data) enclosed in Appendix C. However, it must be recognized that groundwater levels can fluctuate with time due to variations in seasonal precipitation, lateral drainage, and the soil permeability characteristics. The higher water levels encountered within the organic silt soils at B-4 may be indicative of a perched condition. Additional exploration and/or longer term monitoring typically performed at the time of a more comprehensive exploration/evaluation would generally be required to better evaluate groundwater levels/conditions on this site.

EVALUATIONS AND RECOMMENDATIONS

General Development Considerations

Natural soils suitable for support of the proposed solar racks, service buildings, and transformers are generally present within most of the borings and test pits at relatively shallow depths. However, fill, buried topsoil, organic, and low strength natural soils were present within some of the borings/test pits performed (B-4, B-7, B-8, B-10, B-12, and TP-2 (B-6)) to depths as great as about 27 feet. These soils are not considered suitable for foundation support. All foundations must be extended through these unsuitable soils to bear upon suitable natural soils of sufficient strength. Based upon the greater depth of unsuitable soil encountered at several locations, such as B-4, B-7, B-8, and B-10, where unsuitable soils extended to depths of about 6 to 27 feet, deep overexcavation for the use of shallow footings for the service buildings will likely not be feasible. In at least these locations, helical piers or driven piles could also be considered for support of the proposed service buildings, since overexcavation for spread footings will likely not be feasible.

Groundwater was encountered at B-2 through B-10, B-12, and B-16; and during test pit excavation operations at TP-1 (B-3); at depths ranging from about 3 to 21 feet below existing grades. Therefore, substantial difficulty with groundwater is expected in some areas and dewatering will therefore be required. Additionally, excavation instability will likely be experienced due to the presence of granular soils at the boring locations, especially where relatively shallow groundwater is also encountered. Sloping, shoring or bracing of open cut excavation sidewalls will also be necessary. The use of driven piles or helical piers in locations of shallow water can help alleviate concerns with constructability from a groundwater control/dewatering perspective where excavations for shallow foundations would otherwise extend to or below the groundwater levels. These foundation types can also alleviate concerns with excavation stability, where deeper excavations required for removal of unsuitable soils, especially those extending to or below water, would likely otherwise experience the potential for significant caving of excavation sidewalls.

Some drilling or excavation difficulty may be experienced in some areas (such as possibly at/near B-17) with increasing depth due to the generally dense nature of the soils, and due to the presence of possible cobbles, boulders, and/or bedrock. Auger refusal on possible cobbles, boulders, or bedrock, was experienced at B-17, at a depth of about 13 feet. Longer times for drilling are anticipated in at least this area. Coring of bedrock, and coring or other specialized drilling techniques to extend through cobbles or boulders, may be necessary in some areas depending on design embedment depths.

At borings B-1, B-6, B-11, B-13, B-14, B-15, and B-17, suitable natural soils were encountered at relatively shallow depths (less than 4 feet below ground surface), and groundwater was encountered at substantial depths of about 17 feet below ground surface or deeper. Based upon the soil conditions at these borings in comparison to the other borings, shallow foundations for the service buildings may be the most practical/feasible in these areas.

The following table serves to summarize the basic advantages and disadvantages of each foundation type discussed above from a constructability/feasibility standpoint at each boring location.

Boring No.	Estimated Depth to Suitable Soil (ft)	Estimated Depth to Ground Water (ft)	Advantage/ Disadvantage of Shallow Mat or Spread Footing for Service Buildings	Advantage/ Disadvantage of Driven Piles for Solar Structures or Service Buildings	Advantage/ Disadvantage of Helical Piers for Solar Structures or Service Buildings
B-1	1±	>20±	Shallow Suitable Soils, No Water; Easy Excavation.	Can be used as practical.*	Can be used as practical.*
B-2	1±	6½±	Shallow Suitable Soils, however may encroach upon groundwater depending on foundation depth.	Piles may eliminate groundwater difficulty. Can be used as practical.	Helical Piers may eliminate groundwater difficulty. Can be used as practical.
B-3	1½±	3±	Shallow Suitable Soils, but excavation difficulty with shallow groundwater	Piles may eliminate groundwater difficulty. Can be used as practical.	Helical Piers may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.
B-4	22±	6±	Unsuitable soils are considered too deep to overexcavate for a shallow foundation system, Excavation into groundwater	Piles may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.	Helical Piers may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.
B-5	1±	5½±	Shallow Suitable Soils, however may encroach upon groundwater depending on foundation depth.	Piles may eliminate groundwater difficulty. Can be used as practical.	Helical Piers may eliminate groundwater difficulty. Can be used as practical.

Boring No.	Estimated Depth to Suitable Soil (ft)	Estimated Depth to Ground Water (ft)	Advantage/ Disadvantage of Shallow Mat or Spread Footing for Service Buildings	Advantage/ Disadvantage of Driven Piles for Solar Structures or Service Buildings	Advantage/ Disadvantage of Helical Piers for Solar Structures or Service Buildings
B-6	1±	17±	Shallow Suitable Soils, No Water; Easy Excavation	Can be used as practical.*	Typically not practical due to shallow foundation feasibility. Can be used as practical.*
B-7	8±	6±	Unsuitable soils may be too deep to overexcavate for a shallow foundation system, Excavation into groundwater	Piles may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.	Helical Piers may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.
B-8	27±	4±	Unsuitable soils are considered too deep to overexcavate for a shallow foundation system, Excavation into groundwater	Piles may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.	Helical Piers may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.
B-9	1±	6±	Shallow Suitable Soils, however may encroach upon groundwater depending on foundation depth	Piles may eliminate groundwater difficulty. Can be used as practical.*	Helical Piers may eliminate groundwater difficulty. Can be used as practical.*
B-10	6±	6±	Unsuitable soils may be too deep to overexcavate for a shallow foundation system, Excavation into groundwater	Piles may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.*	Helical Piers may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.*
B-11	½±	>20±	Shallow Suitable Soils, No Water; Easy Excavation	Can be used as practical.*	Typically not practical due to shallow foundation feasibility. Can be used as practical.*
B-12	3±	3±	Shallow Suitable Soils, but excavation difficulty with shallow groundwater	Piles may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.*	Helical Piers may eliminate groundwater difficulty and can extend through deeper unsuitable soils. Can be used as practical.*
B-13	1½±	>20±	Shallow Suitable Soils, No Water; Easy Excavation	Typically not practical due to shallow foundation feasibility. Can be used as practical.*	Typically not practical due to shallow foundation feasibility. Can be used as practical.*
B-14	1±	>20±	Shallow Suitable Soils, No Water; Easy Excavation	Typically not practical due to shallow foundation feasibility. Can be used as practical.*	Typically not practical due to shallow foundation feasibility. Can be used as practical.*
B-15	1±	>20±	Shallow Suitable Soils, No Water; Easy Excavation	Typically not practical due to shallow foundation feasibility. Can be used as practical.*	Typically not practical due to shallow foundation feasibility. Can be used as practical.*
B-16	1½±	7±	Shallow Suitable Soils, however may encroach upon groundwater depending on foundation depth	Piles may eliminate groundwater difficulty. Can be used as practical.	Helical Piers may eliminate groundwater difficulty. Can be used as practical.
B-17	1±	>13±	Shallow Suitable Soils, No Water; Easy Excavation	May not be practical due to auger refusal at depth of about 13 feet*	May not be practical due to auger refusal at depth of about 13 feet*

* Based upon information obtained in the borings and/or test pits, some difficulty may be experienced with advancement through dense soils, cobbles, and/or boulders encountered at this location (depending on depth).
** Additional deeper evaluation may be required for a driven pile or helical pier option.

Site Preparation

The presence of topsoil and vegetation in the subgrade can adversely affect the serviceability of structural fills, foundations, floor slabs, and other structures placed upon them. Approximately 5 to 24 inches of topsoil were present on the surface of the site at most of the boring and test pit locations. However, some variation should be anticipated, especially within agricultural fields which predominate the project areas. All topsoil, vegetation, trees, roots and other organic matter must be stripped from the areas of footings, floor slabs, and other structures.

The majority of the project site was within agricultural fields at the time of the exploration. If any drain tiles are encountered during construction, they must be tied into new drainage structures. Existing drain tiles should not be abandoned, since they may still actively drain areas of the subject site or adjacent properties.

After the removal of topsoil and other unsuitable bearing materials, the subgrade in surface slab areas, should be thoroughly proofrolled to detect unstable, yielding soils, which must be removed or improved by appropriate preparation and compaction techniques. Scarification and drying of wet soils or removal and replacement with suitable fill, are two methods which can be considered, but this should be determined by the soils engineer at the time of construction. Once a firm and stable subgrade condition is achieved, low areas may then be raised to the planned grades with suitable properly placed and compacted fill.

The exposed near surface subgrade is expected to consist of at least some areas of cohesive or other fine grained (silt) soils. Such soils are considered highly moisture sensitive and subject to softening from disturbance. Some difficulty with subgrade preparation should be expected, especially if the subgrade becomes wet during construction. Therefore, equipment and worker traffic must be kept to a minimum on subgrade bearing surfaces, especially during times of precipitation or following spring thaw. Some difficulty with subgrade preparation can be expected, especially in wet or cold weather conditions. Removal of unsuitable portions of the near surface soils and replacement with structural fill will likely be required, on at least an isolated basis, especially if earthwork is not carried out during periods of relatively warm, dry weather, which provide more favorable conditions for drying of these soils. Any soft zones, which cannot be improved by scarification and aeration, must be removed and replaced with compacted structural fill, such as clean crushed stone, possibly in conjunction with the use of a geotextile fabric. **This may be necessary at least in the areas of B-4, B-7, B-8, B-10, and B-12; where very moist organic and/or low strength soils were present.** Lime and fly ash modification are two additional remedial measures which can be considered, and are generally most feasible for larger areas of widespread instability. However, chemical modification must only be performed at the direction and under the supervision of the geotechnical engineer. A proper mix design must be performed prior to the performance of any modification. Substantial construction delays and difficulty with subgrade stabilization should be expected during periods of wet and/or cool weather. Consideration should be given to installing construction roads to reduce disturbance to the sensitive subgrade soils.

Every effort must be made to keep excavations dry. If construction proceeds during wet weather, some additional overexcavation may be necessary. If weather permits, the soil could be dried and recompacted. A crushed stone working mat, possibly in conjunction with a geotextile fabric may also be feasible to help stabilize subgrades. Site grading runoff should be directed away from excavations, structures and prepared subgrades, so that the potential for the softening of the exposed subgrade soils is reduced.

Where the removal of unsuitable bearing material is performed beneath proposed footings or other structural areas, the overexcavations must extend laterally beyond the perimeter of the structural component (footing, road edge, etc.) for a distance at least equal to the thickness of the fill below the footing bottom. This general guideline also applies to instances where a raised structural fill pad is constructed to achieve a bearing elevation greater than existing grades. The influence zone of footing and road stresses can be represented as an imaginary 45° line extending downward and outward from the outer edges of the footing bottom or road base. All fill placed within this zone after cutting to firm soil must be properly engineered, from the bottom of the cut, up to the floor slab subgrade elevation.

If site grades are raised in excess of 2 feet, the first lift of new fill must be placed so as to extend a minimum lateral distance of 5 feet beyond the planned top building pad dimension (for fills less than 5 feet in thickness), or for a distance equal to at least 1 foot laterally beyond the top pad dimension for every foot of fill thickness (for fills greater than 5 feet in depth). Subsequent lifts can then be placed on an approximate 1H:1V slope back up to the planned top perimeter dimension of the pad. Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities.

When a firm and stable subgrade is established, low areas may be raised to planned grades with properly compacted structural fill. Any new fill should be a clean granular soil, such as those materials meeting the gradations outlined in Section 209 or 305 of the State of Wisconsin Standard Specification for Highway and Structure Construction. If fine grained soils, such as those with high silt or clay content are used, they should generally be placed over large open areas, where conditions are more favorable for the proper placement and compaction of such materials. It must be recognized that high silt or clay content materials are difficult to compact when placed at moisture contents beyond a few percent of the optimum moisture content. Fill must be placed in layers of not more than nine (9) inches in thickness, at moisture contents at or near optimum, and be compacted to a minimum density of 95 percent of the maximum dry density as determined by ASTM designation D-698. The on-site non-organic soils beneath the topsoil that are obtained from above the groundwater table are generally considered suitable for use as new fill to raise grades, generally over large areas. However, some sorting or moisture conditioning may be required. Silt, clay, and wet granular soils are not suitable for reuse as compacted fill in trenches, or adjacent to foundation stem walls or retaining walls.

Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities. This is especially true of clayey soils, where scarification and aeration may be required to achieve near optimum moisture levels prior to compaction. A sheepsfoot roller is generally required for compaction of clayey soils, whereas a vibratory smooth drum roller is preferred for granular material. Small hand-operated compactors and granular fill should be used in confined areas. Granular fills are generally more readily compacted to the required densities in such applications.

It is recommended that well-graded granular soils be utilized as backfill in new utility trenches and alongside below grade walls to reduce the potential for consolidation and settlement of the fill. Importing of suitable granular backfill soils will be necessary. All fill soils must be placed and compacted under engineering controlled conditions, to provide suitable support for overlaying structures and roadways. Additional guidance can be provided at the time of construction in the selection process for grade-raising fill and trench backfill.

When excavations encroach upon or extend below the groundwater or perched zones, and into sandy or silty soils, subgrade instability and sloughing/caving of sidewalls can occur. Some overexcavation of softened or loosened soils, in conjunction with the use of a crushed stone working mat and possibly a geotextile, may be necessary. Additionally, significantly widened excavations may result, or be required for stability.

The selection of fill materials for various applications should be done in consultation with the soils engineer. Similarly, the evaluation of the subgrade and placement and compaction of fill for structural applications should be monitored and tested by a qualified representative of the soils engineer.

Preliminary Foundation Design Recommendations

The following is a general overview of the subsurface conditions for the site as it relates to the evaluation of foundations. More detailed geotechnical design parameters determined on the basis of the field and laboratory testing at the specific boring locations, are included in Table 1 (Soil Data) enclosed in Appendix C.

Shallow Mat and Conventional Spread Foundations

Based on the data obtained at the borings, the natural non-organic soils encountered at varying depths at the borings are generally considered suitable for support of conventional spread or mat type foundations for the proposed service buildings. Spread or mat foundations, bearing upon suitable soils at frost depth or below, may be designed for net allowable soil bearing pressures in the range of 1,000 psf to 4,000 psf depending on location and depth. The foregoing ranges of bearing pressures are based upon foundations bearing within suitable stiff to very stiff natural clay soils, or loose to very dense native granular soils.

It must be recognized that fill, buried topsoil, organic, and low strength natural soils were present within B-4, B-7, B-8, B-10, B-12, and TP-2 (B-6) to depths ranging from about 1.5 to 27 feet below existing ground surface. It is recommended that all structure foundations, regardless of type or installation method, be extended to bear within suitable natural soils below any fill, buried topsoil, low strength, organic, or otherwise unsuitable soils. Nominal undercutting of unsuitable fill, buried topsoil, or low strength soils may be required for shallow spread foundations, at least in the areas of B-12 and TP-2 (B-6), where these soils were present to depths of about 2.5 to 3 feet. **However, in the areas of B-4, B-7, B-8, and B-10, where organic and/or low strength soils extended to depths of about 6 to 27 feet; shallow foundations will likely not be feasible, due to the substantially undercuts that would be required. The use of driven piles, helical piers, or other suitable alternative foundation support method will likely be required in at least these areas, and other areas not disclosed in the borings, where undercut depths and/or excavatability are determined to be infeasible for open cut shallow foundation construction/excavation.** The estimated depths to suitable soils and net allowable bearing capacities for spread foundations at each boring location is provided on Table 1 (Soil Data), enclosed in Appendix C.

It should be noted that water bearing soils are expected at the footing excavation depths in some areas, at least at/near B-3, B-5, B-8, B-10, and B-12, where groundwater was encountered at depths of about 3 to 6 feet. Excavations required for shallow foundations are expected to extend to or below groundwater, at least in these areas. These soils are susceptible to a substantial loss in strength when the confining effect of the overburden is removed. A significantly softened subgrade may develop, requiring undercutting and the use of a compacted crushed stone working mat to establish a stable bearing grade. Substantial sloughing and caving may also occur. Substantial dewatering will likely be required. A deep foundation system such as driven piles helical piers, or other suitable alternative foundation support method could be considered in these areas to help minimize groundwater and excavation stability related difficulties associated with excavations that would be required for shallow foundation construction.

The preceding analysis is based on relatively widely spaced test borings throughout the project limits and variation will occur between the test boring locations. Some nominal overexcavation may be necessary in some areas to utilize the recommended bearing capacities, depending upon planned foundation bearing depths. Due to the variation in subsoil conditions, the suitability of the existing soils for support of the proposed foundations must be determined by testing by a qualified geotechnical engineer during construction, utilizing static cone penetrometer tests or dynamic cone penetrometer tests for cohesive and granular soils, respectively. Soft, loose, or otherwise unsuitable materials not disclosed by the borings, may be encountered in the foundation excavations at the bearing elevations, especially when encroaching upon or extending below the groundwater or perched zones. If unsuitable existing soil is present, it must be removed throughout a zone extending one foot laterally for each foot removed below the foundation, on each side of the planned footing. The overexcavated area must be backfilled with structural compacted fill.

In lieu of the use of deep spread footings or the placement of compacted structural fill, any unsuitable materials could be removed from beneath proposed footings and the excavation backfilled to the original planned bearing depth with a lean concrete slurry mix. If it is elected to utilize a lean concrete slurry to replace the unsuitable soils, the foundation excavation should be 4 inches wider than the proposed footing width and must extend through the unsuitable bearing materials to reach suitable natural soils. The slurry must be placed immediately after excavation to avoid intrusion of soil into the excavation. The concrete should contain sufficient aggregate and cement to attain a 28-day compressive strength of at least 1,000 psi. Some sloughing or caving of the overlying soils may be experienced. Should this occur during the slurry placement, the area must be removed and recast. Additionally, should caving become extensive, it may be necessary to substantially widen excavations to avoid soil intrusion into the concrete slurry. This may result in the use of additional slurry quantities significantly in excess of preconstruction budget estimates.

It is recommended that the footings supporting individual columns have a minimum dimension of 24 inches, and continuous footings have a minimum width of 18 inches (or as required by the local building code), even if the maximum allowable bearing pressure is not fully utilized.

All perimeter footings and any interior footings that will be subjected to freezing temperatures must be placed at a minimum depth of 4 feet below the finished exterior grade for frost protection. All footings must be protected from the effects of frost if construction is carried out during winter months. In order to minimize the effects of any slight differential movement that may occur due to variations in seasonal moisture contents, it is recommended that all footings be suitably reinforced to make them as rigid as necessary.

It is recommended that backfill above the foundations be placed in lifts not exceeding 9 inches in thickness, at moisture contents at or near optimum, and be compacted to at least 95% of the maximum dry density as determined by ASTM D698 (Standard Proctor). The clay soils present at most of the borings are highly moisture sensitive, and are extremely difficult to compact to the required density in relatively confined areas. Importing of suitable granular fill will be necessary in order to achieve proper placement and compaction.

In general, the performance of the foundation systems on this site is dependent on the various factors discussed herein. The excavation, preparation, and concreting of foundations should be monitored and tested by a representative of the soils engineer.

All footings in unheated areas must be placed at a minimum of 4 feet below the adjacent exterior grade for frost protection. Where foundations (turned-down or thickened edge slabs) are placed above the typical frost depth, they must be provided with sufficient insulation, extending downward along the sides and then outward from the outside edge portion, to prevent frost heave. If foundations are not adequately insulated, some movement should be expected.

In order to minimize the effects of any slight differential movement that may occur due to variations in the character of the supporting soils and any variation in seasonal moisture contents, it is recommended that all foundations be suitably reinforced to make them as rigid as needed.

Driven Piles

A deep foundation system comprised of driven piles extending into suitable natural granular soils can also be used for support of the proposed solar farm structures, and also for any service buildings where the soil and/or groundwater conditions warrant. Driven piles may be considered at B-4, B-7, B-8, and B-10, where low strength and/or organic soils were present to greater depths ranging from about 8 to 27 feet below the existing ground surface. Driven piles may be advantageous in comparison shallow foundations in areas where shallow groundwater was encountered. For preliminary design considerations, 10¾ inch diameter cast in place (CIP) pipe piles driven to depths of about 20 to 30 feet below the existing ground surface at B-4, B-7, B-8, and B-10 will generate estimated allowable capacities of about 2 to 7 tons per pile when utilizing a factor of safety of 3. **Additional borings, likely to greater depths, along with bottom of pile cap elevations will generally be required to evaluate desired pile capacities and to estimate driving depths and greater capacities.**

Foundations for the support of interior columns or singularly supported structures will require a minimum of three (3) piles in order to provide lateral stability. Perimeter columns can be supported upon a minimum of two (2) piles, providing there is an interconnecting grade beam to provide stability in one direction. Where groups of piles are required to support concentrated loads, an appropriate modification of the estimated bearing capacity must be made on the basis of the effective envelope area of the group.

The structural capacity of the piles should be checked for downward axial loads, tension forces and lateral forces. The spacing between the centers of piles in a cluster should be equal to at least 2.5 times the diameter of the piles.

After desired pile capacities have been determined and additional deeper borings have been performed to estimate pile driving depths, it is recommended that at least two (2) test piles be driven at the start of construction to check the safe design loads by the use of a recognized dynamic pile driving formula, and to observe the reaction of the piles during the driving operations. If piles encounter apparent capacity significantly above the anticipated depths, PSI must be informed, and some revision of the pile driving method may be necessary.

Zones of granular soils will have a tendency to freeze the piles in place when pile driving operations are halted. Therefore, each pile should be driven to the desired elevation and driving resistances without interruption in the driving operations. Driving the center piles of a cluster first will facilitate the driving operations. Accurate records of the pile elevations and driving resistance should be obtained during the pile driving operations.

In certain soil conditions, soil strength loss during driving can be significant, and may indicate driving resistance which indicate capacities well below estimated static capacities at specific depths. In these instances, soil setup around the pile after driving may develop higher capacities. However, soil setup generally requires some time to occur and may have significant impacts on the project schedule which should be allotted for.

Pipe or steel shelled piles may be subjected to corrosion due to possible acidic conditions of the groundwater and the conductivity of the soils. The possibility of excessive corrosion taking place should be reviewed with an engineer specializing in corrosion control.

During the installation of driven piles, precautions must be taken to prevent vibration related damage to nearby buildings, utilities, and other structures. Consideration should be given to making video and/or photographic documentation of the condition of such structures prior to construction.

Helical Piers

If the previously discussed foundation support options for the proposed solar racks, service buildings, and transformers are not considered feasible, at least in the areas of B-4, B-7, B-8, B-10, helical piers extending through the existing low strength and/or organic soils and into suitable natural soils could be utilized for foundation support. Helical piers may be advantageous in comparison to shallow foundations in areas where shallow groundwater was encountered. A helical pier foundation system is a design/build foundation system that should be designed and installed by a qualified contractor. The contractor should be provided with the structural loads for the proposed structures and work with the project structural engineer to provide a helical pier type and layout that will provide adequate structural support while meeting the settlement criteria for the project.

Additional borings are recommended to be performed as part of a comprehensive subsurface exploration and foundation evaluation. It is possible that the borings may need to be extended to greater depths where deep foundations including driven piles or helical piers are being considered.

According to the Chance® Helical Pier® Foundation System Technical Manual, the following guidelines should be followed when designing and installing helical piers:

- Helical piers should be designed and constructed as deep foundations. The vertical distance between the uppermost helix and the soil surface should be no less than 5 feet.
- Installation torque should be averaged over the last three diameters of embedment of the largest helix. This will indicate that the foundation is installed into soil of sufficient strength to support expected loads.
- The uppermost helix should be installed at least three diameters below the frost depth of 60 inches.
- The uppermost helix should be installed at least three helix diameters into competent load bearing soils. Competent native load bearing soils were observed below the low strength and/or organic soils at borings B-4, B-7, B-8, and B-10 at depths of about 8 to 27 feet below existing ground surface.

- Helical foundations should be spaced no closer than three diameters on centers. A better spacing is five diameters. Use the largest helix diameter in making the spacing determination.

It is recommended that installation of piers be monitored and documented by a representative of the geotechnical engineer to verify installation complies with the project specifications.

Floor Slab Subgrade

Prior to constructing floor slabs, and prior to the placement of any fill used to raise grades, the exposed subgrade must be prepared utilizing the proofrolling procedures described previously. It is recommended that the proofrolling operations be monitored by a representative of the geotechnical engineer to ensure that a firm, suitable subgrade is present prior to placement of new fills, or construction of floor slabs and pavements. In areas that exhibit soft, yielding or unstable soil conditions, the following remedial measures are recommended to provide a stable subgrade.

Localized wet, soft or unstable areas can be undercut to such depths determined necessary in the field to reach stable material, and the area backfilled with imported crushed stone, such as the 1.25-inch gradation specified in Section 305 of the WisDOT Standard Specifications, placed and compacted as recommended in the *Site Preparation* section of this report. If relatively thick zones or areas of extensive yielding are observed, and they cannot be stabilized by normal discing, aeration and recompaction procedures, undercutting and replacement with crushed stone and geotextile fabric may also be required in these areas.

The floor slabs may be designed utilizing an estimated modulus of subgrade reaction of 150 pci where suitably prepared natural clay soils are present; and 200 pci where suitably prepared natural granular soils are present, as discussed in this report. In areas of newly placed and compacted engineered fill, floor slabs may be designed with modulus of subgrade reactions ranging from 150 to 200 pci, depending upon the fill material that is used. The final design and detailing should be performed by a qualified structural engineer based on the intended slab use, loading conditions and anticipated subgrade conditions.

A granular mat, which can be designed as a drainage layer, should be provided below floor slabs. This must be a minimum of six (6) inches in thickness and properly compacted. In moisture sensitive areas, a vapor retarder may be placed beneath the floor slab or base course. However, it is recommended that the architect/designer be consulted in this regard. The proper use of a vapor retarder may not completely prevent moisture beneath or on top of slabs. If the base course contains sharp particles, a cushion layer of sand approximately 2 inches in thickness may be required to provide protection from puncture.

Floor slabs should be suitably reinforced to make them as rigid as necessary and proper joints provided at the junction of slabs and the foundation system so that a small amount of independent movement can occur without causing damage. Large floor areas must be provided with joints at frequent intervals (maximum spacing of 30 times the slab thickness, per

ACI) to compensate for concrete volume changes (shrinkage). Where slabs will be supporting live loads, such as from moving vehicles, joints must be keyed or dowelled to permit proper load transfer. It is recommended that appropriate construction methods and curing procedures be used to minimize shrinkage and curling of the floor slabs.

Slabs in unheated areas may bear upon silty or clayey soils. Such materials are highly frost susceptible and poorly drained. Slabs placed directly upon such soils are subject to heaving and subsequent settlement due to freeze/thaw cycles. This can result in cracking, misalignment, and other related effects (especially at joints). It is recommended that consideration be given to limited undercutting of the frost susceptible materials to a depth of 1 to 2 feet below the slab, and replacement with well graded, properly placed and compacted granular soils. A properly designed underdrain system connected to the municipal sewer (if permissible) or directed to on-site stormwater management areas should also be incorporated to reduce the potential effects of freeze/thaw cycles.

Groundwater Considerations

Table 1, enclosed in Appendix C, indicates the estimated depths of the static groundwater table at the test boring locations. The use of conventional sump pumps placed in the bottom of conventional excavations may be suitable for isolated perched zones or excavations not extending more than a few inches below the groundwater. However, major groundwater difficulty may be experienced during construction, dependent upon final bearing depth. The use of high capacity sump pumps, with sufficient lifting capacity, may be required for conventional excavations which encroach upon or extend below the groundwater or substantial perched zones.

The majority of the structures for this project are expected to be constructed within existing agricultural fields, which may contain drain tiles used for irrigation and drainage purposes. If such tiles are encountered during construction, substantial groundwater volumes not otherwise expected may be encountered. More comprehensive dewatering procedures may then be required. Additionally, any damaged drain tile may still actively drain existing fields and should therefore be properly repaired and rerouted, if necessary. Intact drain tile should not be abandoned.

Excavation Considerations

Sloping, shoring or bracing of the excavation sidewalls for shallow foundations and utilities will be necessary. Trenching in granular, organic, and soft soils will be difficult due to the instability of vertical slopes, and will therefore require a flattening of trench sides, or some other means of protection, to facilitate construction and to protect life and property. Substantial sloughing and caving should be expected within unprotected excavations. The degree of excavation instability problems is dependent upon the depth and length of time that excavations remain open, excavation bank slopes, water levels and the effectiveness of any dewatering systems. However, severe instability can be expected within granular, organic, and soft soils, especially encroaching upon and extending below the groundwater. All excavation work must be performed in accordance with OSHA and local building code requirements.

Where excavations encroach upon or extend below the groundwater or perched zones and into fine sand, silt, soft clay, or organics, they may become substantially unstable when the confining effect of the overburden is removed. Significant sloughing or caving of sidewalls may also occur. Some overexcavation of softened or loosened soils, in conjunction with the use of a crushed stone working mat and possibly a geotextile fabric, may be necessary to establish a stable bearing subgrade. Additionally, significantly widened excavations may result, or be required to maintain or achieve sidewall stability.

Substantial difficulty in accessing and moving around very moist areas of the project should be expected, especially during wet weather periods. Surface conditions can deteriorate significantly when exposed to construction traffic, especially in low-lying areas, wetland areas, and agricultural fields.

Utility Construction

The on-site soils in most areas can generally be used for support of utility lines. However, some isolated undercutting, and replacement with a crushed stone mat, may be necessary where wet, low strength, or otherwise unsuitable soils are present, especially in areas where organic soils such as at B-4 and B-8 (which are not typically considered to be suitable for the support of conventional utilities) are present. More extensive undercutting may be necessary in any wetland areas. Substantial difficulty with the stability of utility trenches should be expected due to the presence of granular soils across the site. The use of shoring, bracing, or trench boxes will be required. Additionally, excavations encroaching upon or extending below the groundwater can become substantially unstable when the confining effect of the overburden is removed. In this case, an adequate dewatering effort and bracing of sidewalls will be required. Utility construction should be performed in accordance with “The Standard Specifications for Sewer and Water Line Construction” for the State of Wisconsin.

From the information provided by Stantec, it is understood that the utilities for this project will generally be limited to electric utilities which will be placed at depths of about 2 to 3 feet below proposed grades. Due to the relatively shallow installation depths of these utilities, no major excavation related difficulties are anticipated. The electric utilities are recommended to be backfilled with materials outlined in the following paragraph below.

It is recommended that well graded granular soils such as those specified in Tables 37 and 39 of the “Standard Specification for Sewer and Water Construction” be utilized as backfill in utility trenches to reduce the potential for consolidation and settlement of the backfill. Portions of the on-site granular soils obtained above the groundwater table may be suitable for use as backfill. However, this should be determined by a representative of the soils engineer at the time of construction. All fill soils must be properly placed and compacted under engineering controlled conditions to provide suitable support for overlaying structures and roadways. Silty and clayey soils, organics, or wet granular materials are not recommended for use as backfill within utility trenches due to the substantial difficulty of obtaining proper compaction in confined areas.

As with all excavation work, all open cut trenches must be properly shored and braced as required by applicable federal and state OSHA codes, and as necessary to protect life and property.

Seismic Considerations

Based upon the soils encountered at the borings, and Table 1615.1.1 from the 2006 International Building Code, the individual boring sites are considered to be classified as Seismic Class C or D, depending on the specific location.

GENERAL COMMENTS

This preliminary subsurface exploration and foundation evaluation has been prepared to aid in the evaluation of the site for construction of the proposed new solar racks and for the new electrical transmission line. The recommendations presented herein are based on the available soil information and the design information provided. Any changes in the design information should be brought to the attention of the soils engineer to determine if modifications in the recommendations are required.

This geotechnical study has been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations and opinions contained herein have been promulgated in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations, expressed or implied, and no warranty or guarantee is included or intended in this report.

Appendix A

- Boring and Test Pit Location Plan (Figure 1)

Figure No.
X

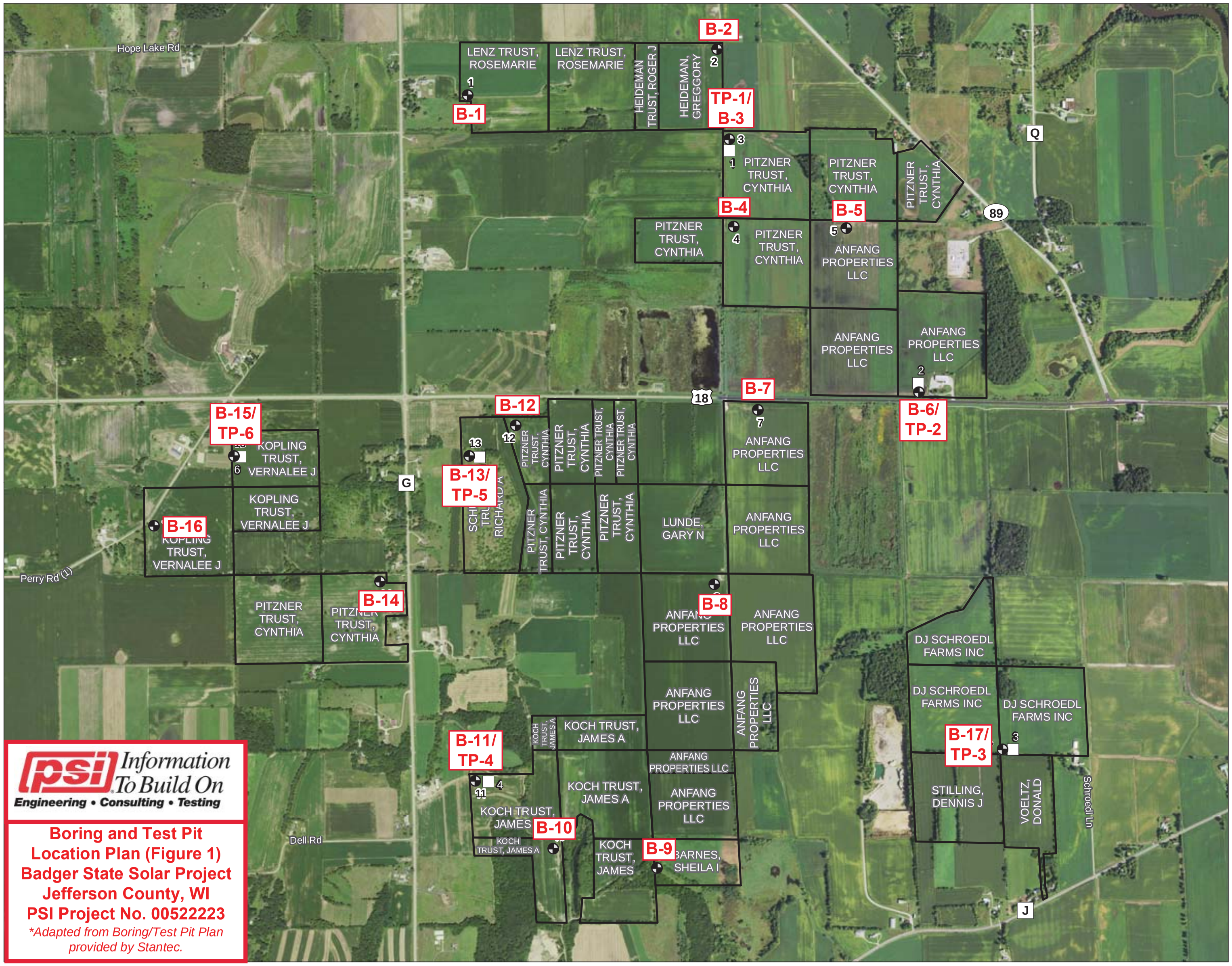
Title
Soil Boring and Test Pit Locations

DRAFT

Client/Project
Badger State Solar, LLC
Badger State Solar Project

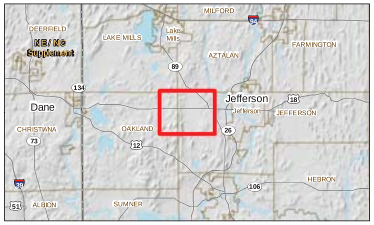
Project Location
T. of Jefferson,
Jefferson Co., WI

193705928
Prepared by JD on 2018-07-25
Technical Review by CP on 2018-08-07
Independent Review by XX on 2018-XX-XX



Legend
- ▭ Project Parcels
- ● Soil Borings
- ☐ Test Pit
- ▬ Likely Access Path

Revised 2018-08-07



Notes
1. Coordinate System: NAD 1983 StatePlane Wisconsin South FIPS 4803 Feet
2. Data Sources Include: Stantec, Ranger, WDNR, WisDOT
3. Orthophotography: NAIP 2017

Stantec

Page 1 of 1

psi Information To Build On
Engineering • Consulting • Testing

Boring and Test Pit Location Plan (Figure 1)
Badger State Solar Project
Jefferson County, WI
PSI Project No. 00522223
**Adapted from Boring/Test Pit Plan provided by Stantec.*

V:\1937\Active\193705828\03_data\gis_cad\gis\mxds\figx_soil_boring_locations BadgerSolar.mxd Revised: 2018-08-07 By: cpekar

Appendix B

- Soil Boring and Test Pit Logs (23)
- General Notes

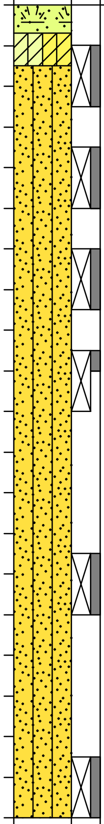
BORING B-01

DATE STARTED: 8/7/18
DATE COMPLETED: 8/7/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 865 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

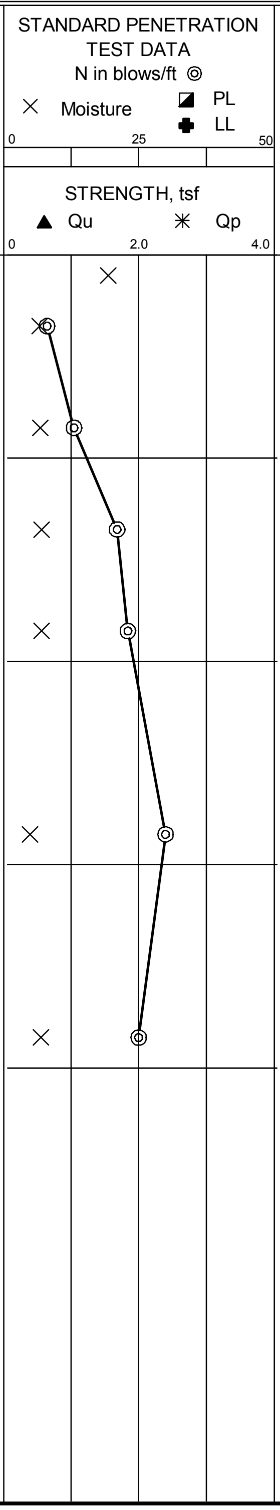
DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	Not Obsvd
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:



Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Moist to Very Moist (8"± Thick)			19	
				Brown Silty Clay, Trace Sand, Moist				
		1	18	Light Brown Silty Fine Sand with Gravel, Moist		6-4-4 N=8	7	
		2	18			8-6-7 N=13	7	
860	5							
		3	18			7-12-9 N=21	7	
		4	6			11-11-12 N=23	7	
855	10							
		5	18			16-16-14 N=30	5	
850	15							
		6	18			10-11-14 N=25	7	
845	20			End of Boring at 20' Cave-In at 14'				



Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125

PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

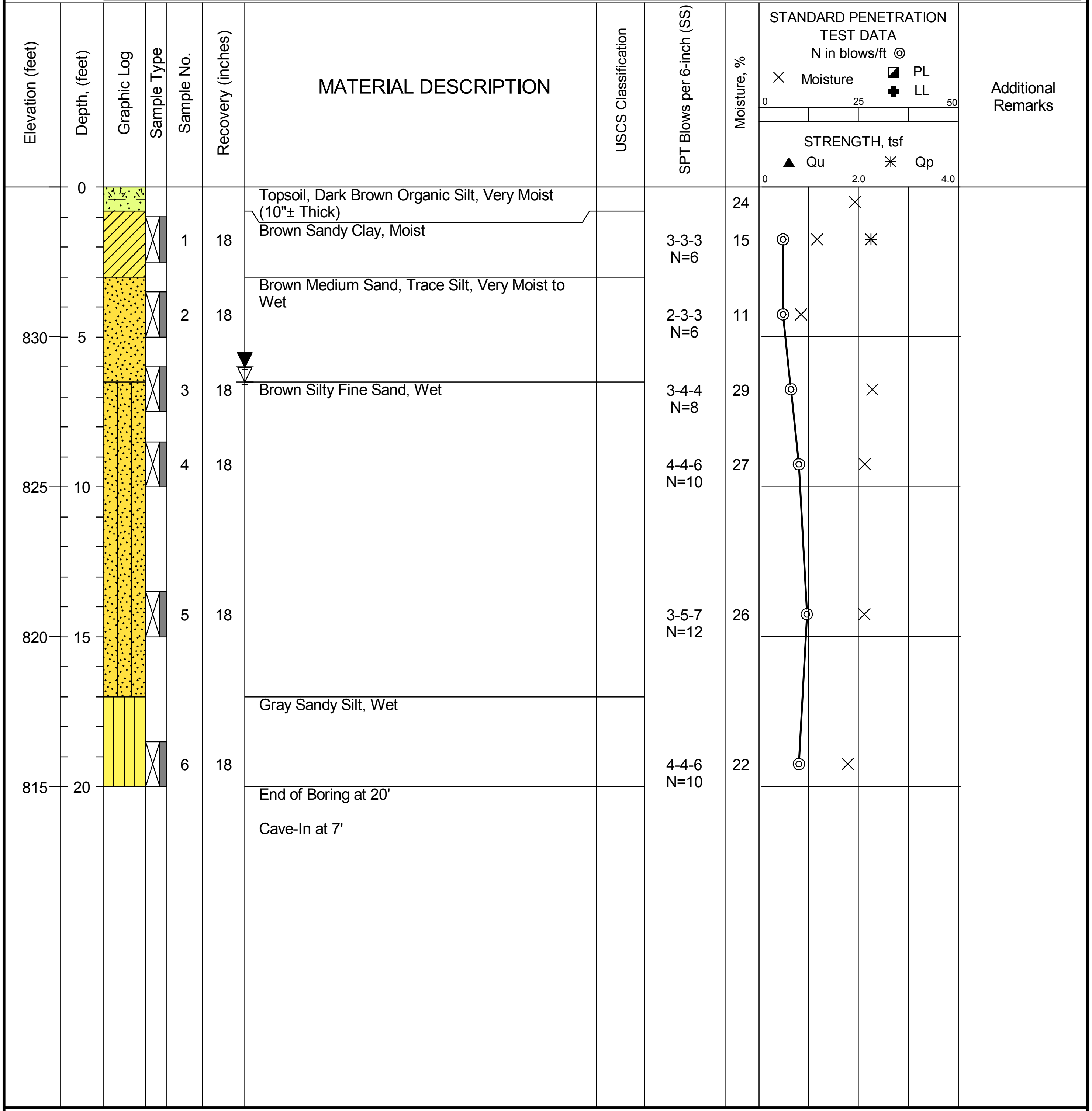
DATE STARTED: 8/9/18
DATE COMPLETED: 8/9/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 835 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

BORING B-02

Water		
▽	While Drilling	6.5 feet
▼	Upon Completion	6 feet
▽	Delay	N/A

BORING LOCATION:



Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Very Moist (10"± Thick)			24	
		1	18	Brown Sandy Clay, Moist		3-3-3 N=6	15	
		2	18	Brown Medium Sand, Trace Silt, Very Moist to Wet		2-3-3 N=6	11	
830	5							
		3	18	Brown Silty Fine Sand, Wet		3-4-4 N=8	29	
		4	18			4-4-6 N=10	27	
825	10							
		5	18			3-5-7 N=12	26	
820	15							
				Gray Sandy Silt, Wet				
		6	18			4-4-6 N=10	22	
815	20			End of Boring at 20' Cave-In at 7'				

intertek psi

Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125

PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-03

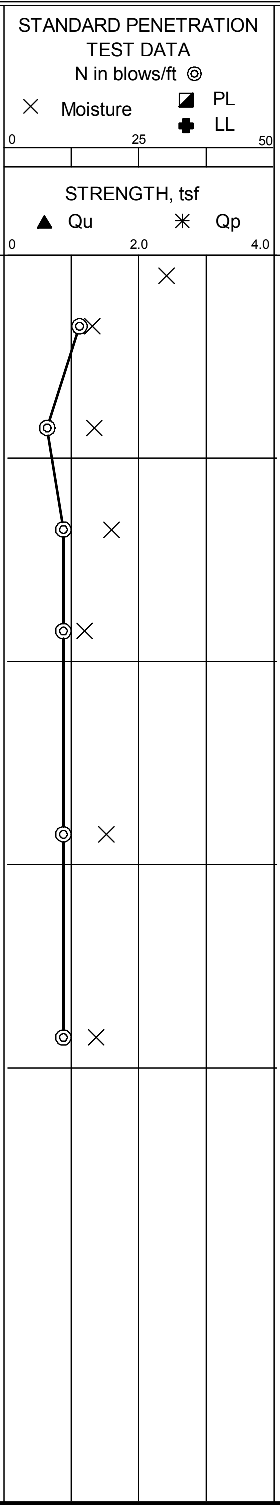
DATE STARTED: 8/12/18
DATE COMPLETED: 8/12/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 830 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	3 feet
▼	Upon Completion	8 feet
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (15"± Thick)			30	
		1	18	Brown Fine Sand, Very Moist		2-6-8 N=14	16	
		2	18	Gray Fine to Medium Sand, Wet		4-4-4 N=8	17	
825	5							
		3	4			5-5-6 N=11	20	
		4	18	Gray Sandy Silt, Wet		4-4-7 N=11	15	
820	10							
		5	18	Gray Fine to Medium Sand, Wet		4-5-6 N=11	19	
815	15							
		6	18	Gray Silty Fine Sand, Wet		4-4-7 N=11	17	
810	20			End of Boring at 20' Cave-In at 9'				



Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125

PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-04

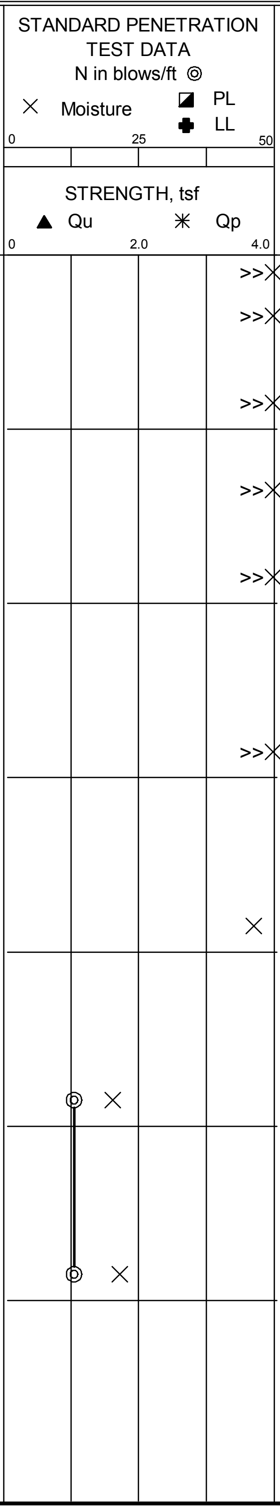
DATE STARTED: 8/13/18
DATE COMPLETED: 8/13/18
COMPLETION DEPTH 30.0 ft
BENCHMARK: N/A
ELEVATION: 830 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	6 feet
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (20"± Thick)			55	
		1	12	Gray to Dark Gray Organic Silt with Shell Matter, Very Moist to Wet (Lake Marl)		2-HW-1	216	
		2	0			1-HW-HW	200	
825	5							
		3	12			1-HW-HW	62	
		4	18			HW-HW-HW	65	
820	10							
		5	18			HW-HW-HW	62	
815	15							
		6	12			1-HW-HW	46	
810	20							
				Gray Fine to Medium Sand, Trace Gravel, Wet				
		7	18			7-7-6 N=13	20	
805	25							
		8	18			5-6-7 N=13	22	
800	30			End of Boring at 30' Cave-In at 14'				



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PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

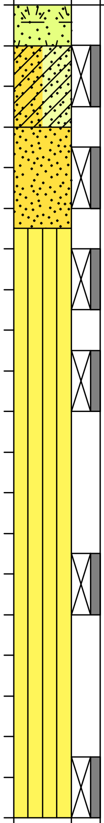
BORING B-05

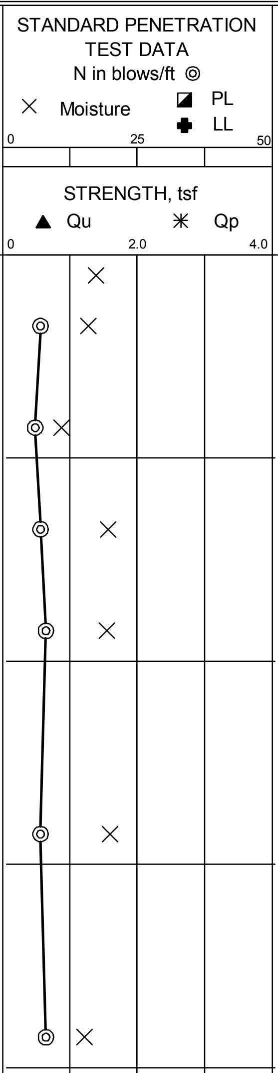
DATE STARTED: 8/13/18
DATE COMPLETED: 8/13/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 830 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	5.5 feet
▼	Upon Completion	6 feet
▽	Delay	N/A

BORING LOCATION:





Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Moist (12"± Thick)			17	
		1	18	Gray Clayey Sand, Very Moist		4-4-3 N=7	16	
		2	18	Brownish Gray Medium to Coarse Sand, Very Moist to Wet		3-3-3 N=6	11	
825	5							
		3	18	Grayish Brown Sandy Silt, Trace Clay, Wet		3-3-4 N=7	20	
		4	18			3-3-5 N=8	19	
820	10							
		5	18			2-3-4 N=7	20	
815	15							
		6	18			3-3-5 N=8	15	
810	20			End of Boring at 20' Cave-In at 7'				

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BORING B-06

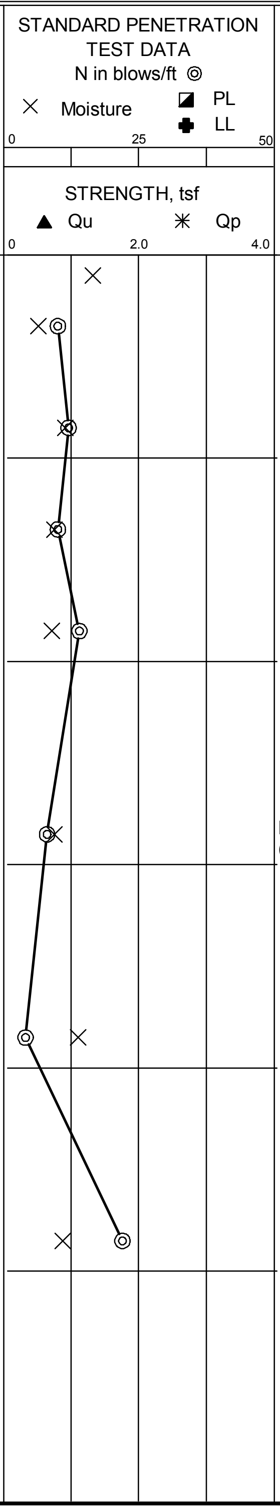
DATE STARTED: 8/9/18
DATE COMPLETED: 8/9/18
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 830 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	17 feet
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
830	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Moist (12"± Thick)			16	
		1	12	Light Brown to Brown Silty Fine Sand, Trace to With Gravel, Trace Clay, Moist to Very Moist		3-4-6 N=10	6	
		2	18			4-6-6 N=12	11	
825	5							
		3	18			4-4-6 N=10	9	
		4	18			10-7-7 N=14	9	
820	10							
				Gray Silty Fine Sand, Trace to With Gravel, Trace Clay, Very Moist to Wet				
		5	0			3-4-4 N=8	9	No Recovery (Auger Sample)
815	15							
		6	18			2-2-2 N=4	14	
810	20							
		7	18			8-10-12 N=22	11	
805	25			End of Boring at 25' Cave-In at 15'				



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DATE STARTED: 8/9/18
DATE COMPLETED: 8/9/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 830 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

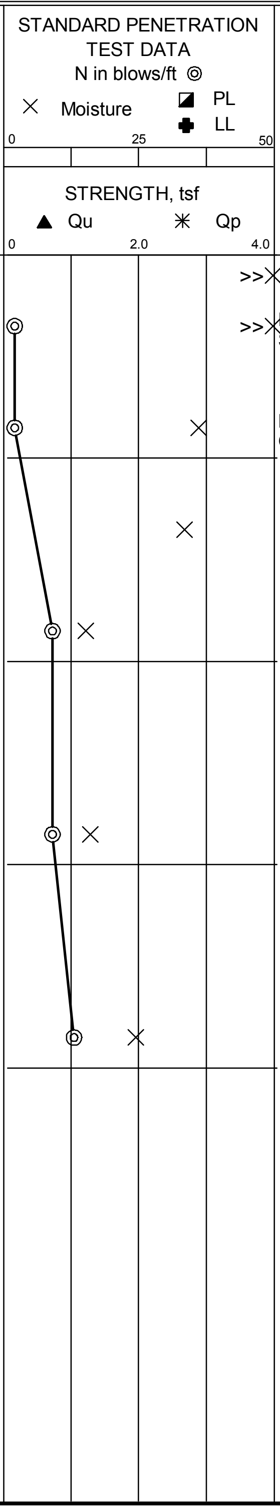
DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

BORING B-07

Water		
▽	While Drilling	6 feet
▼	Upon Completion	Not Obsvd
⊻	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (12"± Thick)			60	
		1	0	Gray Silt with Vegetative Fibers, Some Clay, Trace Organics, Very Moist to Wet		2-1-1 N=2	51	No Recovery (Auger Sample)
		2	18			2-1-1 N=2	36	LOI Testing: Oc=1.7%
825	5							
		3	18			1-HW-HW	34	
				Brownish Gray Fine to Medium Sand, Wet				
		4	18			2-5-4 N=9	15	
820	10							
				Brownish Gray Sandy Silt with Clay Pockets, Wet				
		5	18			4-4-5 N=9	16	
815	15							
				Brownish Gray Fine to Medium Sand, Wet				
		6	18			4-6-7 N=13	24	
810	20			End of Boring at 20' Cave-In at 9'				



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LOCATION: Jefferson County, WI

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BORING B-08

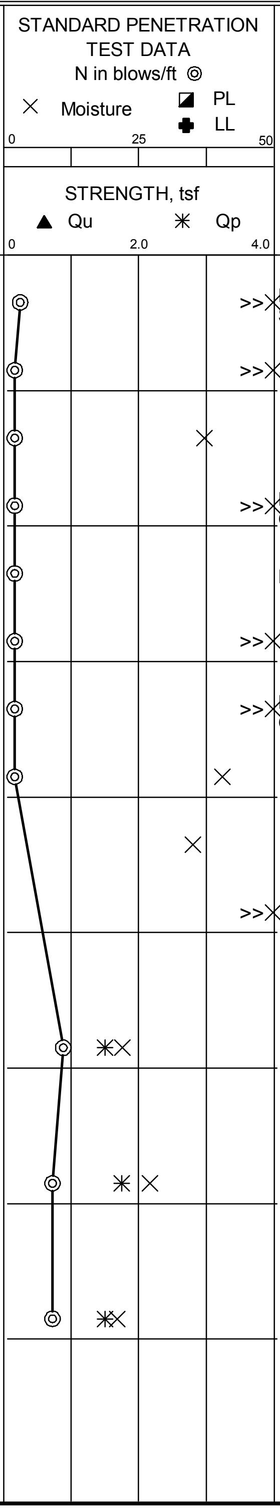
DATE STARTED: 8/8/18
DATE COMPLETED: 8/8/18
COMPLETION DEPTH 40.0 ft
BENCHMARK: N/A
ELEVATION: 830 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
∇ While Drilling	21 feet
▼ Upon Completion	Not Obsvd
∇ Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0				Aggregate Base, Brown Crushed Sand and Gravel, Moist (8"± Thick)				
		☒	1	0	Peaty Topsoil, Black Organic Silt, Very Moist		2-1-2 N=3	82	No Recovery (Auger Sample)
825	5	☒	2	6	Dark Gray and Dark Brown Organic Silt, with Shell Matter, Trace Clay, Very Moit (Lake Marl)		1-1-1 N=2	233	
		☒	3	6	Bluish Gray Silt, Some Clay, Trace Organics, Very Moist		1-1-1 N=2	37	
820	10	☒	4	18			1-1-1 N=2	52	LOI Testing: Oc=2.7%
		☒	5	4	Brownish/Greenish Gray Silt, Some Clay, Trace Organics, Very Moist to Wet		1-1-1 N=2		Poor Recovery
815	15	☒	6	12			1-1-1 N=2	55	
		☒	7	18			1-1-1 N=2	53	LOI Testing: Oc=2.5%
810	20	☒	8	18			1-1-1 N=2	41	
		☒	9	18	∇		HW-1-HW	35	
805	25	☒	10	18			HW-1-HW	55	
					Brownish Gray Silty Clay, Very Moist to Wet				
800	30	☒	11	18			3-6-5 N=11	22	
795	35	☒	12	18			3-4-5 N=9	27	
		☒	13	18			3-4-5 N=9	21	
790	40				End of Boring at 40' Cave-In at 22'				



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Waukesha, WI 53189
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PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

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BORING B-09

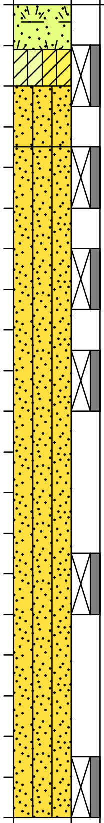
DATE STARTED: 8/10/18
DATE COMPLETED: 8/10/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 845 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

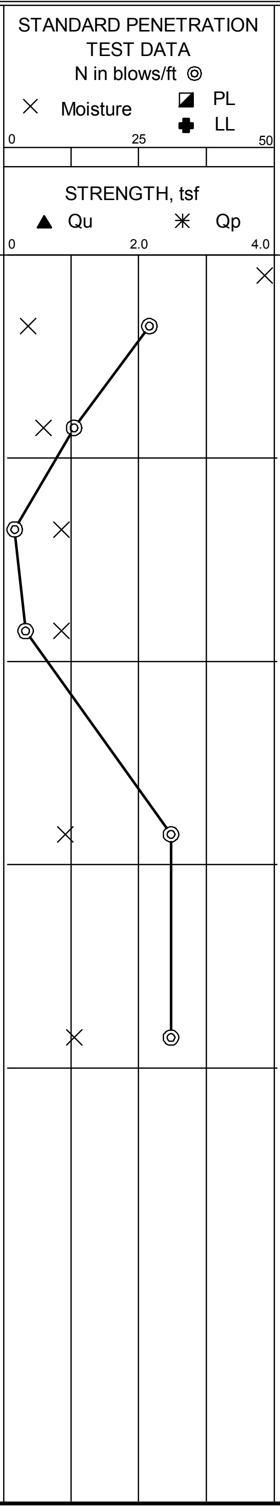
DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	6 feet
▼	Upon Completion	5 feet
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (13"± Thick)			48	
		1	18	Brown Silty Clay, Trace Sand, Moist		3-8-19 N=27	4	
				Brown Silty Sand and Gravel, Damp to Moist				
		2	18	Brown Silty Fine Sand, Trace to with Gravel, Moist to Wet		20-7-6 N=13	7	
840	5							
		3	18			2-1-1 N=2	11	
		4	18			2-2-2 N=4	11	
835	10							
		5	18			10-14-17 N=31	11	
830	15							
		6	18			9-13-18 N=31	13	
825	20			End of Boring at 20' Cave-In at 8' *Boring Offset 40' South Due to Soft Terrain				





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PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

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BORING B-10

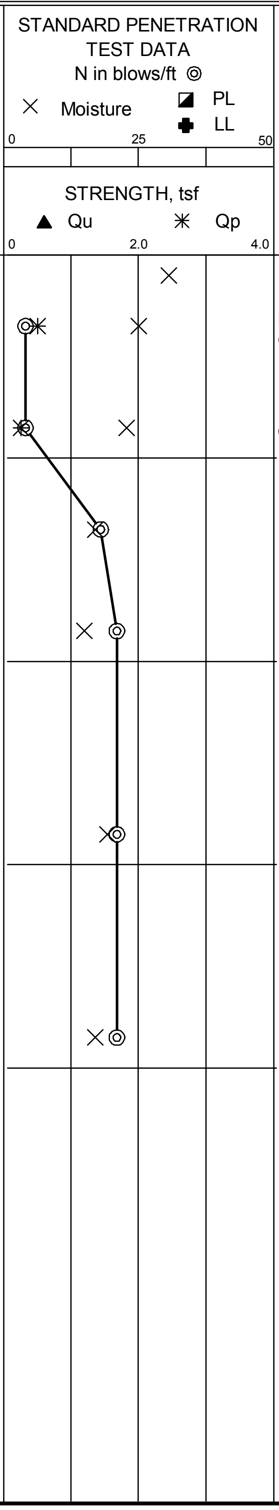
DATE STARTED: 8/10/18
DATE COMPLETED: 8/10/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 850 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	6 feet
▼	Upon Completion	6 feet
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0				Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (13"± Thick)			31	
		☒	1	12	Gray Silty Clay with Vegetative Fibers, Trace Organics, Very Moist		2-2-2 N=4	25	LOI Testing: Oc=2.0%
		☒	2	18			2-2-2 N=4	23	Q_r = 0.3 tsf
845	5								
		☒	3	18	Brown Clayey Sand with Gravel, Wet		6-8-10 N=18	17	
		☒	4	18	Brown Medium to Coarse Sand, Trace Gravel, Wet		6-10-11 N=21	15	
840	10								
		☒	5	18			8-8-13 N=21	19	
835	15								
		☒	6	18			7-9-12 N=21	17	
830	20				End of Boring at 20' Cave-In at 8'				



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PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

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DATE STARTED: 8/7/18
DATE COMPLETED: 8/7/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 970 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

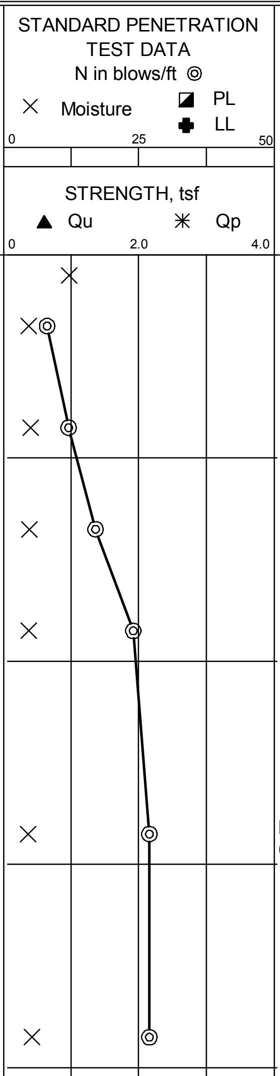
DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

BORING B-11

Water		
▽	While Drilling	Not Obsvd
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
970	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Moist (5"± Thick)			12	
				Light Brown Silty Fine Sand with Gravel, Moist				
		1	18			5-4-4 N=8	5	
965	5	2	18			3-5-7 N=12	5	
		3	18			9-9-8 N=17	5	
960	10	4	18			8-11-13 N=24	5	
955	15	5	0			12-12-15 N=27	4	No Recovery (Auger Sample)
950	20	6	12	End of Boring at 20' Cave-In at 13'		11-13-14 N=27	5	



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LOCATION: Jefferson County, WI

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BORING B-12

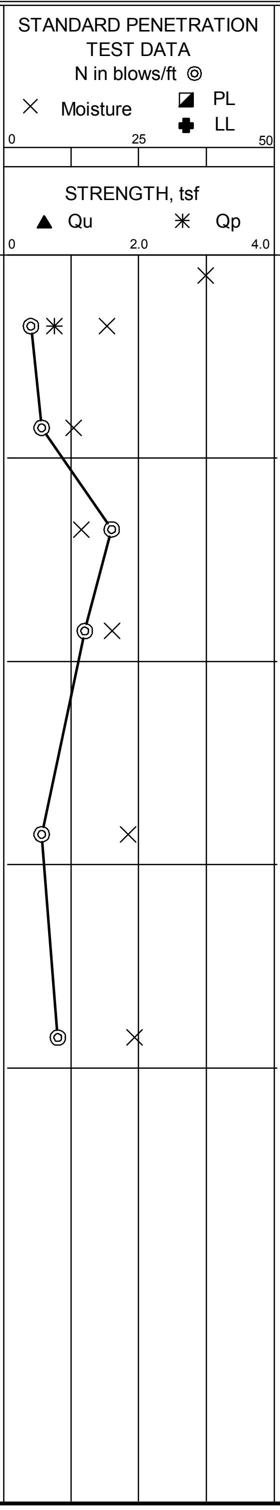
DATE STARTED: 8/8/18
DATE COMPLETED: 8/8/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 835 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
∇	While Drilling	3 feet
▼	Upon Completion	5 feet
∇	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0				Topsoil, Black Organic Silt, Trace Clay, Very Moist (20"± Thick)			37	
		☒	1	18	Gray Silty Clay, Trace Sand, Moist to Very Moist		2-2-3 N=5	19	
830	5	☒	2	18	Grayish Brown Silty Sand, Trace Gravel, Wet		3-3-4 N=7	13	
		☒	3	18	Brown Medium to Coarse Sand and Gravel, Wet		9-10-10 N=20	14	
825	10	☒	4	18	Gray Silty Fine Sand, Wet		8-8-7 N=15	20	
820	15	☒	5	18	Gray Silt, Some Clay, Wet		4-3-4 N=7	23	
		☒	6	18			3-5-5 N=10	24	
815	20				End of Boring at 20' Cave-In at 6'				



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BORING B-13

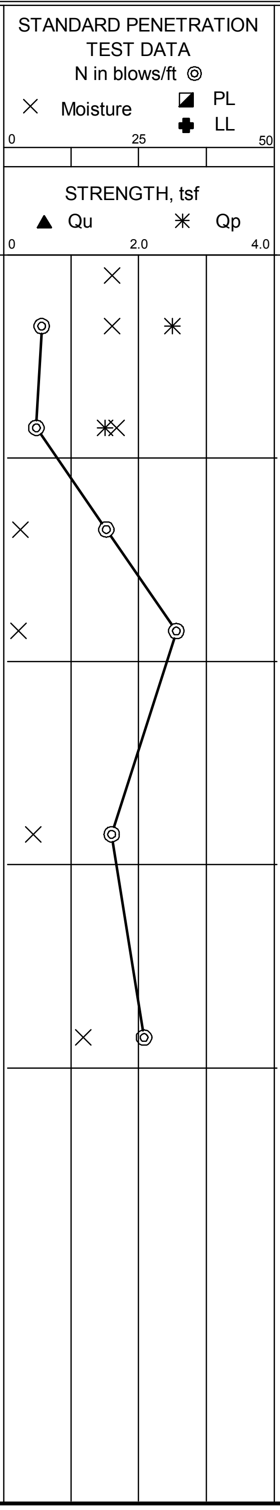
DATE STARTED: 8/8/18
DATE COMPLETED: 8/8/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 860 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	Not Obsvd
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (18"± Thick)			20	
				1	18	Brown Sandy Clay, Very Moist		2-3-4 N=7	20	
				2	18			3-3-3 N=6	21	
855	5									
				3	18	Light Brown Fine Sand, Little to Some Gravel, Damp		7-9-10 N=19	3	
				4	18	Light Brown Silty Sand and Gravel, Damp to Moist		7-14-18 N=32	3	
850	10									
				5	18			23-11-9 N=20	5	
845	15									
				6	18	Light Brown Silt with Sand Pockets, Trace Gravel, Moist to Very Moist		13-12-14 N=26	15	
840	20					End of Boring at 20' Cave-In at 13'				



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LOCATION: Jefferson County, WI

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DATE STARTED: 8/7/18
DATE COMPLETED: 8/7/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 910 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

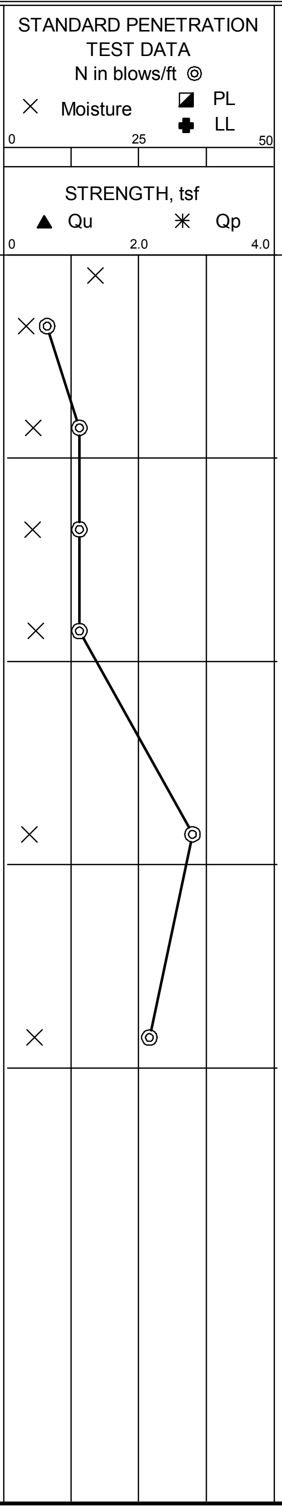
DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

BORING B-14

Water		
▽	While Drilling	Not Obsvd
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0				Topsoil, Dark Brown Organic Silt, Trace Clay, Moist (8"± Thick)			17	
		☒	1	18	Light Brown Silty Fine Sand with Gravel, Damp to Moist		5-3-5 N=8	4	
		☒	2	18			6-7-7 N=14	5	
905	5								
		☒	3	18			5-7-7 N=14	5	
		☒	4	18			6-6-8 N=14	6	
900	10								
		☒	5	18			16-21-14 N=35	5	
895	15								
		☒	6	12			12-14-13 N=27	6	
890	20				End of Boring at 20' Cave-In at 14'				



Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125

PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

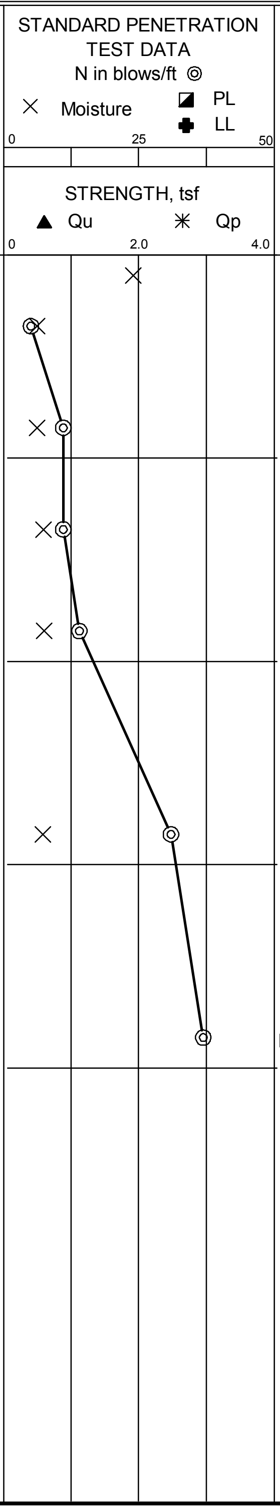
DATE STARTED: 8/8/18
DATE COMPLETED: 8/8/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 900 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

BORING B-15

Water		
▽	While Drilling	Not Obsvd
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:



Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (12"± Thick)			24	
			☒	1	18	Light Brown to Brown Silty Fine Sand, Trace to With Gravel, Moist		3-2-3 N=5	6	
			☒	2	12			4-4-7 N=11	6	
895	5									
			☒	3	18			5-5-6 N=11	7	
			☒	4	18			4-6-8 N=14	7	
890	10									
			☒	5	18			16-17-14 N=31	7	
885	15									
			☒	6	6			15-18-19 N=37		Poor Recovery
880	20					End of Boring at 20' Cave-In at 14'				

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821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125

PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-16

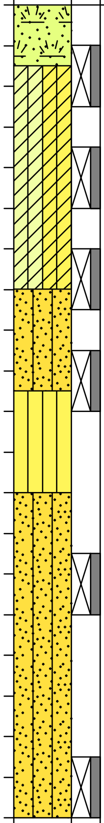
DATE STARTED: 8/7/18
DATE COMPLETED: 8/7/18
COMPLETION DEPTH 20.0 ft
BENCHMARK: N/A
ELEVATION: 875 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

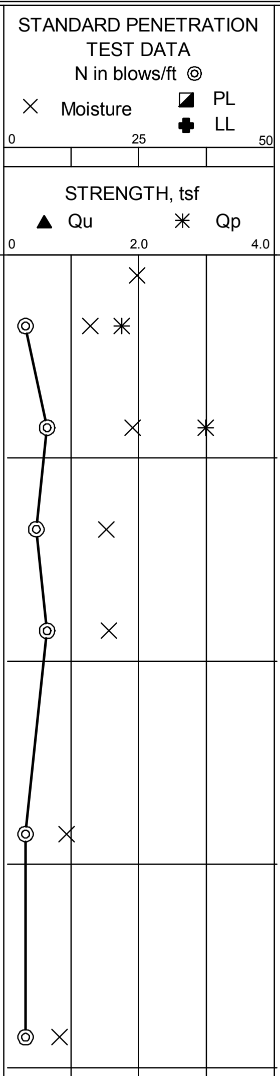
DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

Water		
▽	While Drilling	7 feet
▼	Upon Completion	6 feet
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (18"± Thick)			25	
		1	18	Brown Silty Clay, Trace Sand, Moist to Very Moist		2-2-2 N=4	16	
		2	18			2-3-5 N=8	24	
870	5							
		3	18	Light Brown Silty Sand with Clay Pockets, Wet		2-3-3 N=6	19	
		4	18	Light Brown Sandy Silt, Trace Clay, Wet		2-3-5 N=8	20	
865	10							
				Light Brown Silty Fine Sand, Trace to Little Gravel, Wet				
		5	18			2-2-2 N=4	12	
860	15							
		6	18			2-2-2 N=4	10	
855	20			End of Boring at 20' Cave-In at 8'				





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Waukesha, WI 53189
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PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-17

DATE STARTED: 8/10/18
DATE COMPLETED: 8/10/18
COMPLETION DEPTH 13.0 ft
BENCHMARK: N/A
ELEVATION: 880 ft
LATITUDE:
LONGITUDE:
STATION: N/A **OFFSET:** N/A
REMARKS:

DRILL COMPANY: PSI, Inc.
DRILLER: JaF **LOGGED BY:** DP
DRILL RIG: CME 45 ATV - Rig #383
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: 2-in SS
HAMMER TYPE: Automatic
EFFICIENCY N/A
REVIEWED BY: CH

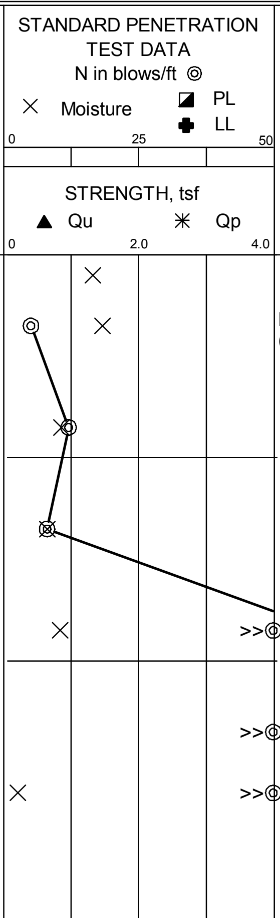
Water		
▽	While Drilling	Not Obsvd
▼	Upon Completion	Not Obsvd
▽	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil, Dark Brown Organic Silt, Trace Clay, Moist (7"± Thick)			17	
		1	0	Brown Sandy Clay, Moist		3-2-3 N=5	18	No Recovery (Auger Sample)
875	5	2	18	Brown Clayey Sand with Gravel, Moist		2-4-8 N=12	11	
		3	18	Brown Silty Fine Sand with Gravel, Moist to Very Moist		5-4-4 N=8	8	
870	10	4	3	Brown Silty Fine Sand with Gravel, Moist to Very Moist (Possible Cobbles and Boulders)		50/3"	10	
		5	1			50/1"		
		6	1	Light Brown Silty Sand and Gravel, Damp (Possible Cobbles, Boulders, or Weathered Bedrock)		50/1"	3	

End of Boring at 13' Due to Auger Refusal on Possible Cobbles, Boulders or Bedrock

Cave-In at 8'



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Waukesha, WI 53189
Telephone: (262) 521-2125

PROJECT NO.: 00522223
PROJECT: Proposed Badger Solar Project
LOCATION: Jefferson County, WI

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Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125
Fax: (262) 521-2471

LOG OF TP-1

Sheet 1 of 1

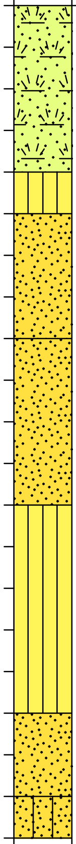
PSI Job No.: 00522223
Project: Proposed Badger Solar Project
Location: Jefferson County, WI

Excavation Method: Backhoe
Sampling Method:
DCP Type:
Boring Location: Boring B-3

WATER LEVELS

∇	While Excavating	6 feet
▼	Delay	N/A
▼		

Elevation (feet)	Depth, (feet)	MATERIAL DESCRIPTION
830	0	**Surface Elev.:** 830 ft Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (24"± Thick)
828	2	Brown Clayey Silt, Trace Organics, Very Moist
	2.5	Light Brown Fine Sand, Very Moist
826	4	Gray Fine to Medium Sand, Very Moist to Wet
824	6	∇ Gray Sandy Silt, Trace Clay, Wet
	8.5	Gray Medium to Coarse Sand, Trace Gravel, Wet
	9.5	Gray Silty Fine Sand, Wet
820	10	End of Boring at 10' *Test Pit Started Caving at Depth of About 8 Feet.



Column headings: Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | Dynamic Cone (DCP) Blows per -inch | Moisture, % | Additional Remarks

DYNAMIC CONE PENETRATION TEST DATA
Blows per -inch ◎
0 15 30
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

Completion Depth:	10.0 ft
Date Boring Started:	9/13/18
Date Boring Completed:	9/13/18
Logged By:	CH
Excavation Contractor:	Kutz Farms

Sample Types:
- ■ Shelby Tube
- ⧗ Dynamic Cone (DCP)
- Grab Sample

Latitude: °
Longitude: °
Excavation Equipment: Backhoe
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125
Fax: (262) 521-2471

LOG OF TP-2

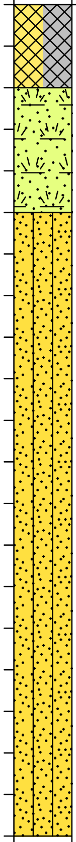
Sheet 1 of 1

PSI Job No.: 00522223
Project: Proposed Badger Solar Project
Location: Jefferson County, WI

Excavation Method:Backhoe
Sampling Method:
DCP Type:
Boring Location: Boring B-6

WATER LEVELS

▽	While Excavating	Not Obsvd
▼	Delay	N/A
⊻		



Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Dynamic Cone (DCP) Blows per -inch	Moisture, %	DYNAMIC CONE PENETRATION TEST DATA Blows per -inch ◎ 0 15 30 × Moisture ◪ PL ✚ LL 0 25 50 STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
						Surface Elev.: 830 ft					
	0					Fill, Light Brown Silty Fine Sand with Gravel, Moist					
	1					Buried Topsoil, Black Organic Silt, Trace Clay, Very Moist					
828	2										
	3					Light Brown Silty Fine Sand with Gravel, Trace to Some Cobbles, Trace Clay, Moist to Very Moist *Cobbles were Approximately 2" to 4" in Diameter.					
826	4										
	5										
824	6										
	7										
822	8										
	9										
820	10					End of Test Pit at 10' *No Caving Observed. Test Pit Excavation Stayed Open to Depth of 10'.					

Completion Depth: 10.0 ft
Date Boring Started: 9/13/18
Date Boring Completed: 9/13/18
Logged By: CH
Excavation Contractor: Kutz Farms

Sample Types:
■ Shelby Tube
⧗ Dynamic Cone (DCP)
☐ Grab Sample

Latitude: °
Longitude: °
Excavation Equipment: Backhoe
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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Fax: (262) 521-2471

LOG OF TP-3

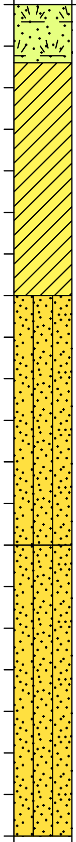
Sheet 1 of 1

PSI Job No.: 00522223
Project: Proposed Badger Solar Project
Location: Jefferson County, WI

Excavation Method:Backhoe
Sampling Method:
DCP Type:
Boring Location: Boring B-17

WATER LEVELS

▽ While Excavating	Not Obsvd
▼ Delay	N/A
▼	



Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Dynamic Cone (DCP) Blows per -inch	Moisture, %	DYNAMIC CONE PENETRATION TEST DATA Blows per -inch ◎ 0 15 30 / × Moisture ◪ PL ✚ LL 0 25 50 / STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
						Surface Elev.: 880 ft					
	0					Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (8"± Thick)					
	1					Brown Sandy Clay, Trace Gravel, Moist					
878	2										
	3										
876	4					Brown Silty Fine Sand with Gravel, Moist					
	5										
874	6										
	7					Light Brown Silty Sand with Gravel and Cobbles *Cobbles were Approximately 2" to 5" in Diameter.					
872	8										
	9										
870	10					End of Test Pit at 10' *No Caving Observed. Test Pit Excavation Stayed Open to Depth of 10'.					

Completion Depth:	10.0 ft
Date Boring Started:	9/13/18
Date Boring Completed:	9/13/18
Logged By:	CH
Excavation Contractor:	Kutz Farms

Sample Types:
- ▮ Shelby Tube
- ⧗ Dynamic Cone (DCP)
- ☐ Grab Sample

Latitude: °
Longitude: °
Excavation Equipment: Backhoe
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125
Fax: (262) 521-2471

LOG OF TP-4

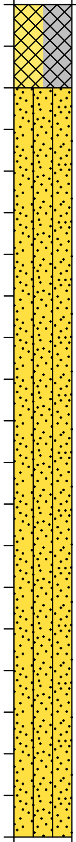
Sheet 1 of 1

PSI Job No.: 00522223
Project: Proposed Badger Solar Project
Location: Jefferson County, WI

Excavation Method: Backhoe
Sampling Method:
DCP Type:
Boring Location: Boring B-11

WATER LEVELS

▽ While Excavating Not Obsvd
▼ Delay N/A
▼

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Dynamic Cone (DCP) Blows per -inch	Moisture, %	DYNAMIC CONE PENETRATION TEST DATA Blows per -inch ◎ 0 15 30 × Moisture ◪ PL ✚ LL 0 25 50 STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
						Surface Elev.: 970 ft					
	0					Brown Clayey Sand, Moist					
	1					Light Brown Silty Fine Sand with Gravel, Some Cobbles and Boulders, Trace Clay, Moist *Cobbles were Approximately 2" to 4" in Diameter; Boulders were Approximately 6" to 8" in Diameter.					
968	2										
	3										
966	4										
	5										
964	6										
	7										
962	8										
	9										
960	10					End of Test Pit at 10' *No Caving Observed. Test Pit Excavation Stayed Open to Depth of 10'.					

Completion Depth: 10.0 ft
Date Boring Started: 9/13/18
Date Boring Completed: 9/13/18
Logged By: CH
Excavation Contractor: Kutz Farms

Sample Types:
■ Shelby Tube
⧗ Dynamic Cone (DCP)
☐ Grab Sample

Latitude: °
Longitude: °
Excavation Equipment: Backhoe
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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Waukesha, WI 53189
Telephone: (262) 521-2125
Fax: (262) 521-2471

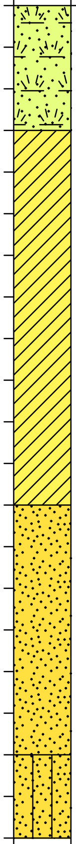
LOG OF TP-5

Sheet 1 of 1

PSI Job No.: 00522223
Project: Proposed Badger Solar Project
Location: Jefferson County, WI

Excavation Method:Backhoe
Sampling Method:
DCP Type:
Boring Location: Boring B-13

WATER LEVELS	
▽ While Excavating	Not Obsvd
▼ Delay	N/A
▼	



Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Dynamic Cone (DCP) Blows per -inch	Moisture, %	DYNAMIC CONE PENETRATION TEST DATA Blows per -inch ◎ 0 15 30; × Moisture ◪ PL ✚ LL 0 25 50; STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
						Surface Elev.: 860 ft					
	0					Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (18"± Thick)					
	1										
858	2					Brown Sandy Clay, Trace to Little Gravel, Moist					
	3										
856	4										
	5										
854	6					Light Brown Fine to Medium Sand, Some to With Gravel, Moist					
	7										
852	8										
	9					Light Brown Silty Sand with Gravel, Moist					
850	10					End of Test Pit at 10' *No Caving Observed. Test Pit Excavation Stayed Open to Depth of 10'.					

Completion Depth:	10.0 ft
Date Boring Started:	9/13/18
Date Boring Completed:	9/13/18
Logged By:	CH
Excavation Contractor:	Kutz Farms

Sample Types:
- ■ Shelby Tube
- ⧗ Dynamic Cone (DCP)
- ☐ Grab Sample

Latitude: °
Longitude: °
Excavation Equipment: Backhoe
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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Waukesha, WI 53189
Telephone: (262) 521-2125
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LOG OF TP-6

Sheet 1 of 1

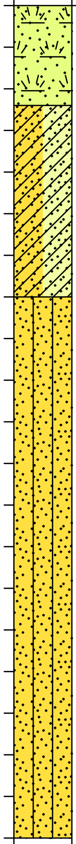
PSI Job No.: 00522223
Project: Proposed Badger Solar Project
Location: Jefferson County, WI

Excavation Method: Backhoe
Sampling Method:
DCP Type:
Boring Location: Boring B-15

WATER LEVELS	
∇ While Excavating	Not Obsvd
▼ Delay	N/A
▼	

Surface Elev.: 900 ft

DYNAMIC CONE PENETRATION TEST DATA: Blows per -inch ◎ (0, 15, 30)
× Moisture ◪ PL ✚ LL (0, 25, 50)
STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)



Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	Dynamic Cone (DCP) Blows per -inch	Moisture, %	Additional Remarks
	0					Topsoil, Dark Brown Organic Silt, Trace Clay, Very Moist (14"± Thick)				
	1					Brown Clayey Sand, Trace to Little Gravel, Very Moist				
898	2									
	3					Light Brown Silty Fine Sand with Gravel, Some Cobbles, Trace Boulders, Moist *Cobbles were Approximately 2" to 5" in Diameter; Boulders were up to Approximately 12" in Diameter. Boulders were Observed on an Isolated Basis.				
896	4									
	5									
894	6									
	7									
892	8									
	9									
890	10					End of Test Pit at 10' *No Caving Observed. Test Pit Excavation Stayed Open to Depth of 10'.				

Completion Depth: 10.0 ft
Date Boring Started: 9/13/18
Date Boring Completed: 9/13/18
Logged By: CH
Excavation Contractor: Kutz Farms

Sample Types:
- ▮ Shelby Tube
- ⧗ Dynamic Cone (DCP)
- ✋ Grab Sample

Latitude: °
Longitude: °
Excavation Equipment: Backhoe
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

☒ SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
■ ST: Shelby Tube - 3" O.D., except where noted.
▯ RC: Rock Core
↓ TC: Texas Cone
✋ BS: Bulk Sample
▚ PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼, ▽, ▼: Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated

Description	Criteria
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	●	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			○	GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	○	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	🟨	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			⁘	SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	⁘	SM	SILTY SANDS, SAND - SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▥	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▤	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			≈	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			⁂	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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Appendix C

- Table 1 – Soil Data

Badger State Solar Farm
Jefferson County, Wisconsin
PSI Project No. 00522223
Table 1-Soil Data

Boring No.	Depth Range (ft)	Predominant Soil Type	Geological Desc.	Index Properties (%)			Est. Depth to Ground-water (ft bgs)	Total Unit Weight (pcf)(a)	Std. Blow Count (N)	Undrained Parameters (a)		Bearing Capacity Factors			Earth Pressure Coefficients			^Coefficient of Base Friction	Net Allowable Bearing Capacity for Shallow Foundation (psf)	Estimated Depth to Suitable Soils (ft)
				LL	PL	W				c_u (ksf)	ϕ (deg)	N_c	N_q	N_γ	K_a	K_p	K_o			
B-1	0-0.7	Organic Silt	Topsoil			19	>20	110												1±
	0.7-1.5	Silty Clay						120	8	1.0		5.7	1.0	0.0	-	-	-	0.30	2,000	
	1.5-5.5	Silty Fine Sand with Gravel				7		120	11		30	-	22.5	20.1	0.33	3.00	0.50	0.35	3,000	
	5.5-20	Silty Fine Sand with Gravel				6		125	25		35	-	41.4	47.3	0.27	3.69	0.43	0.35	4,000	
B-2	0-0.8	Organic Silt	Topsoil			24	6.5	110												1±
	0.8-3	Sandy Clay				15		125	6	2.3 (b)		5.7	1.0	0.0	-	-	-	0.30	2,000	
	3-6.5	Medium Sand				11		115	6		29	-	20.0	17.1	0.35	2.88	0.52	0.45	2,000	
	6.5-17	Silty Fine Sand				27		110	10		30	-	22.5	20.1	0.33	3.00	0.50	0.35	3,000	
	17-20	Sandy Silt				22		110	10		30	-	22.5	20.1	0.33	3.00	0.50	N/A	N/A	
B-3	0-1.3	Organic Silt	Topsoil			30	3	110												1½±
	1.3-3	Fine Sand				16		115	14		31	-	25.3	23.7	0.32	3.12	0.48	0.45	3,000	
	3-8	Fine to Medium Sand				19		110	10		30	-	22.5	20.1	0.33	3.00	0.50	0.45	3,000	
	8-12	Sandy Silt				15		110	11		30	-	22.5	20.1	0.33	3.00	0.50	0.30	3,000	
	12-17	Fine to Medium Sand				19		110	11		30	-	22.5	20.1	0.33	3.00	0.50	0.45	3,000	
	17-20	Silty Fine Sand				17		110	11		30	-	22.5	20.1	0.33	3.00	0.50	N/A	N/A	
B-4	0-1.7	Organic Silt	Topsoil			55	6	105												22±
	1.7-22	Organic Silt with Shell Matter	Lake Marl			109		80	1		24	-	11.4	7.9	0.42	2.37	0.59	-	Not suitable	
	22-30	Fine to Medium Sand				21		115	13		31	-	25.3	23.7	0.32	3.12	0.48	N/A	N/A	
B-5	0-1	Organic Silt	Topsoil			17	5.5	105												1±
	1-3	Clayey Sand				16		115	7		29	-	20.0	17.1	0.35	2.88	0.52	0.35	2,000	
	3-5.5	Medium to Coarse Sand				11		115	6		29	-	20.0	17.1	0.35	2.88	0.52	0.55	2,000	
	5.5-20	Sandy Silt				19		110	8		29	-	20.0	17.1	0.35	2.88	0.52	0.30	2,000	
B-6	0-1	Organic Silt	Topsoil			16	17	105												1±
	1-12	Silty Fine Sand, Trace to With Gravel				9		115	12		30	-	22.5	20.1	0.33	3.00	0.50	0.35	2,000	
	12-22	Silty Fine Sand, Trace to With Gravel				12		115	6		29	-	20.0	17.1	0.35	2.88	0.52	0.35	2,000	
	22-25	Silty Fine Sand, Trace to With Gravel				11		120	22		34	-	36.5	39.6	0.28	3.54	0.44	N/A	N/A	

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Boring No.	Depth Range (ft)	Predominant Soil Type	Geological Desc.	Index Properties (%)			Est. Depth to Ground-water (ft bgs)	Total Unit Weight (pcf)(a)	Std. Blow Count (N)	Undrained Parameters (a)		Bearing Capacity Factors			Earth Pressure Coefficients			^Coefficient of Base Friction	Net Allowable Bearing Capacity for Shallow Foundation (psf)	Estimated Depth to Suitable Soils (ft)
				LL	PL	W				c_u (ksf)	ϕ (deg)	N_c	N_q	N_γ	K_a	K_p	K_o			
B-7	0-1	Organic Silt	Topsoil				6	110												8±
	1-8	Silt with Vegetative Fibers, Trace Organics				40		105	2		27	-	15.9	12.1	0.38	2.66	0.55	-	Not Suitable	
	8-12	Fine to Medium Sand				15		110	9		30	-	22.5	20.1	0.33	3.00	0.50	0.45	3,000	
	12-17	Sandy Silt with Clay Pockets				16		110	9		30	-	22.5	20.1	0.33	3.00	1.50	0.30	3,000	
	17-20	Fine to Medium Sand				24		110	13		31	-	25.3	23.7	0.32	3.12	0.48	N/A	N/A	
B-8	0-0.7	Crushed Sand and Gravel	Aggregate Base				4	120												27±
	0.7-3	Organic Silt	Peaty Topsoil			82		70	3		-	-	-	-	-	-	-	-	Not Suitable	
	3-6	Organic Silt	Lake Marl			233		80	2		24	-	11.4	7.9	0.42	2.37	0.59	-	Not Suitable	
	6-27	Silt, Trace Organics				47		100	2		27	-	15.9	12.1	0.38	2.66	0.55	-	Not Suitable	
	27-40	Silty Clay				23		120	10	1.6 (b)		5.7	1.0	0.0	-	-	-	N/A	N/A	
B-9	0-1.1	Organic Silt	Topsoil			48	6	105												1±
	1.1-2	Silty Clay						120	11	1.0		5.7	1.0	0.0	-	-	-	0.30	2,000	
	2-3.5	Silty Sand and Gravel				4		130	27		35	-	41.4	47.3	0.27	3.69	0.43	0.45	2,000	
	3.5-6	Silty Fine Sand, Trace to With Gravel				7		120	13		31	-	25.3	23.7	0.32	3.12	0.48	0.35	1,000	
	6-12	Silty Fine Sand, Trace to With Gravel				11		110	3		28	-	17.8	14.6	0.36	2.77	0.53	0.35	1,000	
	12-20	Silty Fine Sand, Trace to With Gravel				12		125	31		36	-	47.2	56.7	0.26	3.85	0.41	0.35	4,000	
B-10	0-1.1	Organic Silt	Topsoil			31	6	105												6±
	1.1-6	Silty Clay with Vegetative Fibers, Trace Organics				24		115	4	0.4 (b)		5.7	1.0	0.0	-	-	-	0.30	-	
	6-8	Clayey Sand with Gravel				17		120	18		32	-	28.5	28.0	0.31	3.25	0.47	0.45	4,000	
	8-20	Medium to Coarse Sand				17		120	21		33	-	32.2	33.3	0.29	3.39	0.46	0.55	4,000	
B-11	0-0.4	Organic Silt	Topsoil			12	>20	105												½±
	0.4-8	Silty Fine Sand with Gravel				5		115	12		30	-	22.5	20.1	0.33	3.00	0.50	0.35	4,000	
	8-20	Silty Fine Sand with Gravel				5		125	26		35	-	41.4	47.3	0.27	3.69	0.43	0.35	4,000	
B-12	0-1.8	Organic Silt	Topsoil			37	3	105												2±
	1.8-3	Silty Clay				19		115	5	0.8 (b)		5.7	1.0	0.0	-	-	-	0.30	1,500	
	3-5.5	Silty Sand				13		110	7		29	-	20.0	17.1	0.35	2.88	0.52	0.35	2,000	
	5.5-8	Medium to Coarse Sand and Gravel				14		125	20		33	-	32.2	33.3	0.29	3.39	0.46	0.55	4,000	
	8-12	Silty Fine Sand				20		115	15		32	-	28.5	28.0	0.31	3.25	0.47	0.35	4,000	
	12-20	Silt				24		110	9		30	-	22.5	20.1	0.33	3.00	0.50	0.30	3,000	

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				LL	PL	W				c_u (ksf)	ϕ (deg)	N_c	N_q	N_γ	K_a	K_p	K_o			
B-13	0-1.5	Organic Silt	Topsoil			20	>20	105												1½±
	1.5-5.5	Silty Clay				21		120	7	2.0 (b)		5.7	1.0	0.0	-	-	-	0.30	4,000	
	5.5-8	Fine Sand				3		115	19		33	-	32.2	33.3	0.29	3.39	0.46	0.45	4,000	
	8-12	Silty Sand and Gravel				3		130	32		37	-	53.8	68.1	0.25	4.02	0.40	0.45	4,000	
	12-17	Silty Sand and Gravel				5		125	20		33	-	32.2	33.3	0.29	3.39	0.46	0.45	4,000	
	17-20	Silt				15		120	26		35	-	41.4	47.3	0.27	3.69	0.43	0.30	4,000	
B-14	0-0.7	Organic Silt	Topsoil			17	>20	105												1±
	0.7-3	Silty Fine Sand with Gravel				4		115	8		29	-	20.0	17.1	0.35	2.88	0.52	0.35	2,000	
	3-12	Silty Fine Sand with Gravel				5		120	14		31	-	25.3	23.7	0.32	3.12	0.48	0.35	3,000	
	12-20	Silty Fine Sand with Gravel				6		125	31		36	-	47.2	56.7	0.26	3.85	0.41	0.35	3,000	
B-15	0-0.7	Organic Silt	Topsoil			24	>20	105												1±
	0.7-3	Silty Fine Sand with Gravel				6		110	5		29	-	20.0	17.1	0.35	2.88	0.52	0.35	2,000	
	3-12	Silty Fine Sand with Gravel				7		115	12		30	-	22.5	20.1	0.33	3.00	0.50	0.35	4,000	
	12-20	Silty Fine Sand with Gravel				7		125	34		37	-	53.8	68.1	0.25	4.02	0.40	0.35	4,000	
B-16	0-1.5	Organic Silt	Topsoil			25	7	105												1½±
	1.5-3	Silty Clay				16		120	4	1.8 (b)		5.7	1.0	0.0	-	-	-	0.30	2,000	
	3-7	Silty Clay				22		130	7	3.0 (b)		5.7	1.0	0.0	-	-	-	0.30	2,000	
	7-9.5	Silty Sand				20		110	7		29	-	20.0	17.1	0.35	2.88	0.52	0.35	2,000	
	9.5-12	Sandy Silt				12		110	8		29	-	20.0	17.1	0.35	2.88	0.52	0.30	2,000	
	12-20	Silty Fine Sand				10		105	4		28	-	17.8	14.6	0.36	2.77	0.53	0.35	1,000	

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				LL	PL	W				c_u (ksf)	ϕ (deg)	N_c	N_q	N_γ	K_a	K_p	K_o			
B-17	0-0.6	Crushed Stone with Fines	Aggregate Base				>13	120												1±
	0.6-3	Sandy Clay				18		115	5	1.0		5.7	1.0	0.0	-	-	-	0.30	2,000	
	3-6	Clayey Sand with Gravel				11		115	12		30	-	22.5	20.1	0.33	3.00	0.50	0.45	3,000	
	6-8	Silty Fine Sand with Gravel				8		115	8		29	-	20.0	17.1	0.35	2.88	0.52	0.35	3,000	
	8-12	Silty Fine Sand with Gravel (Possible Cobbles and Boulders)				10		135	60+		43	-	126.5	211.6	0.19	5.29	0.32	0.35	4,000	
	12-13	Silty Sand and Gravel (Possible Cobbles and Boulders)				3		135	60+		43	-	126.5	211.6	0.19	5.29	0.32	0.45	4,000	
	>13	Possible Cobbles, Boulders, or Bedrock						135	60+		43	-	126.5	211.6	0.19	5.29	0.32	0.45	4,000	

(a) Unless otherwise noted, estimated value based on averages of field and laboratory testing, and published correlations.

(b) Based on test results.

(c) Compressive strength of core sample in psi.

[#] Peck, Hansen, and Thornburn 1974

[^] Coefficient of Base Friction for shallow spread or mat foundations.