Professional Service Industries, Inc.
3009 Vandenbroek Road, Kaukauna, WI 54130
Phone: (920) 735-1200

March 24, 2026

Mr. Nate Bell
Village of Sister Bay
PO Box 769
Sister Bay, Wisconsin 54234

SUBJECT: Sister Bay Marina
10733 N. Bay Shore Drive
Sister Bay, Wisconsin
PSI Project No. 00942870

Dear Mr. Bell,

The geotechnical exploration and evaluation for the referenced project has been completed. An electronic copy of the report is being provided via email. Paper copies can be issued upon request. After you have had the opportunity of reading the report, please call at any time with any questions or comments you may have. Professional Service Industries, Inc. (PSI) appreciates the opportunity to be of service on this project, and looks forward to continuing as your geotechnical consultant during the design and construction phases, as well as your upcoming projects.

Sincerely,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Cameron Greene
Project Manager

Patrick Bray, E.I.T.
Branch Manager

3/24/26

James M. Becco, P.E.
Principal Consultant

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GEOTECHNICAL EXPLORATION AND EVALUATION

Sister Bay Marina

10733 N. Bay Shore Drive

Sister Bay, Wisconsin

Prepared For:

Village of Sister Bay

PO Box 769

Sister Bay, Wisconsin 54234

PSI Project No. 00942870

March 25, 2026

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1 INTRODUCTION

1.1 GENERAL

This report presents the results of the geotechnical exploration and evaluation for the proposed Sister Bay Marina in Sister Bay, Wisconsin. The work was performed for the Village of Sister Bay, at the request of Mr. Nate Bell.

1.2 PURPOSE

The purpose of this study was to evaluate the subsurface conditions at specific boring locations on the site, and to establish parameters for use by the design engineers and architects in preparing the foundation and floor slab designs for the proposed project.

1.3 SCOPE

The scope of services included a site reconnaissance, the geotechnical exploration, a determination of soil characteristics by field and laboratory testing, and an evaluation of the data obtained. The scope of the field work, including the number, depth, and locations of the borings was determined by the client, the Village of Sister Bay.

1.4 AUTHORIZATION

The description of services and authorization to perform this geotechnical exploration and evaluation were in the form of a signed acceptance copy of PSI Proposal No. 0094-471173, dated February 20, 2026. The general conditions for the performance of the work were referenced in the proposal. This report has been prepared on behalf of, and exclusively for the use of the Village of Sister Bay. 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.

2 SITE AND PROJECT DESCRIPTION

2.1 SITE FEATURES

The project site is located at 10733 N. Bay Shore Drive in Sister Bay, Wisconsin. At the time of the exploration, the site and area of the proposed marina was occupied by the existing marina structure. The surrounding parcels consisted of residential and commercial properties. A review of historical aerial photography available from Google Earth of various years between 1992 and 2023 indicates that at the time of the earliest photos taken in 1992, the site was covered by asphalt pavements and manicured grass. In the photo taken in 2005, the existing marina structure was present. The surface of the site has remained relatively similar to as described above since the photo taken in 2005. However, most of the photos prior to 2010 were extremely grainy, and details of surface features were difficult to discern. The subject site is depicted on the enclosed Boring Location Plan (Figure 1).

The topography of the subject site is relatively flat, with an elevation difference of approximately 1 foot between the boring locations. The site generally slopes down towards the south. The surface elevations of the boring locations ranged between about EL. 586.8 and EL. 585.5. At the time of the exploration, the surface of the site was relatively firm; therefore, a truck mounted drill rig was utilized to access the boring locations.

2.2 PROJECT DESCRIPTION

Based on the information provided by the Village of Sister Bay, it is understood that the proposed project will consist of the demolition of the existing marina structure and subsequent construction of a new Marina Building. The new building will be an approximately 3,655 square foot, two-story structure, with a 350 square foot single-story restroom area. There are no below grade levels. The structure is planned to be supported upon a conventional spread foundation. Structural loading details were not provided. For the purpose of this report, it is estimated that maximum column and wall loads will not exceed 100 kips and 3 kips per lineal foot, respectively. When structural loads are determined, PSI must be informed in order to determine if revisions to this report are necessary.

The finished first floor elevation was not known at the time of report preparation. Based on the existing elevations at the building borings (EL. 586.8 to EL. 585.5), a finished floor elevation of EL. 586.0 was estimated for use in this evaluation. On this basis, cuts and fills of up to about 1 foot are estimated to be necessary. However, this will also be dependent on the subgrade preparation criteria, to be discussed in a later section.

When any additional information regarding the project becomes available (especially a finished floor elevation) and/or if any of the information provided herein is incorrect or changes, PSI must be informed so that any necessary re-evaluation or revisions to this report can be made.

3 EXPLORATION AND LABORATORY PROCEDURES

3.1 SCOPE SUMMARY

The field and laboratory data utilized in the evaluation and analysis of the subsurface materials was obtained by drilling exploratory test borings, securing soil samples by the split-spoon sampling method, and subjecting the samples to laboratory testing.

3.2 FIELD EXPLORATION

A total of three (3) soil test borings were planned to be performed to a depth of about 20 feet below the existing ground surface. However, auger refusal on possible cobbles, boulders, or bedrock was encountered in the borings at depths ranging from about 10 to 13 feet (EL. 575.5 to EL. 573.8) below existing grade. Coring of the refusal materials was not requested or performed. The number, depths, and locations of the borings were determined by the client. The borings were located in the field by PSI utilizing a handheld GPS device. They are estimated to be accurate to within several feet. The surface elevations shown on the logs were estimated by interpolation of an existing conditions map with points of known elevations, provided by the client. The elevations are estimated to be accurate to within about 1 foot.

The soil test borings were performed with a truck-mounted rotary drilling rig utilizing continuous flight hollow stem augers to advance the holes. 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 into clean glass jars immediately after retrieval and returned to the laboratory upon completion of the field operations. Samples will be discarded unless other instructions are received. All soil samples were visually classified in general accordance with the Unified Soil Classification System (ASTM D-2488-75). A description of the subsurface conditions encountered at each boring location is shown on the enclosed Soil Boring Logs. After completion of the borings the auger holes were backfilled to the ground surface with bentonite chips.

A copy of the Soil Boring Logs and Boring Location Plan (Figure 1) are enclosed in the Appendix. The soil stratification shown on the logs represents the approximate soil conditions in the actual boring locations at the time of the exploration. The terms and symbols used on the logs are described in the General Notes found in the Appendix.

3.3 LABORATORY PHYSICAL TESTING

Soil samples obtained from the exploration were visually classified in the laboratory, and subjected to testing, which included moisture content determinations. Selected cohesive soil samples were tested in unconfined compression with an uncontrolled strain loading rate and/or with a calibrated hand penetrometer to aid in evaluating the soil strength characteristics. The values of strength tests performed on soil samples obtained by the Standard Penetration Test Method (SPT) are considered approximate, recognizing that the SPT method provides a representative but somewhat disturbed soil sample.

The laboratory testing was performed in general accordance with the respective ASTM methods, as applicable, and the results are shown on the boring logs and Laboratory Data Sheets in the Appendix.

4 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 GENERAL

A description of the subsurface conditions encountered at the test boring locations is shown on the Soil Boring Logs. 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 boring location, but that variations may occur between and beyond the sampling intervals and boring locations. Soil depths, topsoil and layer thicknesses, and demarcation lines utilized for preconstruction planning should not be expected to yield exact and final quantities. A summary of the major soil profile components is described in the following paragraphs.

4.2 SUBSURFACE CONDITIONS

The surface of the site at borings B-1 through B-3 consisted of about 2 to 3 inches of asphalt, underlain by about 5 to 8 inches of base course comprised of brown, dark brown, and grayish dark brown sand with gravel and silt. Beneath the base course, fill and possible fill consisting of brown and grayish brown sand; and gray and grayish brown gravelly sand was encountered in the borings to a depth of about 7.5 feet (EL. 579.3 to EL. 578.0) below existing grade. Beneath the fill and possible fill, natural soils consisting of brown clayey gravelly sand; brown sand with silt and gravel; and brown silt and gravelly silt were present to the maximum depth explored by the borings.

The fill and possible fill materials were classified as such based on their varied visual characteristics and composition. However, it must be recognized that in the absence of foreign substances and/or debris within the soil samples obtained, it is difficult to distinguish between natural soils and clean soil fill.

The natural granular soils encountered in the borings were generally medium dense to very dense in relative density, with Standard Penetration Resistances (N-values) ranging from about 12 to 58 blows per foot (bpf). The granular fill and possible fill soils encountered in the borings were generally medium dense in relative density, with N-values ranging from about 8 to 13 bpf.

Auger refusal on possible cobbles, boulders, or bedrock was encountered in the borings at depths ranging from about 10 to 13 feet (EL. 575.5 to EL. 573.8) below existing grade.

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 Logs.

4.3 GROUNDWATER OBSERVATIONS

Groundwater observations were made during the drilling operations and in the open boreholes upon completion. Groundwater was not encountered during auger advancement or upon completion and removal of the augers in the boreholes.

The groundwater observations reported herein are considered approximate. It must be recognized that groundwater levels fluctuate with time due to variations in seasonal precipitation, lateral drainage conditions, and soil permeability characteristics. Longer term monitoring would be required to further evaluate groundwater levels on this site.

5 CONSIDERATIONS AND RECOMMENDATIONS

5.1 GENERAL DEVELOPMENTAL CONSIDERATIONS

In view of the subsurface conditions encountered in the test borings, together with the structural loading criteria and development grades anticipated, the proposed structure can be supported by conventional spread foundations. However, fill and possible fill soils were encountered in borings B-1 through B-3 to a depth of about 7.5 feet (EL. 579.3 to EL. 578.0) below existing grade. Existing fill soils are not suitable for foundation support due to the potential for variability in strength and support characteristics. Therefore, all foundations must extend through existing fill and any buried topsoil to bear upon suitable natural soils, or upon newly placed compacted structural fill (or lean concrete mix) used to replace unsuitable materials. Undercuts of up to about 3 feet are estimated to be necessary for frost depth foundations (with deeper cuts necessary for interior footings). However, some variation should be expected. Undercutting of soft, loose, wet, or otherwise unsuitable natural soils may be necessary, at least on an isolated basis.

The existing natural soils can generally be utilized for support of the floor slabs and pavements after proper subgrade preparation. However, some overexcavation of unsuitable soils may be necessary. A discussion of the building foundation and pavement design parameters, as well as the support conditions for the floor slab and pavement are included in later sections.

5.2 SITE PREPARATION

The presence of organic topsoil and vegetation within the subgrade can adversely affect the serviceability of structural fills, foundations, floor slabs, pavements, and other structures placed upon them. The surface at the borings was covered with about 2 to 3 inches of asphalt, underlain by about 5 to 8 inches of base course. However, some variation should be expected. The pavement, and any topsoil, vegetation, trees, roots, organic matter, and other unsuitable materials must be removed from the areas of floor slabs, footings, and other structural areas.

Site preparation will require removal of the existing building, including foundations and underground utilities. Extensive areas of loose backfill material may be encountered within utility trenches, adjacent to the existing structures, and in former building, basement, and other structural areas. These will also require removal. The areas, including basements, must then be properly backfilled with compacted structural fill. Prior to the backfilling, the areas must be observed by a PSI representative to evaluate the suitability of the subgrade for subsequent support of the new building, utilities, or other structures.

After stripping the topsoil and cutting high areas of the site to the planned finished grade, and prior to the placement of new fill which may be placed to raise grades, the exposed subgrade must be thoroughly proofrolled to detect unstable, yielding soils. This should consist of overlapping passes in a perpendicular grid pattern, with a fully-loaded tandem-axle dump truck, or other equipment of similar size and weight suitable for the surface conditions. Proofrolling should be performed in consultation with the geotechnical engineer at the time of construction. Some difficulty with subgrade preparation may be experienced, especially in wet or cold weather, or during thawing conditions. Additionally, instability can become more severe in silty and clayey materials, which are considered to be moderately to highly moisture sensitive. It is generally recommended that earthwork be carried out during relatively warm, dry weather. Any soft, wet, or otherwise unstable 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. Construction delays and difficulty with subgrade stabilization may be experienced during periods of wet and/or cool weather.

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 to catch basins, or other appropriate areas of the site, so that the potential for the softening of the foundation and pavement subgrade soils is reduced.

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. Similarly, where undercutting of unsuitable soils is performed beneath foundations, floor slabs, or other structural areas, it is recommended that the removal extend laterally beyond the perimeter of the structure at least 0.5 feet for every 1 foot of removal below the planned bearing depth. 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 extremely difficult to compact when placed at moisture contents beyond a few percent of the optimum moisture content. In addition, the near surface soils across the site are considered to be moisture sensitive; therefore, some difficulty with subgrade preparation should be expected, especially if they become wet during construction. 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 (Standard Proctor). Portions of the on-site soils can be used as new fill to raise grades, generally over large, open areas. However, some sorting or moisture conditioning will likely be required. Silt, clay, and wet granular soils are not suitable for reuse as fill in trenches, or adjacent to foundation stem walls or retaining walls. Some importing of suitable granular backfill soils may be necessary.

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 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 along side below grade walls to reduce the potential for consolidation and settlement of the fill. 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.

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.

5.3 FOUNDATION EVALUATION

The proposed structure may be supported by a conventional spread foundation system. Based upon the estimated finished floor elevation (EL. 586.0), interior and exterior footings will bear at about EL. 584.5 and EL. 582.0, respectively. However, fill and possible fill was encountered at B-1 to B-3 to a depth of about 7.5 feet (EL. 579.3 to EL. 578.0) below existing grade. Existing fill soils are not suitable for foundation support due to the potential for variability in strength and support characteristics. Therefore, all foundations must be extended through the fill and any buried topsoil to bear upon underlying suitable natural soils or upon compacted structural fill or lean concrete mix used to replace the unsuitable materials. Undercuts of up to about 3 feet for exterior footings and up to about 5.5 feet for interior footings may be necessary. However, some variation should be expected. Conventional spread footings bearing upon suitable natural soils, or upon compacted structural fill (or lean concrete mix) used to replace unsuitable materials, may be designed for a net allowable soil pressure of 3,000 psf. Undercutting of soft, loose, wet, or otherwise unsuitable natural soils may be necessary, at least on an isolated basis.

The suitability of the existing soils for support of the proposed foundation 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, wet, or otherwise unsuitable materials not disclosed by the borings, may be encountered in the foundation excavations at the bearing elevation. 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 either side of the planned footing. The over-excavated area must be backfilled with structural compacted fill.

In lieu of the use of compacted structural fill, lean concrete mix can be used to replace the unsuitable soils. The foundation excavations should be about 4 inches wider than the proposed footing width and must extend to suitable natural bearing soils. The concrete 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 1000 psi. Some sloughing or caving of the overlying soils may be experienced. Should this occur during concrete placement, the area must be removed and recast. Additionally, should caving become extensive (such as can more typically occur within granular or soft clay soil), it may be necessary to substantially widen excavations to avoid soil intrusion into the concrete. This may result in the use of additional concrete quantities significantly in excess of preconstruction budget estimates.

All perimeter footings must be placed at a depth of 4 feet (or deeper if in accordance with local requirements or customary practice) below the finish grade for frost protection. Due to periodic severity of winters in this area, it is recommended that footings in poorly heated or unheated areas of the building also be placed at least 4 feet below the adjacent exterior grade. Interior footings not subject to frost action may be placed at a shallow depth of 18 inches below the floor slab, provided they bear on suitable natural soils or engineered fills. All foundations must be protected from the effects of frost if construction is carried out during winter months.

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, even if the maximum recommended allowable bearing pressure is not fully utilized. 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 variations in seasonal moisture contents, it is recommended that all foundations be suitably reinforced to make them as rigid as needed.

In general, the performance of the foundation system 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.

5.4 FLOOR SLAB AND PAVEMENT SUBGRADES

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

Localized wet, soft or unstable areas should be undercut to such depths determined necessary in the field to reach stable material. The overexcavations should then be backfilled with imported crushed stone, such as a 1¼-inch dense graded base 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 that cannot be stabilized by normal discing, aeration and recompaction procedures, undercutting and replacement with crushed stone and geotextile fabric (if needed) may also be required in these areas.

The floor slab(s) may be designed utilizing an estimated modulus of subgrade reaction of 200 pci based on the presence of a stable and suitable sand, gravel, or crushed stone fill subgrade, prepared as discussed in this report. However, this is based on common range values obtained from 1 ft. x 1 ft. plate load tests on specific soil types. Depending on how the slab load is applied, the value may need to be modified for larger areas using the following:

Modulus of Subgrade Reaction $k_s = \left(\frac{k}{B}\right)$ for cohesive soil

$k_s = k\left(\frac{B+1}{2B}\right)^2$ for cohesionless soil

where: k_s = coefficient of vertical subgrade reaction for loaded area
k = coefficient of vertical subgrade reaction for a 1x1 foot square area
B = width of area loaded, in feet

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 the floor slab. This must be a minimum of six (6) inches in thickness and properly compacted. In moisture sensitive areas, a vapor barrier may be placed beneath the floor slab or base course; however, it is recommended that the architect be consulted in this regard. The proper use of a vapor barrier 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.

The floor slabs must 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 the slab 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.

5.5 EXTERIOR/UNHEATED AREA SLABS

Based on the borings, entry slabs, sidewalks, aprons, and other slabs in exterior or unheated areas are expected to bear upon generally sandy soils. Such materials are not considered to be highly frost susceptible. However, it must be noted that slabs placed directly upon more frost susceptible soils, such as those with high silt or clay content, 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). If more fine-grained soils are encountered in areas beyond the borings, or are used to raise grades, it is recommended that consideration be given to limited undercutting of frost susceptible materials, where encountered, to a depth of 1 to 2 feet below the slab, and replacement with well graded, properly placed and compacted granular soils.

5.6 UTILITY CONSTRUCTION

In general, the on-site soils can be used for support of utility lines. However, some undercutting of soft, loose, or otherwise unsuitable soils, in conjunction with the placement of crushed stone or other suitable granular backfill may be necessary to establish a stable working mat and/or bearing subgrade. Some difficulty with the stability of utility trenches may be experienced, especially in the presence of water. The use of shoring, bracing, or trench boxes 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.

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. 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, organic soils, and 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. Some importing of suitable fill will likely be required.

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.

6 CONSTRUCTION CONSIDERATIONS

6.1 GROUNDWATER CONTROL

Because no groundwater was encountered in the boreholes during the exploration, no major difficulties during excavation and construction work are anticipated on this site. A gravity drainage system and a filtered sump pump should be adequate to control isolated small volume perched water. However, if larger volume perched zones are encountered, or if groundwater levels rise, more comprehensive dewatering with a series of sump pumps may be required.

Every effort should be made to keep excavations dry. Discharge water from roof drains should be directed away from the building, and the site grading direct runoff to catch basins or other appropriate areas of the site, so that the potential for the softening of the foundation and pavement subgrade soils is reduced.

While no groundwater was encountered at the time the borings were drilled, seasonal variations, site drainage conditions, soil permeability, and other factors can cause groundwater levels to rise and/or perched zones to be present in the upper soils at varying times of the year.

6.2 EXCAVATIONS AND SITE DRAINAGE

Sloping, shoring or bracing of the excavation sidewalls will be necessary to facilitate construction and to protect life and property. Sloughing and caving, and subgrade instability may occur 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 may occur within organic, granular, and soft cohesive soils, especially encroaching upon and extending below any groundwater or perched zones. All excavation work must be performed in accordance with OSHA and local building code requirements.

All excavations must be performed with caution and utilize methods which will prevent undermining or destabilization of buildings, utilities, pavements, sidewalks or other structures. The use of a properly designed shoring and bracing, sheet piling, or underpinning system must be utilized as necessary to adequately protect buildings, utilities, pavements, and other structures. This must be performed by an experienced specialty contractor. Additionally, extreme care must be used during the installation of any bracing system, especially those using driven or vibratory methods, in order to avoid damaging existing buildings, utilities, and other structures. Consideration should be given to the performance of video and/or photographic documentation of the condition of nearby buildings, utilities, and other structures prior to installation.

Auger refusal on possible cobbles, boulders, or bedrock was encountered at B-1 through B-3 at depths ranging from about 10 to 13 feet (EL. 575.5 to EL. 573.8) below existing grade. Based upon the estimated finished floor elevation for the building (EL. 586.0), it is generally estimated that typical shallow footing and utility excavations will remain above the refusal depths. However, should deeper than typical excavations be desired or required, and they will encroach upon or extend below the refusal depths encountered in the borings, additional subsurface exploration with backhoe test pits is recommended as part of design and construction planning.

Since the subgrade soils are generally sensitive to moisture, every effort should be made to provide adequate drainage across the site during construction, and to prevent ponding of runoff on the subgrade. These soils are also subject to erosion caused by runoff, and erosion control measures should be implemented where needed or required by local ordinances.

It is mandated that excavations, whether they be for utility trenches, basement excavations or footing excavations, be constructed in accordance with current Occupational Safety and Health Administration (OSHA) guidelines to protect workers and others during construction. PSI recommends that these regulations be strictly enforced; otherwise, workers could be in danger and the owner(s) and the contractor(s) could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

PSI is providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

6.3 SEISMIC DESIGN CONSIDERATIONS

Based on the results of the soil test borings, and upon past local experience, it is recommended that Site Class D in accordance with Table 20.3-1 of ASCE 7-16 be used for design.

The site latitude and longitude are 45.113231°N and 87.070605°W. Using the USGS Seismic Design Maps (https://seismicmaps.org); and the requirements of International Building Code (IBC) 2021 and Minimum Design Loads for Buildings and Other Structures (ASCE 7-16), the following are mapped acceleration parameters for this site.

Mapped MCE Spectral Response Acceleration		Site Amplification Factor		Numeric Seismic Design Value		Site Modified Spectral Acceleration		PGA (Peak Ground Acceleration)	F_{PGA} (Site Application Factor at PGA	PGA_M (Site Modified Peak Ground Acceleration
$*S_s$	0.046	$*F_a$	1.6	$*S_{Ds}$	0.049	S_{Ms}	0.074	0.035	1.6	0.035
$**S_1$	0.031	$**F_v$	2.4	$**S_{D1}$	0.049	S_{M1}	0.075			

*0.2 second time period
** 1.0 second time period

7 GENERAL COMMENTS

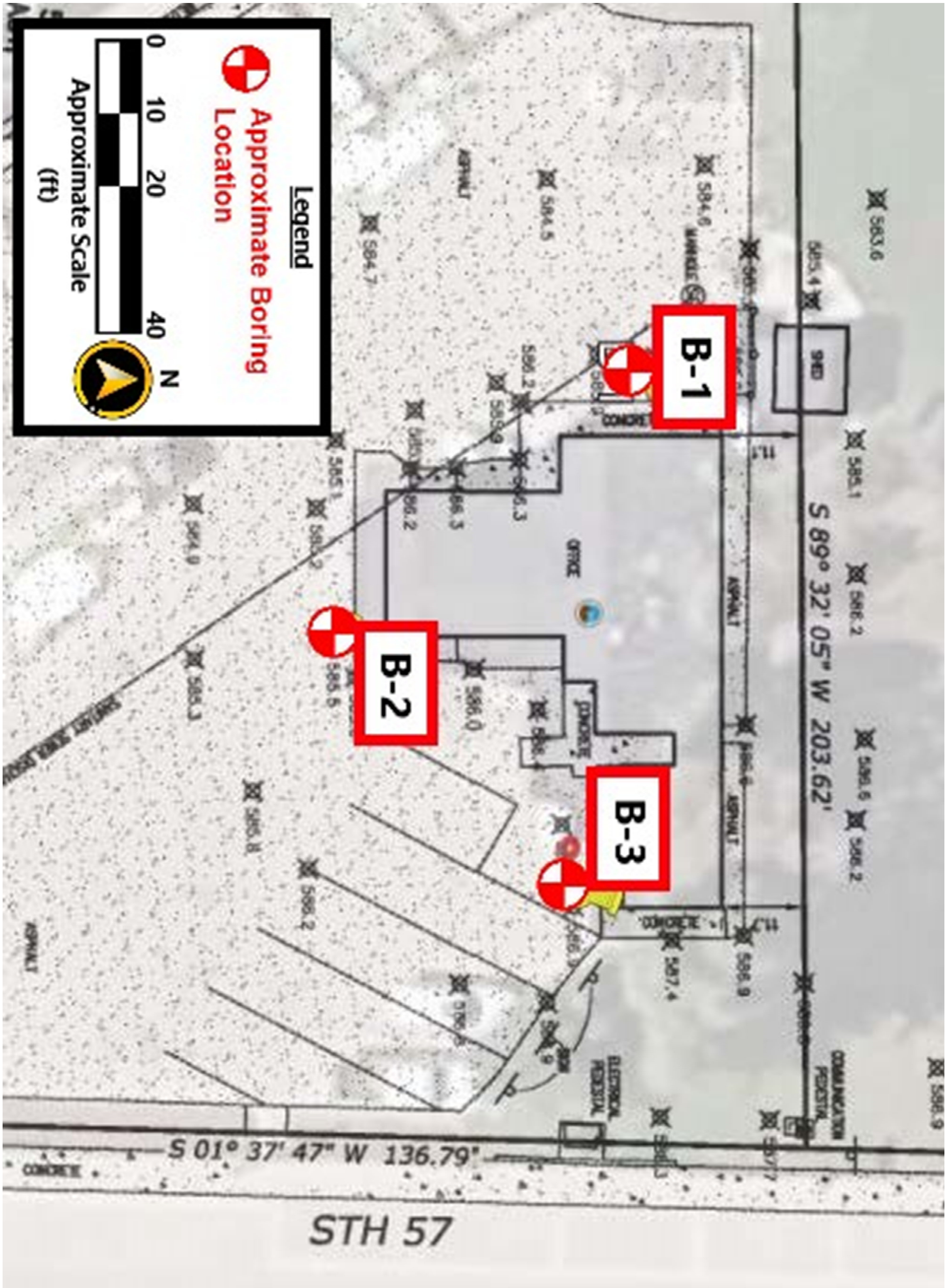
This geotechnical exploration and foundation evaluation has been prepared to aid in the evaluation of the foundation conditions on this site. The recommendations presented herein are based on the available soil information and the design information provided. Any changes in the design information or building locations should be brought to the attention of the soils engineer to determine if modifications in the recommendations are required. The final design plans and specifications should also be reviewed by the soils engineer to determine that the recommendations presented herein have been interpreted and implemented as intended.

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.

It is recommended that the earthwork and foundation operations be monitored by the soils engineer, to test and evaluate the bearing capacities, and the selection, placement and compaction of controlled fills.

APPENDIX

Figure 1 - Boring Location Plan
Soil Boring Logs
General Notes



	Sister Bay Marina 10733 N. Bay Shore Drive Sister Bay, Wisconsin	**SCALE: SHOWN ABOVE**
		PROJECT NO: 00942870
	FIGURE 1: Boring Location Plan	**PAGE 1 OF 1** **3/23/2026**

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SOIL BORING LOG: B - 1

Project: Sister Bay Marina **Project No.:** 00942870

Location: 10733 N. Bay Shore Drive, Sister Bay, Wisconsin **Drill Date:** March 10, 2026 **Drilled By:** KD/KH/TP

DEPTH (feet)	EL. (feet)	VISUAL SOIL CLASSIFICATION (GROUND SURFACE ELEVATION: 586.1)	SAMPLE NO.	N (bpf)	Qp (tsf)	Qu (tsf)	MC (%)	REMARKS
		0-2" ASPHALT						
1	585.1	2-10" Brown SAND, with silt and trace gravel, moist (BASE COURSE)	1-SS	13	-	-	5	
2	584.1	Brown SAND, with gravel and trace silt, moist (FILL)			-	-	4	
3	583.1	Gray Gravelly SAND, with trace silt, moist (FILL)	2-SS	39	-	-	2	
4	582.1							
5	**581.1**							
6	580.1	Brown SAND, with gravel and trace silt, moist (POSSIBLE FILL)	3-SS	17	-	-	3	
7	579.1							
8	578.1	Brown SILT, with trace clay and sand, very moist	4-SS	12	-	-	10	
9	577.1							
10	**576.1**							
11	575.1	Brown Gravelly SILT, with sand and trace clay, wet	5-SS	52	-	-	11	
12	574.1							
13	573.1	**AUGER REFUSAL ON POSSIBLE COBBLES, BOULDERS, OR BEDROCK @ 12± FEET END OF BORING @ 12± FEET**						
14	572.1							
15	**571.1**							
16	570.1							
17	569.1							
18	568.1							
19	567.1							
20	**566.1**							

FIELD OBSERVATIONS:

Water Level during drilling: Not Encountered
Water Level upon completion: Not Present
Caved at upon completion: N/A
Delay Time: N/A
Water Level delayed: N/A
Caved at delayed: N/A

ADDITIONAL COMMENTS:

Note: Lines of stratification represent an approximate boundary between soil types. Variations may occur between sampling intervals and/or boring locations. Transitions may also be gradual.

SOIL BORING LOG: B - 2

Project: Sister Bay Marina
Project No.: 00942870

Location: 10733 N. Bay Shore Drive
Sister Bay, Wisconsin

Drill Date: March 10, 2026
Drilled By: KD/KH/TP

DEPTH (feet)	EL.	VISUAL SOIL CLASSIFICATION — GROUND SURFACE ELEVATION: 585.5	SAMPLE NO.	N (bpf)	Qp (tsf)	Qu (tsf)	MC (%)	REMARKS
		0-3" ASPHALT						
1	584.5	3-11" Dark brown SAND, with silt and trace gravel, moist (BASE COURSE)	1-SS	10	-	-	3	
2	583.5	Grayish brown Gravelly SAND, with silt, moist (FILL)			-	-	6	
3	582.5	Grayish brown Gravelly SAND, with trace silt, moist (FILL)	2-SS	14	-	-	2	
4	581.5							
5	580.5	Light brown SAND, with gravel and silt, moist (POSSIBLE FILL)	3-SS	18	-	-	6	
6	579.5							
7	578.5							
8	577.5	Brown Clayey Gravelly SAND, with silt, wet	4-SS	41	-	-	3	
9	576.5							
10	575.5	**AUGER REFUSAL ON POSSIBLE COBBLES, BOULDERS, OR BEDROCK @ 10± FEET END OF BORING @ 10± FEET**						
11	574.5							
12	573.5							
13	572.5							
14	571.5							
15	570.5							
16	569.5							
17	568.5							
18	567.5							
19	566.5							
20	565.5							

FIELD OBSERVATIONS:

Water Level during drilling: Not Encountered
Water Level upon completion: Not Present
Caved at upon completion: N/A
Delay Time: N/A
Water Level delayed: N/A
Caved at delayed: N/A

ADDITIONAL COMMENTS:

Note: Lines of stratification represent an approximate boundary between soil types. Variations may occur between sampling intervals and/or boring locations. Transitions may also be gradual.

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SOIL BORING LOG: B - 3

Project: Sister Bay Marina
Project No.: 00942870

Location: 10733 N. Bay Shore Drive
Sister Bay, Wisconsin

Drill Date: March 10, 2026
Drilled By: KD/KH/TP

DEPTH (feet)	EL.	VISUAL SOIL CLASSIFICATION (GROUND SURFACE ELEVATION: 586.8)	SAMPLE NO.	N (bpf)	Qp (tsf)	Qu (tsf)	MC (%)	REMARKS
0	586.8	0-3" ASPHALT						
		3-8" Grayish dark brown SAND, with gravel, moist (BASE COURSE)	1-SS	8	-	-	2	
1	585.8	Brown SAND, with gravel and trace silt, moist (FILL)			-	-	6	
2	584.8							
3	583.8	Gray Gravelly SAND, with trace silt, moist (FILL)	2-SS	16	-	-	4	
4	582.8							
5	581.8							
6	580.8		3-SS*	12	-	-	-	
7	579.8							
8	578.8	Brown SAND, with silt and gravel, moist	4-SS	58	-	-	5	
9	577.8							
10	576.8							
11	575.8		5-SS	35	-	-	7	
12	574.8							
13	573.8	**AUGER REFUSAL ON POSSIBLE COBBLES, BOULDERS, OR BEDROCK @ 13± FEET** **END OF BORING @ 13± FEET**						
14	572.8							
15	571.8							
16	570.8							
17	569.8							
18	568.8							
19	567.8							
20	566.8							

FIELD OBSERVATIONS:

Water Level during drilling: Not Encountered
Water Level upon completion: Not Present
Caved at upon completion: N/A
Delay Time: N/A
Water Level delayed: N/A
Caved at delayed: N/A

ADDITIONAL COMMENTS:

*** Poor Sample Recovery**

Note: Lines of stratification represent an approximate boundary between soil types. Variations may occur between sampling intervals and/or boring locations. Transitions may also be gradual.

GENERAL NOTES

SAMPLE IDENTIFICATION

1. Information on each log is a compilation of subsurface conditions, based on visual soil classifications of soil samples obtained from the field as assigned by a soils engineer, as well as from laboratory testing of samples, if performed. The strata lines on the logs may be approximate or the transition between the strata may be gradual rather than distinct. Water level measurements refer only to those observed at the times and locations indicated, and may vary with time, geologic condition and construction activity.
2. Unified Soil Classification System (USCS) designations are based on visual soil classification estimates on the basis of textural and particle size categorization and various soil behavior characteristics. If laboratory tests were performed to classify the soil, the USCS designation is shown in parenthesis.

USCS SOIL PARTICLE SIZE CLASSES

U.S. Std. Sieve			#200	#40	#10	#4	¾”	3”	12”
Soil Type	Clay	Silt	Sand			Gravel		Cobbles	Boulders
			Fine	Medium	Coarse	Fine	Coarse		
Millimeters	0.002	0.074	0.42	2	4.8	19	76	300	

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487-00)

Criteria for assigning group symbols and group names using laboratory tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean gravels w/ < 5% fines [E]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [C]	GW	Well-graded gravel [D]
			Cu < 4 and/or1 > Cc > 3 [C]	GP	Poorly graded gravel [D]
		Gravels w/ > 12% fines [E]	Fines classify as ML or MH	GM	Silty gravel [D,F,G]
			Fines classify as CL or CH	GC	Clayey gravel [D,F,G]
	Sands (More than 50% of coarse fraction passes the No. 4 sieve)	Clean sands w/ < 5% fines [I]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [C]	SW	Well-graded sand [H]
			Cu < 6 and/or 1 > Cc > 3 [C]	SP	Poorly graded sand [H]
		Sands w/ > 12% fines [I]	Fines classify as ML or MH	SM	Silty sand [F,G,H]
			Fines classify as CL or CH	SC	Clayey sand [F,G,H]
FINE-GRAINED SOILS (More than 50% passes the No. 200 sieve)	Silts and clays w/ liquid limit (LL) < 50	Inorganic	PI > 7 and plots on or above “A” line [J]	CL	Lean clay [K,L,M]
			PI < 4 and plots below “A” line [J]	ML	Silt [K,L,M]
		Organic	LL (Oven dried) / LL (Not dried) < 0.75	OL	Organic clay [K,L,M,N]
				OL	Organic silt [K,L,M,O]
	Silts and clays w/ liquid limit (LL) ≥ 50	Inorganic	PI plots on or above “A” line	CH	Fat clay [K,L,M]
			PI plots below “A” line	MH	Elastic silt [K,L,M]
		Organic	LL (Oven dried) / LL (Not dried) < 0.75	OH	Organic clay [K,L,M,P]
				OH	Organic silt [K,L,M,Q]
HIGHLY ORGANIC SOILS		Primarily organic matter, dark in color, and organic odor		PT	Peat

[A] Based on the material passing the 3-inch (75 mm) sieve
[B] If field sample contained cobbles or boulders, or both, add “ with cobbles or boulders, or both” to group name
[C] $Cu = D_{60}/D_{10}$; $Cc = (D_{30})^2 / D_{10} \times D_{60}$
[D] If soil contains ≥ 15% sand, add “with sand” to group name
[E] Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
[F] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM
[G] If fines are organic, add “with organic fines” to group name
[H] If soil contains ≥ 15% gravel, add “with gravel” to group name
[I] Sands with 5 - 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay
[K] If soil contains 15 - 29% plus No. 200, add “with sand” or “with gravel”
[L] If soil contains ≥ 30% plus No. 200, predominantly sand, add “sandy” to group name
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name
[N] PI ≥ 4 and plots on or above “A” line
[O] PI < 4 or plots below “A” line
[P] PI plots on or above “A” line
[Q] PI below “A” line

RELATIVE SOIL COMPOSITION

Trace - 0 - 15% of sample
With - 15 - 35% of sample
Soil modifier - > 35% of sample (i.e. sandy, silty, clayey, gravelly)

DRILLING & SAMPLING SYMBOLS

AU	-	Auger sample from cuttings
BS	-	Bag sample
HA	-	Hand auger sample
SS	-	Split spoon sample (2" O.D. by 1⅜" I.D.)
ST	-	Shelby Tube sample (2" or 3" O.D.)
WS	-	Wash sample from wash water return

SOIL PROPERTY SYMBOLS

N - N-value (blow count) is the standard penetration resistance based on the total number of blows required to advance a split spoon sampler one (1) foot, using a 140 lb. hammer with a 30 inch free fall. To avoid damage to sampling tools, driving is typically limited to 50 blows during any 6 inch interval. Additional description is provided below:

N-value (bpf)	Description
HW	Sampler penetrated soil under weight of hammer and rods; no driving required
25	25 blows to advance sampler 12 inches after initial 6 inches of seating
75/10"	75 blows to advance sampler 10 inches after initial 6 inches of seating
50/S3"	50 blows to advance sampler 3 inches during initial 6 inch seating interval

MC	-	Moisture content, %
Qu	-	Unconfined compressive strength, tons per square foot (tsf)
Qp	-	Calibrated hand penetrometer resistance, tsf
γd	-	Dry density, pounds per cubic foot (pcf)
LL	-	Liquid limit, % (ASTM D4318)
PL	-	Plastic limit, % (ASTM D4318)
PI	-	Plasticity index, % (ASTM D4318)
%P200	-	Percent of sample passing the No. 200 sieve
RQD	-	Rock quality designation of NX-size core sample
RMR	-	Rock mass rating, as developed by Z.T. Bieniawski
PID	-	Photoionization detector (Hnu meter) volatile vapor level, ppm

SOIL RELATIVE DENSITY & CONSISTENCY CLASSIFICATION

NON-COHESIVE SOILS		COHESIVE SOILS		
Density	N-Value Range	Consistency	Qu Range (tsf)	Approximate N-value Range
Very loose	0 - 3	Very soft	0 - 0.25	0 - 2
Loose	3 - 7	Soft	0.25 - 0.5	2 - 5
Medium dense	7 - 15	Medium stiff	0.5 - 1.0	5 - 10
Dense	15 - 38	Stiff	1.0 - 2.0	10 - 14
Very dense	38+	Very Stiff	2.0 - 4.0	14 - 32
		Hard	4.0+	32+

SOIL STRUCTURE TERMINOLOGY

Interlayered	-	Alternating layers of different soil types
Layer	-	Inclusion greater than 3 inches thick
Seam	-	Inclusion ⅛ to 3 inches thick
Laminated	-	Alternating seams of different soil type
Intermixed	-	Pockets of different soil types, no layering
Pocket	-	Inclusion of material of different texture
Varved	-	Alternating layers or seams of sand, silt, and/or clay

GROUNDWATER & MOISTURE CONDITIONS

v	-	Approximate groundwater level as noted during drilling and sampling
▼	-	Groundwater level as noted within the open borehole upon removal of the augers
¥	-	Delayed groundwater level within open borehole
Dry	-	Absence of moisture, dry to the touch
Moist	-	Damp, but no visible water
Wet	-	Visible free water, saturated, usually below water table

NOTE: General Notes have been adapted from and incorporate portions of ASTM D2487 "Classification of Soils for Engineering Purposes (Unified Soil Classification System)" and ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)."

Professional Service Industries, Inc.