Silvernail Apartments

Geotechnical Engineering Report

October 30, 2025 | Terracon Project No. 58255267

Pewaukee, Wisconsin

Prepared for:

12 Gauge Construction, LLC
4125 Terminal Drive, Suite 100
McFarland, WI 53558

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October 30, 2025

12 Gauge Construction, LLC
4125 Terminal Drive, Suite 100
McFarland, WI 53558

Attn: Ms. Stacy Kronebusch
Phone: (608) 490-0131
Email: stacyk@12gcc.com

Re: Geotechnical Engineering Report
Silvernail Apartments
2417 Silvernail Road
Pewaukee, WI
Terracon Project No. 58255267

Dear Ms. Kronebusch:

We have completed the scope of Geotechnical Engineering services for the referenced project in general accordance with the Agreement of services dated September 19, 2025. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Abdelhady Deif, E.I.T.
Field Engineer

Paul J. Koszarek, P.E., C.S.T.
Senior Principal

WISCONSIN PAUL J. KOSZAREK E-36708 WAUKESHA WIS. PROFESSIONAL ENGINEER

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Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services for the construction of a new apartment building in Pewaukee, WI. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Demolition considerations
- Foundation design and construction
- Floor slab design and construction
- Lateral earth pressures for basement walls
- Lateral design parameters for unbalanced lateral load
- Dewatering and below slab drainage/waterproofing
- Seismic considerations per IBC
- Frost considerations
- Design and construction of pavements
- Design and construction of stormwater management

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the **Exploration Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	An email request for proposal was sent on September 8, 2025 which included a site plan with proposed boring locations. Terracon discussed the scope via email with 12 Gauge and recommended additional borings for the stormwater management features for the project. Preliminary architectural drawings prepared by Bleck and Bleck Architects, dated October 9, 2025 were provided by email.
Project Description	We understand the project will consist of a multi-story apartment building with below grade parking. Three levels of parking are planned below the structure, two of which will be below grade. Four levels of apartments will be constructed above the parking levels. Surface parking is planned on the east side of the building. A stormwater pond is planned to the south of the building.
Proposed Structure	The proposed structure has area footprint of approximately 18,000 square feet. Three levels of parking will be constructed below the footprint of the entire building. On the north side of the structure, two of the parking levels will be constructed below grade. The proposed grades for the site generally follow the existing grades and there will be approximately 15 feet of elevation difference across the building in the north south direction. At the south end of the planned structures, the lower parking level will tie into existing grade and all three parking levels will be above grade.
Finished Floor Elevation (FFE)	The finished floor level for the lower garage is planned at elevation 881 feet. The finished floor for the first occupied floor is elevation 911 feet.
Maximum Loads	In the absence of information provided by the design team, we will use the following loads in estimating settlement based on our experience with similar projects. ■ Columns: 500 to 600 kips, assumed ■ Walls: 8 to 9 kips per linear foot (klf), assumed ■ Lower Level Parking Slab: 250 pounds per square foot (psf), assumed
Grading/Slopes	Finished grades around the perimeter of the building range from approximately 898 feet on the north to 882 feet on the south side of the building.

Item	Description
Below-Grade Structures	Three levels of parking are planned below the structure. On the north side of this site, two of these levels will be below grade. Because of the slope of the site, the amount of structure which will be constructed below grade decreases from the north to the south side of the planned building. At the far south end of the building, no below grade levels are planned.
Free-Standing Retaining Walls	No freestanding retaining walls are planned for the project.
Pavements	Paved driveway and parking will be constructed on the parcel. A preferred pavement surfacing has not been identified to us as part of the preliminary information. Asphalt surfacing is common in the area for projects of this nature and is the assumed preference. Unless information is provided prior to the report, we assume that the traffic classification will consist of: ■ Class I: Parking stalls for autos and pickup trucks ■ Class II: Traffic consisting of home delivery trucks, trash pickup The pavement design period is 20 years.
Building Code	2021 IBC

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 2417 Silvernail Road in Pewaukee, WI. Latitude/Longitude (approximate) 43.0450, -88.2669 See **Site Location**
Existing Improvements	The site is currently occupied by an office building with existing pavements.

Item	Description
Existing Topography	The site generally slopes downward from the north to the south. Approximately 16 feet of topographic relief appears to be present with elevations ranging from approximately 898 feet to 882 feet.
Current Ground Cover	Asphalt and grass cover

Geotechnical Characterization

We completed a total of 8 borings within the new apartment building area. The following table lists the number and depth of borings performed.

Number of Borings	Approximate Boring Depth [1, 2]	Location
2	19 to 35	North side of building area
2	30	Middle of building area
2	25	South side of building area
2	15	Stormwater Pond

1. Feet below existing ground surface.
2. Boring B-2 was terminated at 18.7 feet due to auger and sampling refusal on a boulder or possible bedrock.

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** attachment of this report.

Model Layer	Layer Name	General Description
1	**Surface Layer**	5- to 10-inch-thick topsoil encountered in Borings B-4, B-6, B-7, and B-8, or 3 to 4 inches of asphalt over 8 to 10 inches of base course in paved areas.

2	**Existing Fill**	Fill consisting of brown and gray to dark brown lean clay with sand and sandy lean clay or sandy silt
3	**Native Cohesive Soil**	Silty clay was encountered only in Boring B-5 and was soft in consistency, with a moisture content of 23%
4	**Native Non-Cohesive Soils**	Silty and clayey sand or gravel, or silt. Encountered in a loose to medium dense and very dense condition. N-values ranged from 8 blows per foot (bpf) to a refusal of 50 blows over 5" penetration. Moisture contents ranging from about 5% to 23%. Boulders or shallow bedrock may be encountered within or at the base of this layer.

The geotechnical characterization forms the basis of our geotechnical evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Subsurface Water Conditions

The following table presents the shallower groundwater depths observed and the corresponding elevations at which they were encountered.

Boring Number	Depth of Water Below Ground Surface (feet)	Groundwater Elevation (feet)	Boring Number	Depth of Water Below Ground Surface (feet)	Groundwater Elevation (feet)
B-1[1]	3.5	893	**B-2**	Not Encountered	-
B-3	23	855	**B-4**	23.5	864
B-5	5.5	876	**B-6**	4.5	877
B-7	4	877	**B-8**	3.5	877

1. Perched groundwater table.

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was encountered in most borings, ranging from 3.5 to 23 feet during drilling and from 4 to 15 feet upon completion.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project

Geotechnical Overview

The existing fill materials could become unstable with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, grading should be performed during the warmer and drier time of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist.

Existing fill soils were observed in all of the borings between the depths of 3.5 to 6 feet corresponding to elevations between 877 and 893 feet. This existing fill should not be used to support the foundations of the planned structures and should be removed from below the floor slab.

Lower strength and more compressible soils were observed in the two borings at the south end of the planned building (Borings B-5 and B-6). To reduce the potential for differential settlement under this portion of the building, we recommend a ground improvement program, such as rammed aggregate piers (RAPs), is implemented to provide a more uniform support condition across the footprint of the building. Based on the geotechnical information that is currently available, this ground improvement program should be planned for the southern half of the building. A supplement geotechnical program could be performed at the site to try to refine the limits of this lower strength zone and possibly reduce the extents of the ground improvement program. Once the ground improvement program is completed, the building can be designed to be supported on shallow foundations with a net allowable soil bearing pressure of 4,000 pounds per square foot (psf). The foundations will be supported on the native soils in the northern portion of the site and on the improved soils (by RAP insertion) in the southern portion of the building.

The **Shallow Foundations** section addresses foundation support of structure on the improved soil and on the native soils encountered in the northern portion of the site. The shallow foundations may be proportioned using a net allowable bearing pressure of 4,000. We do not recommend that the unimproved existing fill soils be used for support of the new foundations.

Based on the water levels being as high as elevation 879 feet, the contractor should be prepared to dewater during construction.. In order to maintain stability of the soils, the water levels should be lowered to at least 2 feet below the lowest planned excavation elevation. Due to the planned below grade structure, it is likely that construction dewatering will need to be completed, some of which may require shallow well points in order to lower the water levels to at least 2 feet below the planned excavation depths. Dewatering should be completed prior to beginning foundation and elevator pit excavation.

Due to the observed water levels being higher than the planned basement slab, we also recommend to install a below floor slab drainage system or design a hydrostatic slab. Typically the drainage system is a more cost effective solution rather than increasing the thickness of the basement slab. Either solution should also include fully waterproofing the basement slab and the perimeter walls and construction joints.

The planned parking level configuration will require a significant amount of excavation at the site. An excavation depth of approximately 20 feet will be required at the north end of the building and approximately 6 feet of excavation will be required at the south end of the building. The design team should consider the excavation support system which will be needed to facilitate this work in their planning for the project. The proposed configuration will also result in an unbalanced lateral force on the building which will need to be accounted for in the structural design of the parking levels. When evaluating the lateral forces, a typical triangular pressure distribution should be considered as well a trapezoidal pressure distribution and the more conservative value should be used for the design of the structure.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, pavements, floor slabs, and utility trenches.

Demolition

It is anticipated that the existing office building is planned to be demolished in advance of earthwork activities. Existing structures and remnants of the former structures should also be removed, including any foundations, floor slabs, and utilities. The existing foundations could be left in place below new exterior slabs and pavements provided they are not below any new foundations and there is at least 2 feet of vertical separation between the existing foundation and new slabs or pavements. This should also include removal of all poorly compacted trench backfill extending into the proposed building area.

Site Preparation

Site preparation for the project will consist of typical clearing and grubbing activities for the surface pavements and improvements along with the mass excavation for the parking levels. The design team should evaluate the means and methods for the excavation of the below grade levels as they plan their work at the site to understand the extent of the area which will be disturbed by the planned excavation. For areas not disturbed by the mass excavation, existing asphalt and concrete pavement, topsoil, trees including roots, vegetation, and any loose, soft, or otherwise unsuitable materials should be removed from proposed construction areas. Remnants of the former structures should also be removed, including any foundations, floor slabs, and utilities.

Following the removal of the materials described above, and prior to placing new engineered fill, the exposed cohesive subgrade soils should be proofrolled to delineate any unstable areas and the exposed granular subgrade soils should be proof compacted. Proofrolling of cohesive soils can be accomplished using a loaded tandem-axle dump truck with a gross weight of at least 25 tons, or similarly loaded equipment. The proofrolling should be performed under the direction of the Geotechnical Engineer. Soils that deflect or rut in excess of 1" should be considered unstable and require stabilization. Areas of loose, soft, or otherwise unsuitable materials should be undercut and replaced with either new structural fill or suitable, existing on site materials.

Areas of soft, or otherwise unsuitable material should be improved by scarification and compaction or by removal and replacement. If weather permits, scarifying, drying, and recompacting the exposed subgrades is expected to be the most economical means of improving soft/wet or unstable soils. If removal and replacement is the preferred method of stabilization, the areas of overexcavation should be backfilled with an approved engineered fill as discussed in **Fill Material Types.** Depending on the severity of the instability, typical undercut depths would range from about ½ to 1 foot. The use of a geogrid (such as Tensar BX1200 or equivalent) could also be considered after undercutting. We recommend that construction equipment not be operated above the geogrid until one full lift of crushed stone fill is placed above it.

After an acceptable subgrade condition is achieved, the placement and compaction of new fills may begin, as appropriate. The placement and compaction of all base course and fill soils should be monitored by a representative of the geotechnical engineer. Fill and base course placement should be done in accordance with the State of Wisconsin's Standard Specifications for Highway and Structure Construction.

The excavation for the parking levels should be performed by a contractor experienced with the implementation of excavations of this size and extent. Temporary earth retention systems which are determined to be necessary should be designed by a Professional Engineer licensed in the State of Wisconsin with experience with structures of this size and extent.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 feet of structures, pavements, or constructed slopes. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements.

Soil Type [1, 2]	USCS Classification	Acceptable Locations for Placement
Cohesive	CL [3], CL/ML [3] (LL ≤ 45 and PI ≤ 20)	Below/adjacent to floor slabs and foundations. Placement and compaction during mass earthwork only. Typically, not used for backfilling of undercuts. Can be used for utility trench backfill at depth shallower than 1 foot above the crown of the pipe in non-structural areas.
Granular	GW, GP, GM, GC SW, SP, SM, SC 5% to 15% passing #200 sieve	Backfill for utilities and foundations. Can also be used below/adjacent to floor slabs. and pavement foundations. If used below pavements, drainage should be considered.
Granular	Crushed limestone or crushed concrete meeting WisDOT Section 305 for 1¼ dense graded base	Undercut areas below foundations. Aggregate base below slabs. Can also be used for utility and structural backfill.

1. Structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation prior to use on this site.
2. Any organic materials, rock fragments larger than 3 inches, and other unsuitable materials should be removed prior to use as structural fill.
3. Highly susceptible to frost; unstable when wet, are commonly used for pavement support with the knowledge that additional maintenance and/or shorter pavement life are likely.

Existing Fill

As noted in Geotechnical Characterization, all borings encountered previously placed fill to depths ranging from about 3.5 to 6 feet. We have no records to indicate the degree of control, and consequently, the fill is considered unreliable for support of foundation and floor slab loads. Support of pavements above existing fill soils is discussed in this report. However, even with the recommended construction procedures, inherent risk exists for the owner that compressible fill or unsuitable material, within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report. Additional maintenance of the pavements supported on existing fill should be anticipated.

Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Description
Maximum Fill Lift Thickness	▪ 9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used ▪ 4 inches in loose thickness when hand-guided equipment (i.e., a jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2, 3]	▪ Structural Fills: 95% of the maximum dry density as obtained by the modified Proctor (ASTM D1557) ▪ General Fills: 88% of the maximum dry density as obtained by the modified Proctor (ASTM D1557)
Moisture Content Range [1]	▪ within 2% below to 3% above the modified Proctor optimum moisture content at the time of placement and compaction ▪ granular materials should be compacted within workable moisture levels

Item	Description
	1. We recommend that structural fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved. 2. If the granular material is coarse sand, crushed limestone, or gravel, is of a uniform size, or has a low fines content, compaction should be observed to ensure that each lift is placed in the recommended thickness and compacted using proper equipment. The clean granular soils should be compacted to at least 65% of relative density until they are not observed to yield. 3. Specifically, moisture levels should be maintained to achieved compaction without bulking during placement or pumping when proofrolled.

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with the specifications for the utility be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1.5 horizontal:1 vertical projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site materials are considered suitable for backfill of utility and pipe trenches from 1 foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of controlled compacted fills, backfilling of excavations into the completed subgrade, and just prior to construction of building floor slabs.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, as well as other applicable codes, and in accordance with any applicable local, state, and federal safety regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed those specified by these safety regulations.

Construction Observation and Testing

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should be contacted to discuss mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

As noted in the **Geotechnical Characterization** existing fill soils were encountered within all of the borings completed within the building extending to depths of about 3.5 to 6 feet below existing grades; however deeper fill associated with the existing building may be encountered. Additionally, lower strength soils which are more compressible were observed in the two borings on the south side of the building. We recommend that these soils are treated with a ground improvement system referred to as rammed aggregate piers (RAPs) to increase the allowable bearing capacity and reduce the potential for settlement in the southern half of the building.

If the site has been prepared in accordance with the requirements noted in **Earthwork**, and ground improvement is performed in the southern half of the building, the following design parameters are applicable for newly constructed shallow foundations. We do not recommend that the unimproved existing fill soils be used for support of foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing pressure [1, 2]	4,000 psf
Required Bearing Stratum [3]	Granular native soils that have a minimum DCP value commensurate with an SPT N value of at least 9 blows per foot. Unimproved existing fill soils are not considered suitable for new foundations.
Minimum Foundation Dimensions	Columns: 30 inches Strip Footings: 18 inches
Sliding Resistance	-400 psf ultimate cohesion for foundation bearing directly on native clay. -0.58 ultimate coefficient of friction for foundations bearing on granular structural fill.
Minimum Embedment below Finished Grade [4]	Exterior footings for unheated buildings: 60 inches

Item	Description
	Exterior footings for heated buildings: 48 inches Interior footings in heated buildings: 18 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement from Structural Loads[5]	Approximately ½ inch

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork**.
4. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
5. Differential settlements are measured over a span of 50 feet.

Ground Improvement with Rammed Aggregate Piers

Ground improvement should be planned for in the southern half of the building based on the geotechnical data that is currently available. The extent of the ground improvement program could be refined with additional soil borings at the site to identify the extent of the lower strength, more compressible zone. Ground improvement is anticipated to consist of rammed aggregate piers or stone columns, however other systems could be applicable. Ground improvement methods are proprietary systems designed by licensed contractors who could provide further information regarding support options.

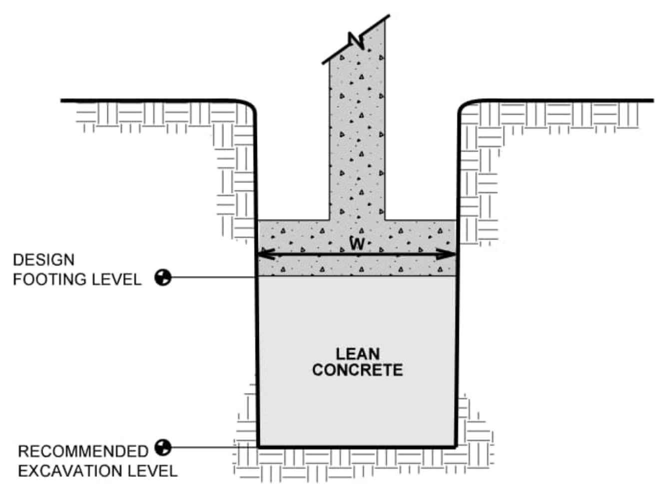
A possible ground improvement alternative that may allow more efficient shallow foundation support (i.e. higher allowable bearing pressures and/or lower estimated settlement) includes the installation of aggregate piers. An aggregate pier consists of a stone-filled column constructed by excavating a cylindrical hole and backfilling it with crushed stone placed in lifts and applying a high degree of compactive effort resulting in stone filled piers. The aggregate pier construction process not only results in a rigid stone-filled column that lends support to structures, it also helps to densify the soils surrounding the pier. Aggregate pier foundations are a proprietary product and, if considered, should be designed and installed by a specialty contractor. Due to the specialty of this soil improvement procedure, we recommend that a performance specification be used for this system. Based on our experience with these systems and the soil conditions encountered at the site, an allowable bearing pressure of 4,000 psf is likely achievable with a settlement tolerance of 1 inch.

We understand if aggregate pier foundations are utilized, the aggregate pier design firm will be the geotechnical engineer of record for these foundations. As such, the design firm would provide the necessary design parameters for the planned foundation system including, but not limited to, allowable bearing capacity, settlement estimates and foundation-specific earthwork recommendations.

Foundation Construction Considerations-Non RAP Areas

As noted in **Earthwork**, the foundation excavations should be evaluated under the direction of the Geotechnical Engineer. If unsuitable material is encountered at the planned bearing level, the material should be overexcavated and replaced. Due to the granular nature of the bearing soils, they will become disturbed by the excavation process. These granular soils should be redensified using a ho pac or diesel plate compactor prior to being evaluated. Illustrations of overexcavation and backfill can be found below. All foundation excavations should be free of water and soft/loose soil, prior to placing concrete/structural fill should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

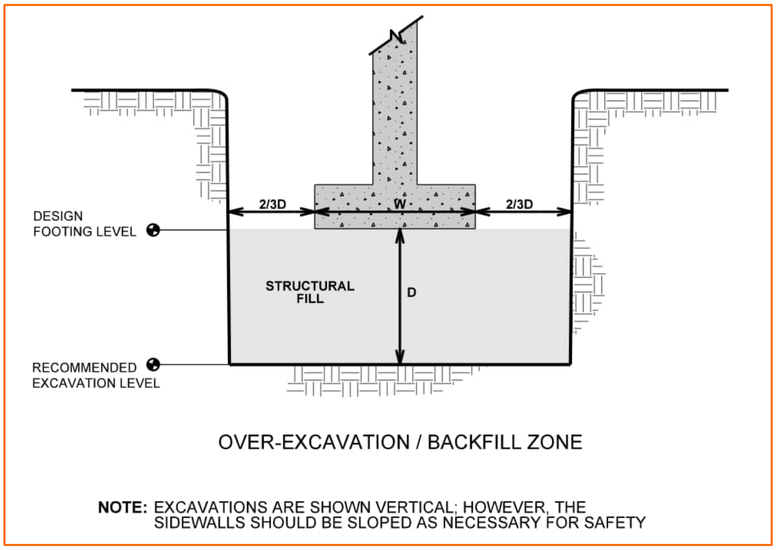
If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level, or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



LEAN CONCRETE BACKFILL

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with structural fill placed, as recommended in the **Earthwork** section.



Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab. The existing fill should be removed in its entirety from below the lower level parking floor slab and replaced with structural fill following the requirements and recommendations in the **Earthwork** section.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Native soils or new structural fill prepared in accordance with the **Earthwork** section and tested/approved by Terracon.
Granular Leveling Course	A minimum 4 inches of well-graded crushed stone meeting WisDOT Section 310 for an open graded base course material compacted to non-yielding condition
Modulus of Subgrade Reaction	100 pounds per square inch per inch (psi/in) Note: a value of 125 pci can be used at the top of the compacted granular leveling course

Item	Description

1. If the lower level parking floor slab is not used as part of the system to resist the lateral loads applied to the basement wall, it should be structurally independent of the building footings and walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation. If the floor slab will be used as part of the laterally system, it should be appropriately reinforced and detailed for the vertical and lateral loads which will be applied.

Based on the groundwater levels observed in the borings, a below slab drainage system or hydrostatic slab will be required. If a hydrostatic slab is used, then a below slab waterproof membrane should be used along with adding a water stop on the interior of the walls where it abuts the floor slab. This is in addition to the water stop used at the joint between the walls and the perimeter footings and waterproofing the basement walls.

If an under-slab drainage is planned for this project, the basement slab should be underlain by a minimum 12-inch thick drainage blanket. The drainage blanket should consist of a crushed stone meeting WISDOT Section 310 for an open graded base. A non-woven geotextile fabric with an AOS in the range of 70 to 100, should be placed on the exposed subgrade prior to placement of the drainage blanket. Minimum 6-inch diameter perforated pipes should be placed at no more than 15 feet on centers within the drainage blanket. The under-slab drainage system should be connected to a perimeter drainage system, consisting of minimum 6-inch diameter perforated pipe, placed even with the bottom of footing (located on both the inside and outside edges of the footing). The perimeter drains should be interconnected through the footings at no more than 30 feet on center. Additionally, the walls should waterproofed, and water stops should be placed in keyed joint between the wall/footing interface.

In the elevator pits, it is not recommended to install a below slab drainage system in areas where it would be hydraulically connected to adjacent drainage systems that would be at higher elevations. This would create a hydraulic gradient and could cause erosion of soil along the drainage path which would lead to lose of material and creation of significant voids. It is recommended to design these areas to be watertight with water stops or membranes at all joints to prevent water from entering into these areas from outside.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Floor slab subgrade soils should be prepared as discussed in the **Earthwork** section of this report. On most project sites, site grading is generally accomplished early in the construction phase; however, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of the granular layer and concrete, and corrective measures will be required. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

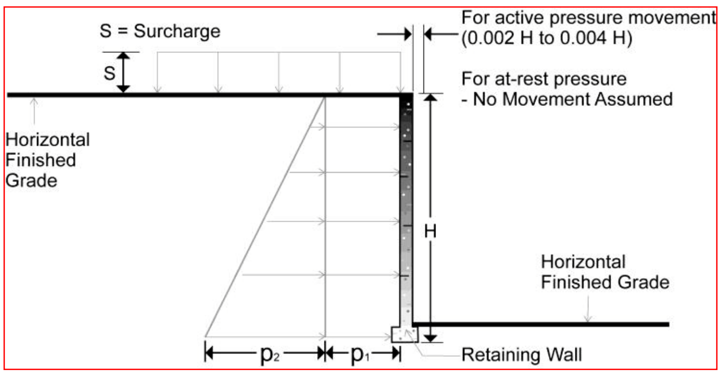
Terracon should review the condition of the floor slab subgrades immediately prior to placement of the granular leveling course and construction of the slabs. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas containing backfilled trenches. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly

Lateral Earth Pressures

Based on the preliminary drawings provided by 12 Gauge, two levels of below grade walls will be present on the north side of the site. The amount of wall which will be constructed below grade will decrease from north to south with no basement present on the southside of the building. This configuration will create a long-term unbalanced lateral pressure in the north-south direction of the building. The following sections provide recommendations for the design parameters which should be used for the evaluation of this basement walls and for an evaluation of the unbalanced condition which will be present.

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3] p_1 (psf)	Equivalent Fluid Pressures (psf) [2,4]
			Unsaturated [5]
Active (Ka)	Granular - 0.31 Fine Grained - 0.41	(0.31)S (0.41)S	(40)H (50)H
At-Rest (Ko)	Granular - 0.47 Fine Grained - 0.58	(0.47)S (0.58)S	(55)H (70)H
Passive (kp)	Granular – 3.00 Cohesive – 2.40	--- ---	(360)H (290)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. Fat clay or other expansive soils should not be used as backfill behind the wall.
2. Uniform, horizontal backfill, with a maximum unit weight of 120 pcf for cohesive soils and 130 pcf for granular soils.

Lateral Earth Pressure Design Parameters

Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3] p_1 (psf)	Equivalent Fluid Pressures (psf) [2,4]
			Unsaturated [5]

3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.

Based on our understanding of the proposed approach to use the floors within the parking level to provide lateral support for the walls, we recommend the basement walls are evaluated for the at-rest earth pressure coefficient as they will be restrained from movement. Since the floors are anticipated to be designed to resist the forces applied by the basement wall which will restrain the basement walls from lateral movement, the structural engineer should also evaluate the lateral loading using a rectangular apparent pressure distribution in addition to the triangular distribution presented above. The rectangular distribution should be a uniform pressure over the height of the wall equivalent to (40)H_{max}, where H_{max} is the maximum retained height of the wall. The more conservative loading from the rectangular and triangular distributions should be used for the sizing the wall and support elements. The overall stability of the structure in the north south direction can be evaluated using the triangular distribution.

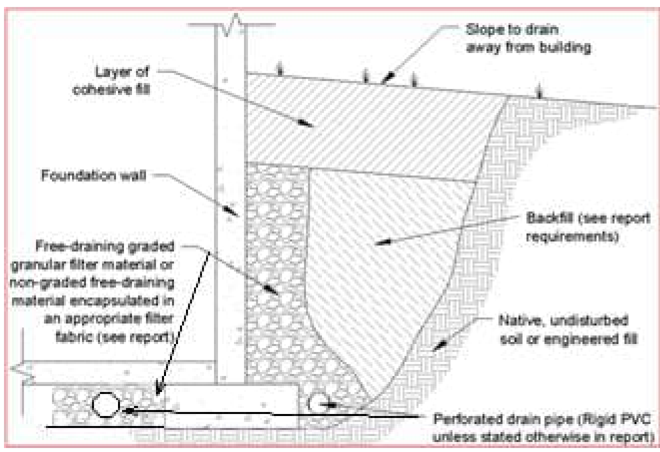
Any elevator shafts extending below finished grade of the parking garage should be designed for full hydrostatic pressures and be fully waterproofed. Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 degrees from vertical for the active case.

Footings, equipment pads, floor slabs or other loads bearing on backfill behind walls may have a significant influence on the lateral earth pressure. Placing footings within wall backfill and in the zone of active soil influence on the wall should be avoided unless structural analyses indicate the wall can safely withstand the increased pressure.

The lateral earth pressure recommendations given in this section are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls (also termed MSE walls). Recommendations covering these types of wall systems are beyond the scope of services for this assignment. However, we would be pleased to develop a proposal for evaluation and design of any wall systems upon request.

Subsurface Drainage for Below-Grade Walls

If the below grade walls are not designed to withstand full hydrostatic pressures, then it is recommended that a drainage system be installed. A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to reduce hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. Foundation drains are not considered necessary for loading dock walls where exterior grade is below the finished floor level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a prefabricated drainage structure may be used. A prefabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

Seismic Considerations

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). During this geotechnical field investigation, soil borings were completed at the site to a maximum depth of about 35 feet. The soil conditions below this depth are anticipated to be similar to those encountered in the upper 35 feet based on our experience with the geology in the vicinity of the project site. Based on the soil conditions encountered and our experience with the geology in the vicinity of the project site, **Seismic Site Classification D** can be used for the design of the proposed structures. Additional deeper borings and/or a site-specific seismic evaluation using geophysical methods would be required to further define the seismic site class.

Frost Considerations

The soils on this site are frost susceptible, and water present or migrating beneath structures in non-climate-controlled areas can affect the performance of the slabs on-grade, sidewalks and pavements. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill or structural slabs (for instance, structural stoops in front of building doors). Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs.
- Install drains around the perimeter of the building, below exterior slabs and pavements, and connect them to the storm drainage system.
- Provide underdrains within NFS backfill to prevent the accumulation of water from surface infiltration
- Grade subgrades, so groundwater potentially perched in overlying more permeable subgrades and/or engineered-fills, slope toward a site drainage system.
- Place NFS fill as backfill beneath slabs and pavements critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS fill and other soils.
- Place NFS materials in critical sidewalk areas.

As an alternative to extending NFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS material. Footings for heated structures should be 48 inches below perimeter grade and 60 inches below perimeter grade for unheated structures.

Pavements

General Pavement Comments

Estimates of minimum pavement thicknesses are provided for the traffic conditions. Site preparation is a critical aspect of pavement performance. The minimum pavement thicknesses are based on the subgrade being prepared as recommended in the **Earthwork** section.

There is often a time lapse between the end of grading operations and the commencement of paving. Subgrades prepared early in the construction process can become disturbed by construction traffic. Non-uniform subgrades often result in poor pavement performance and local failures relatively soon after pavements are constructed. Depending on the paving equipment used by the contractor, measures may be required to improve subgrade strength to greater depths for support of heavily loaded trucks. Improvements should be made as recommended in **Earthwork**.

Before paving, and were recommended by Terracon, pavement subgrades should be proofrolled in the presence of a Terracon representative. Proofrolling can be accomplished using a loaded tandem-axle dump truck with a gross weight of at least 25 tons, or similarly loaded equipment.

Designs for new pavement sections for this project have been based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support.

Pavement Section Thicknesses

All pavements should be designed for the types and volumes of traffic, subgrade, and drainage conditions that are anticipated. Terracon was not provided with anticipated traffic loading information; therefore, the traffic usage and loading should be provided to Terracon so that the thickness recommendations provided below can be verified prior to using them for final design.

The minimum thicknesses provided are based on 18-kip Equivalent Single Axle Load Applications ($ESAL_{18}$) over a 20-year design life, which are provided in the table below.

Traffic patterns and anticipated loading conditions are as follows:

Design Traffic		
Pavement Type	**Location**	**Flexible Design ESAL's Values**
Standard Duty	Passenger car parking areas	30,000
Heavy Duty	Passenger car drive areas	60,000

The following pavement design parameters were used in our evaluation of estimating minimum pavement sections for the project.

Pavement Design Input		
Input Parameter	**Asphalt**	**Concrete**
Reliability	85%	85%
Initial Serviceability	4.2	4.5
Terminal Serviceability	2.0	2.0
Standard Deviation	0.45	0.35
Load Transfer	---	3.6
Drainage	1.0	1.0

Based upon the estimated design parameters listed above, we have developed recommended minimum pavement sections for Asphaltic Concrete (AC) and Portland Cement Concrete (PCC) pavements, where the subgrade appears firm under proofrolling at the time of construction. The recommended minimum pavement sections are provided in the following table. Greater pavement and/or base course thicknesses may be required for greater expected traffic loads and volumes, or if poorer subgrade conditions are encountered.

The following table provides our estimated minimum thickness of AC pavements.

Asphaltic Concrete (AC) Design

Layer	Thickness (inches)	
	Standard Duty Pavement	**Heavy Duty Pavement**
AC Surface [1]	1.5	2
AC Binder [2]	2	2
Aggregate Base [3]	8	9

Asphaltic Concrete (AC) Design

Layer	Thickness (inches)	
	Standard Duty Pavement	Heavy Duty Pavement

1. Surface course, WisDOT Specifications for No. 4 (12.5 mm) Hot Mix Asphalt (HMA)
2. Binder course, WisDOT Specifications for No. 3 (19.0 mm) HMA
3. The base course aggregate beneath the new pavement should conform to the 1-1/4-inch Dense Graded Base listed in Section 305 of the WisDOT Standard Specifications (current edition)

The following table provides our estimated minimum thickness of PCC pavements.

Portland Cement Concrete (PCC) Design

Layer	Thickness (inches)	Thickness (inches)	
	Standard Duty Pavement	Heavy Duty Pavement [3]	Dumpster Pad [3]
PCC [1]	5	6	7
Aggregate Base [2]	6	6	6

1. Portland cement concrete pavements are recommended for roadways and areas subjected to repeated truck traffic, truck turning areas, and trash container pads. Trash container pads should be large enough to support the container and the tipping axle of the trash collection vehicle.
2. The base course aggregate beneath the new pavement should conform to the 1-1/4-inch Dense Graded Base listed in Section 305 of the WisDOT Standard Specifications (current edition).
3. PCC should be considered for areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles.

Pavement Drainage

The pavement sections provided above are based on no significant increase in the subgrade moisture contents. Paved areas should be sloped to provide rapid drainage of surface water and to drain water away from the pavement edges. Water should not be allowed to accumulate on or adjacent to the pavement, since this could saturate and soften the subgrade soils and subsequently accelerate pavement deterioration. Periodic maintenance of the pavements will be required. Cracks should be sealed, and areas exhibiting distress should be repaired promptly to help prevent further deterioration. Even with periodic maintenance, some movement and related cracking may still occur, and repairs may be required.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb and gutter directly on clay subgrade soils rather than on unbound granular base course materials.

Stormwater Management

It is our understanding that retention/detention pond is planned in the south portion of the site. The bottom of the pond is planned at elevation 877 feet. The seasonal high groundwater level for the area of the pond where the borings were conducted was observed at the ground surface (elevation ranges from 877 to 875 feet).

Stormwater management facilities are governed by the Wisconsin Department of Natural Resources Conservation Practice Standard 1002 (Site Evaluation for Storm Water Infiltration). Due to the seasonal high groundwater level being at the surface, the site would be exempt from infiltration.

Free water was observed at relatively shallow depths in each of the stormwater borings. In order to construct the ponds, it is likely that dewatering will be required. Due to the soils being granular and water bearing it is likely that well points will be required in order to lower the water levels to a minimum of 2 feet below the bottom of pond liner elevation. The well points and dewatering should remain active until the clay liner is installed and the pond is filled.

For the pond, a minimum 2-foot thick layer of engineered clay fill should be constructed. The on-site lean clays should be suitable for use as a clay liner. We do not recommend that the fat clay at the site is used for the clay liner due to the potential for drying and cracking. Clay fill materials used for liner construction should be processed to be free of clods greater than about 1 inch in size and placed in horizontal lifts of 9 inches or less in loose thickness. Each lift should be compacted to at least 95% of the maximum dry density as obtained by the standard Proctor (ASTM D698) or 92% of the maximum dry density as obtained by the Modified Proctor (ASTM D1557), or the minimum degree required to achieve the specified maximum permeability recommended below. The liner material should be uniformly moisture conditioned at the time of compaction within 0 to +4% of the optimum moisture content as determined by the standard Proctor test. The pond side slopes should be no steeper than 3H:1V.

Pockets of non-clay soils were observed throughout the site, these pockets may be observed within the bottom and side walls of the ponds. In order to find the pockets of non-clay soils, we recommend that once the bottom and side grades of the ponds are achieved that they be proofrolled by using a large rubber tire machine such as a "lull". Areas that are non-clay soils will tend to pump and rut significantly. When these non - clay soils are observed, they should be removed to allow for a minimum of 24 inches of lean clay to be compacted in lifts as stated above. Sidewalls of over-excavations should be sloped back to allow for proper benching in of the clay backfill materials.

The completed earthen liner should be protected from desiccation and cracking prior to filling the pond. If the liner becomes dry, desiccated, or cracked prior to filling or during the life of the pond, the clay liner should be scarified, moisture conditioned, and recompacted.

The clay liner should typically have a coefficient of permeability of less than or equal to $1x10^{-7}$ cm/sec. On-site or imported clay fill materials used for liner construction should have a liquid limit of 50 or less and a plasticity index of at least 15. We recommend that potential import materials be evaluated by conducting laboratory permeability tests prior to bringing the material on-site. The existing site soils are anticipated to meet the above-mentioned criteria, although some moisture conditioning will be required.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth [1]	Location
2	19 to 35[2]	North side of building area
2	30	Middle of building area
2	25	South side of building area
2	15	Stormwater Pond

1. Feet below existing ground surface.
2. Boring B-2 was terminated at 18.7 feet due to auger and sampling refusal on a boulder or possible bedrock.

Boring Layout and Elevations: Terracon personnel laid out the borings based on the planned structure locations and the locations of existing utilities which are present at the site. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±20 feet) and using existing site features.

Subsurface Exploration Procedures: The borings were advanced their full depth using continuous flight hollow stem augers. Four samples were obtained in the upper 10 feet of each boring, and at 5-foot intervals thereafter to termination depths. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples were placed in appropriate containers, taken to our laboratory for testing, and classified by the project engineer. In addition, we observed and recorded subsurface water levels during drilling and after boring completion. The borings were backfilled with bentonite chips and auger cuttings after drilling.

Our exploration team prepared field boring logs as part of standard drilling operations. These logs include sampling depths, penetration distances, and other relevant sampling information, visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Report logs were prepared from the field logs and incorporated the project engineer's interpretation of the field logs and include modifications based on observations and laboratory tests of the samples in our laboratory.

Laboratory Testing

The samples were tested in the laboratory to measure their natural water content which are provided on the boring logs in **Exploration Results**.. The samples were also classified in the laboratory based on visual observation, texture, and plasticity. The soil descriptions presented on the boring logs are in accordance with the General Notes and Unified Soil Classification System (USCS) included in **Supporting Information**. The estimated USCS group symbols for native soil samples are shown on the boring logs, and a brief description of the USCS is included in **Supporting Information**. Borings for the pond were classified using the USDA classification system.

Attachment

Site Location and Exploration Plans

Contents:

Note: All attachments are one page unless noted above.

Site Location

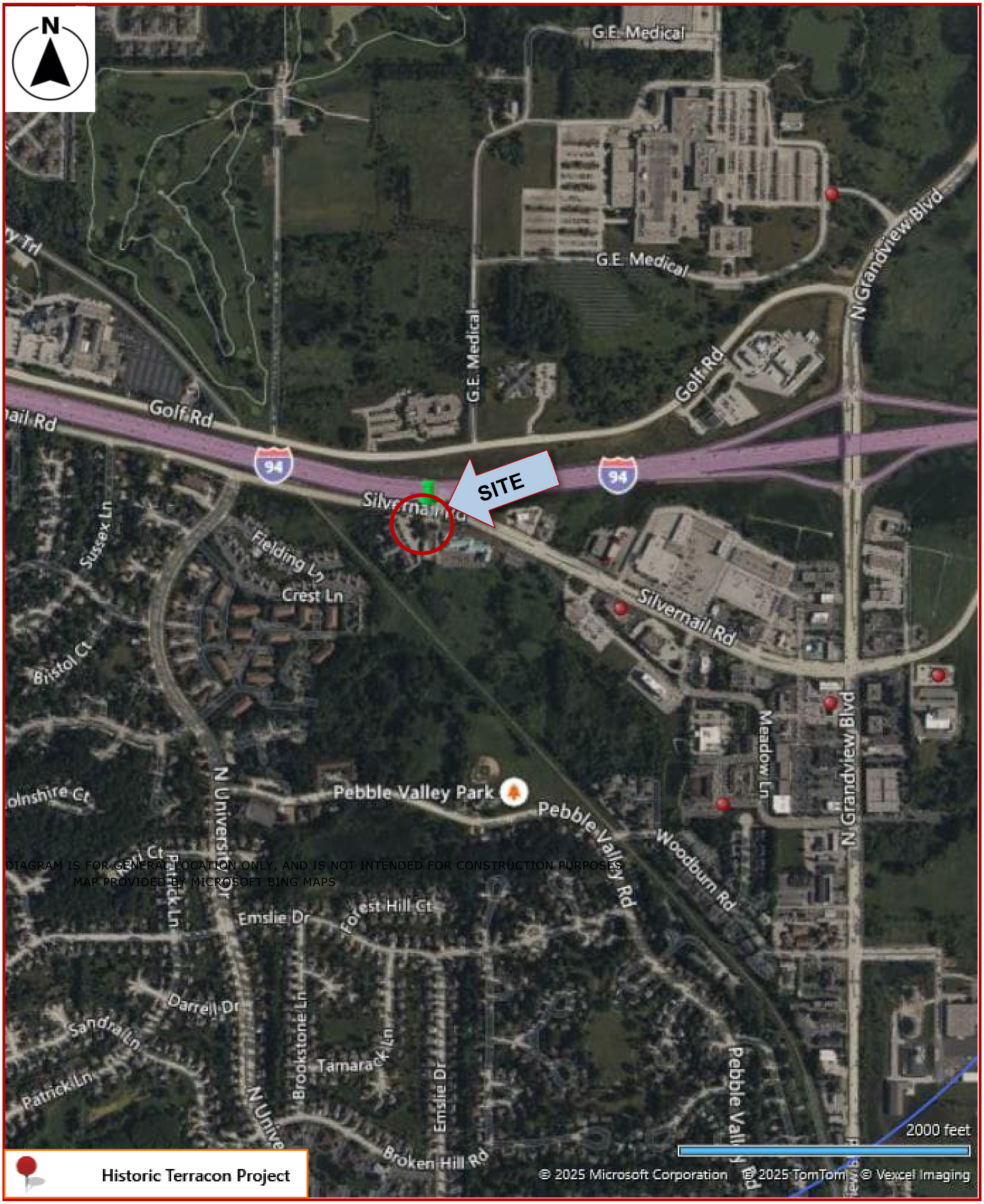


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES
MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

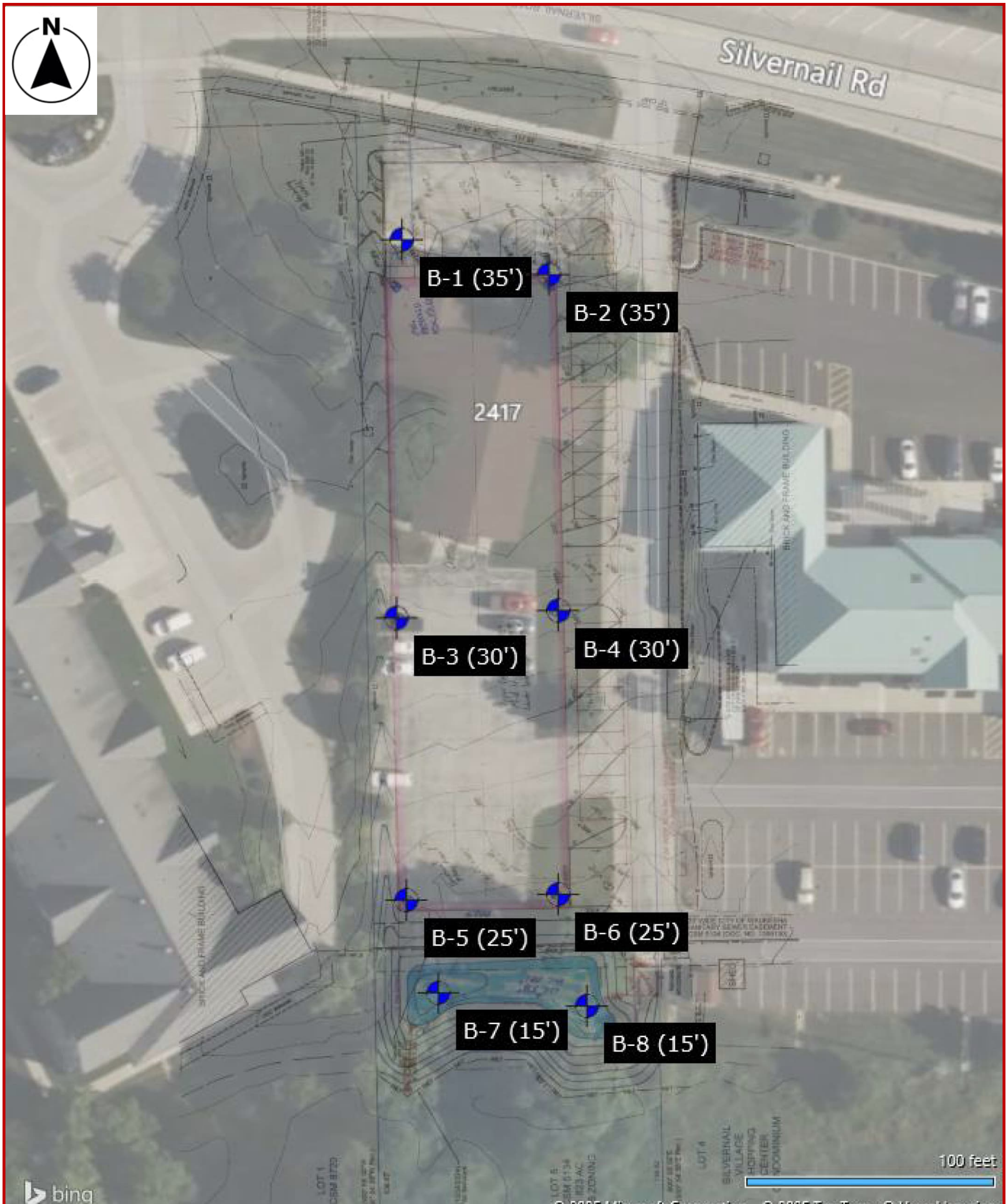


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

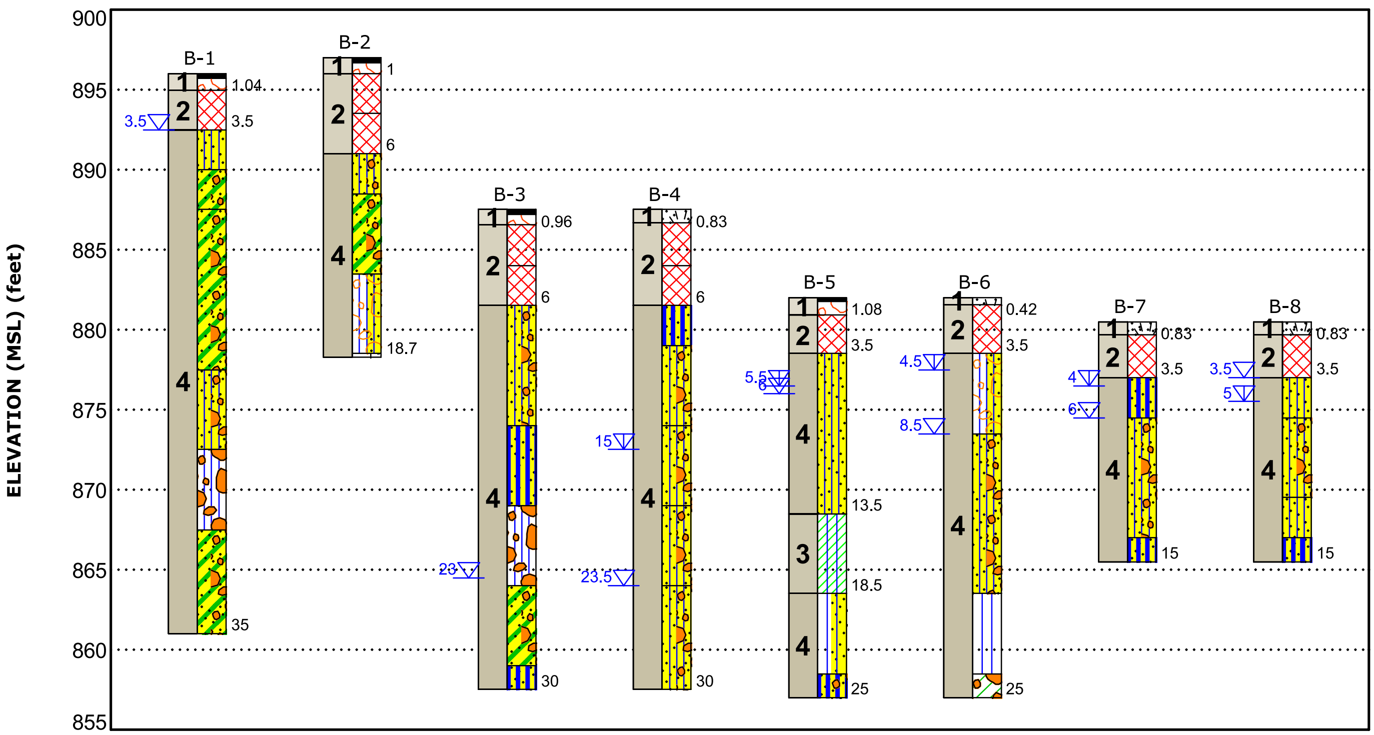
Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Surface Layer	5 to 10-inch thick topsoil, or 3 to 4 inches of asphalt over 8 to 10 inches of base course
2	Existing Fill	Brown and gray with dark brown lean clay with sand and sandy lean clay or sandy silt
3	Native Cohesive Soil	Silty clay, gray, very soft
4	Native Non-Cohesive Soils	Silty and clayey sand, gravel, or silt, loose to very dense, moist to wet.

Legend

Asphalt	Aggregate Base Course
Fill	Silty Sand
Clayey Sand with Gravel	Silty Sand with Gravel
Silty Gravel	Silty Gravel with Sand
Limestone	Sandy Silt
Topsoil	Silty Clay
Silt with Sand	Sandy Silt with Gravel
Silt	Clayey Gravel

First Water Observation
Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

Terracon
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Cudahy, WI

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 43.0452° Longitude: -88.2670°

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)
		Elevation.: 896 (Ft.)	
1	0.3	**ASPHALT**, (3.5" thick)	895.71
1	1.0	**AGGREGATE BASE COURSE**, (9" thick)	894.96
2	3.5	**FILL - LEAN CLAY**, trace sand and gravel, brown and gray	892.5
4	6.0	**SILTY SAND (SM)**, with gravel, trace clay, medium grained, brown, wet, medium dense	890
4	8.5	**CLAYEY SAND WITH GRAVEL (SC)**, trace silt, medium grained, wet, medium dense	887.5
4	18.5	**CLAYEY SAND WITH GRAVEL (SC)**, trace silt, medium to coarse grained, brown, wet, medium dense, trace weathered rock	877.5
4	23.5	**SILTY SAND WITH GRAVEL (SM)**, trace clay, medium to coarse grained, brown, wet, very dense, trace weathered rock	872.5
4		**SILTY GRAVEL (GM)**, trace clay, coarse grained, brown, wet, very dense, weathered bedrock	

Sample Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
1–2.5		X	8	1-2-3 N=5	1.25 (HP)	26.8
3.5	▽					
4–5.5		X	14	7-8-12 N=20		8.0
6.5–8		X	16	10-8-7 N=15		7.7
9–10.5		X	13	4-12-12 N=24		8.4
14–15.5		X	14	8-9-15 N=24		8.5
19–20.5		X	18	24-32-48 N=80		9.8
24–25		X	18	17-50/5"		10.8

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ 3.5 feet While drilling
No free water observed at completion of drilling

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Silvernail Apartments
2417 Silvernail Road | Pewaukee, WI
Terracon Project No. 58255267

4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 43.0452° Longitude: -88.2670°

Elevation.: 896 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
4		**SILTY GRAVEL (GM)**, trace clay, coarse grained, brown, wet, very dense, weathered bedrock *(continued)*								
	28.5	**SANDY LEAN CLAY WITH GRAVEL (SC)**, trace silt, coarse grained, gray, wet, very dense	867.5			X	9	50/5"	dist.	7.9
				30						
						X	9	50/5"	dist.	8.3
	35.0		861	35						
		Boring Terminated at 35 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
3.5 feet While drilling
No free water observed at completion of drilling

Drill Rig
7822DT

Hammer Type
Automatic

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Silvernail Apartments
2417 Silvernail Road | Pewaukee, WI
Terracon Project No. 58255267

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 43.0451° Longitude: -88.2668°

Model Layer	Depth (Ft.)	Material Description	Elevation.: 897 (Ft.)	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
1	0.3	**ASPHALT**, (4" thick)	896.67					
1	1.0	**AGGREGATE BASE COURSE**, (8" thick)	896					
2	3.5	**FILL - SANDY LEAN CLAY**, trace gravel, brown and gray	893.5	X	7	2-8-5 N=13	2.25 (HP)	14.5
2	6.0	**FILL - SILTY SAND**, trace gravel and clay, medium grained, brown, moist	891	X	9	3-3-6 N=9		10.0
4	8.5	**SILTY SAND WITH GRAVEL (SM)**, trace clay, fine to medium grained, brown, moist, medium dense	888.5	X	17	8-8-9 N=17		7.0
4	13.5	**CLAYEY SAND WITH GRAVEL (SC)**, trace silt, medium grained, brown, moist, medium dense	883.5	X	8	5-8-16 N=24		4.6
4	18.5	**SILTY GRAVEL WITH SAND (GM)**, brown, moist, very dense, trace weathered rock	878.5	X	13	8-19-33 N=52		7.1
	18.7	**Boulder or Bedrock**	878.3	X	2	50/2"		6.1

Auger Refusal on possible Boulder or Bedrock at 18.7 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
No free water observed

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 43.0448° Longitude: -88.2670°

Depth (Ft.) / Elevation.: 887.5 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)
1	0.3	**ASPHALT**, (3.5" thick)	887.21
1	1.0	**AGGREGATE BASE COURSE**, (8" thick)	886.54
2	3.5	**FILL - LEAN CLAY**, trace sand and gravel, brown and dark brown	884
2	6.0	**FILL - SANDY LEAN CLAY**, trace gravel, brown and dark brown	881.5
4	13.5	**SILTY SAND WITH GRAVEL (SM)**, medium grained, brown, moist, medium dense	874
4	18.5	**SANDY SILT (ML)**, trace gravel, gray, moist, dense	869
4	23.5	**SILTY GRAVEL (GM)**, trace sand, gray, moist, very dense, weathered bedrock	864
4		**CLAYEY SAND WITH GRAVEL (SC)**, medium grained, gray, wet, very dense	

Sample Depth (Ft.)	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
1–2.5	X	10	1-2-2 N=4		20.7
3.5–5	X	14	2-2-4 N=6		25.7
6–7.5	X	11	6-8-10 N=18		9.0
8.5–10	X	12	10-11-8 N=19		5.5
13.5–15	X	16	6-16-16 N=32		6.5
18.5–20	X	10	29-36-42 N=78		7.5
23.5	X	5	50/5"		7.6

Water Level Observations: ▽ at approximately 23 ft.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ 23 feet While drilling
No free water observed at completion of drilling

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-3

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 43.0448° Longitude: -88.2670° Depth (Ft.) Elevation.: 887.5 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
4		**CLAYEY SAND WITH GRAVEL (SC)**, medium grained, gray, wet, very dense *(continued)* 28.5 859							
		SANDY SILT (ML), trace gravel, gray, wet, very dense 30.0 857.5	30		X	11	24-50/5"		7.6
		Boring Terminated at 30 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
23 feet While drilling
No free water observed at completion of drilling

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 43.0448° Longitude: -88.2667°

Elevation.: 887.5 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)	Water Level Observations	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
1	0.8	**TOPSOIL**, (10" thick)	886.67					
2	3.5	**FILL - LEAN CLAY**, trace sand and gravel, brown	884		10	6-5-7 N=12	dist.	18.7
2	6.0	**FILL - SANDY LEAN CLAY**, trace gravel, brown and dark brown	881.5		6	3-3-5 N=8	dist.	14.6
4	8.5	**SANDY SILT (ML)**, trace clay and gravel, brown, moist, medium dense	879		14	3-3-10 N=13		9.8
4	13.5	**SILTY SAND WITH GRAVEL (SM)**, medium to coarse grained, brown, moist, medium dense	874		15	7-14-16 N=30		6.9
4	18.5	**SILTY SAND WITH GRAVEL (SM)**, trace clay, medium grained, gray, wet, dense, trace rock	869	▽ (15 ft)	18	6-15-17 N=32		6.8
4	23.5	**SILTY SAND WITH GRAVEL (SM)**, medium to coarse grained, gray and black, wet, very dense, trace black rock	864	▽ (23.5 ft)	8	10-50/5"		5.2
4		**SILTY SAND WITH GRAVEL (SM)**, medium grained, gray, wet, dense, trace clay layer			15	7-14-24 N=38		16.6

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ 23.5 feet While drilling
▽ 15 feet At completion of drilling

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 43.0448° Longitude: -88.2667°

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation.: 887.5 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
4		**SILTY SAND WITH GRAVEL (SM)**, medium grained, gray, wet, dense, trace clay layer *(continued)*			X	18	15-35-50/5"		14.7
		30.0 — 857.5	30						
		Boring Terminated at 30 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- 23.5 feet While drilling
- 15 feet At completion of drilling

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Silvernail Apartments
2417 Silvernail Road | Pewaukee, WI
Terracon Project No. 58255267

4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 43.0445° Longitude: -88.2670°

Elevation.: 882 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
1	0.3	**ASPHALT**, (3" thick)	881.75						
1	1.1	**AGGREGATE BASE COURSE**, (10" thick)	880.92						
2	3.5	**FILL - LEAN CLAY**, trace sand and gravel, brown, dark brown, and gray	878.5		X	9	2-1-3 N=4		24.5
4	13.5	**SILTY SAND (SM)**, trace gravel, medium grained, brown, wet, loose to very loose	868.5	6 feet While drilling; 5.5 feet At completion of drilling	X	10	3-3-6 N=9		17.0
					X	13	4-4-5 N=9		20.7
					X	18	2-3-5 N=8		23.2
3	18.5	**SILTY CLAY (CL-ML)**, trace sand and gravel, gray, very soft to soft	863.5		X	18	1-0-0 N=0	dist.	22.9
4	23.5	**SILT WITH SAND (SM)**, trace gravel and clay, gray, wet, medium dense	858.5		X	16	6-8-10 N=18		20.4
4	25.0	**SANDY SILT WITH GRAVEL (ML)**, gray, wet, very dense	857		X	16	12-22-31 N=53		7.7

Boring Terminated at 25 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- 6 feet While drilling
- 5.5 feet At completion of drilling

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Silvernail Apartments
2417 Silvernail Road | Pewaukee, WI
Terracon Project No. 58255267

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-6

Location: See Exploration Plan

Latitude: 43.0445° Longitude: -88.2667°

Elevation.: 882 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)
1	0.4	**TOPSOIL**, (5" thick)	881.58
2	3.5	**FILL - SANDY SILT**, trace gravel, brown and yellowish brown, medium dense	878.5
4	8.5	**SILTY GRAVEL WITH SAND (GM)**, coarse grained, yellowish brown, wet, medium dense, weathered rock	873.5
4	18.5	**SILTY SAND WITH GRAVEL (SM)**, medium grained, brown, wet, loose	863.5
4	23.5	**SILT (ML)**, trace sand and gravel, gray, wet, medium dense	858.5
4	25.0	**CLAYEY GRAVEL (GC)**, trace sand, medium grained, gray, wet, very dense, weathered rock	857

Boring Terminated at 25 Feet

Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
11	2-5-6 N=11	1.5 (HP)	16.2
8	9-11-13 N=24		10.7
2	5-8-5 N=13		13.7
11	3-1-5 N=6		17.1
18	2-3-5 N=8		15.5
18	2-6-6 N=12		21.0
3	50/3"		14.6

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
8.5 feet While drilling
4.5 feet At completion of drilling

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

4900 South Pennsylvania
Avenue, Suite 100
Cudahy, WI

Boring Log No. B-7

Location: See Exploration Plan

Latitude: 43.0444° Longitude: -88.2669°

Depth (Ft.) Elevation.: 880.5 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)	Water Level Observations	Sample Depth (Ft.)	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
1	0.8	**TOPSOIL**, (10" thick)	879.67						
2	3.5	**FILL - SANDY LEAN CLAY**, trace gravel, gray, dark brown, and brown	877		1–2.5	8	3-4-9 N=13		12.1
4	6.0	**SANDY SILT (ML)**, trace gravel and clay, brown, wet, medium dense	874.5	▽ 4 ft; ▽ 6 ft	3.5–5	10	6-6-13 N=19		12.7
4	13.5	**SILTY SAND WITH GRAVEL (SM)**, medium grained, brown, wet, medium dense to loose	867		6–7.5	11	8-10-7 N=17		13.3
					8.5–10	13	3-5-5 N=10		19.2
					11–12.5	14	3-4-5 N=9		21.0
4	15.0	**SANDY SILT (ML)**, trace clay, gray, wet, loose	865.5		13.5–15	18	1-3-4 N=7		18.6

Boring Terminated at 15 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ 6 feet While drilling
▽ 4 feet At completion of drilling

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Silvernail Apartments
2417 Silvernail Road | Pewaukee, WI
Terracon Project No. 58255267

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-8

Location: See Exploration Plan

Latitude: 43.0443° Longitude: -88.2667°

Model Layer	Depth (Ft.)	Material Description	Elevation.: 880.5 (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)
1	0.8	**TOPSOIL**, (10" thick)	879.67						
2	3.5	**FILL - LEAN CLAY WITH SAND**, dark gray, trace organics	877		X	1	3-3-4 N=7		57.5
4	6.0	**SILTY SAND (SM)**, trace gravel and clay, medium grained, brown, wet, medium dense	874.5	▽ 3.5; ▽ 5	X	9	6-6-14 N=20		17.5
4	11.0	**SILTY SAND WITH GRAVEL (SM)**, medium to coarse grained, brown, wet, medium dense to loose, trace rock from 6 feet to 8.5 feet	869.5		X	10	10-12-12 N=24		15.0
					X	14	3-1-3 N=4		20.4
4	13.5	**SILTY SAND (SM)**, trace gravel and clay, brown, loose	867		X	16	2-3-5 N=8		20.2
4	15.0	**SANDY SILT (ML)**, trace clay, gray, wet, medium dense	865.5		X	18	4-5-6 N=11		17.2

Boring Terminated at 15 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ 3.5 feet While drilling
▽ 5 feet At completion of drilling

Drill Rig
7822DT

Hammer Type
Automatic

Driller
Adam

Logged by
Mark

Boring Started
10-07-2025

Boring Completed
10-07-2025

Notes

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Wisconsin Department of Safety and Professional Services
Division of Industry Services
4822 Madison Yards Way
PO Box 7302
Madison, WI 53707

Phone: 608-266-2112
Web: http://dsps.wi.gov
Email: dsps@wisconsin.gov

Program: Plumbing
Web: https://dsps.wi.gov/Pages/Programs/Plumbing

Soil and Site Evaluation – Stormwater Infiltration

In accordance with SPS 382.365, 385, Wis. Adm. Code, and WDNR Standard 1002
Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m)]

Page 1 of 2

Attach a complete site plan on paper not less than 8 ½ x 11 inches in size. Plan must include, but is not limited to: vertical and horizontal reference point (BM); direction and percent of slope; scale or dimensions; north arrow; and BM referenced to nearest road.

PLEASE PRINT ALL INFORMATION

COUNTY: waukesha
PARCEL ID: WAKC0974045

PROPERTY OWNER: BHADHARLA BUILDERS INC
PROPERTY OWNER'S MAILING ADDRESS: 3805 WOODLAND TR
CITY, STATE, ZIP CODE: WAUKESHA, WI 53188
PHONE:

PROPERTY LOCATION
Govt. Lot ____, NE ¼, NE ¼, S 29, T 7 N, R 19 E
Lot #, Block #, Subd. Name or CSM #: ________
Municipality: Waukesha
☑ City ☐ Village ☐ Town
Nearest Road: Silvernail Rd

Drainage area __________ ☐sq. ft. ☐acres

Test site suitable for (check all that apply):
☐Site not suitable ☐Bioretention
☐Reuse ☐Subsurface Dispersal System
☐Irrigation ☐Other __________

HYDRAULIC APPLICATION TEST METHOD
☑ Morphological Evaluation
☐ Double Ring Infiltrometer
☐ Other: (specify) __________

SOIL MOISTURE
Date of soil borings: 10/07/2025
USDA-NRCS WETS VALUE:
☐ Dry = 1
☐ Normal = 2
☑ Wet = 3

B-7 #OBS. ☐ Pit ☑ Boring Ground Surface Elevation 880.5 ft. Elevation of Limiting Factor 877.0 ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.
1	42	FILL								
2	72	10YR 6/4	c,m,d 10YR 6/4	GRSL	0,sg	L	AB	35	30	0.5
3	102	10YR 6/4	NONE	XGRLFS	0,sg	L	AB	60	15	0.5
4	132	10YR 6/4	NONE	LFS	0,sg	L	AB	0	10	0.5
5	162	10YR 6/3	NONE	SCL	0,sg	L	AB	0	40	0.11
6	180	10YR 5/1	NONE	LFS	0,sg	L	AB	0	20	0.5

Comments:

B-8 #OBS. ☐ Pit ☑ Boring Ground Surface Elevation 880.5 ft. Elevation of Limiting Factor 875 ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.
1	42	FILL								
2	72	10YR 6/4	NONE	GRLFS	0,sg	L	AB	25	20	0.5
3	132	10YR 6/6	NONE	XGRLFS	0,sg	L	AB	35	15	0.5
4	162	10YR 6/3	NONE	SL	0,sg	L	AB	0	35	0.5
5	180	10YR 6/1	NONE	C	3,vco,abk	FI	AB	0	95	0.07

Comments:

water at 4 feet to 6 feet

____ #OBS. ☐ Pit ☐ Boring Ground Surface Elevation ________ ft. Elevation of Limiting Factor ________ ft.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines	Hydraulic App. Rate Inches/Hr.

Comments:

Overall Site Comments:

Paul J. Koszarek, P.E., C.S.T.
Name (Please Print)

Signature

1263130
Credential Number

4900 S. Pennsylvania Avenue, Suite 100, Cudah
Address

10/ 29 /2025
Date Evaluation Conducted

262-332-3399
Phone Number

Supporting Information

Contents:

Note: All attachments are one page unless noted above.

General Notes

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING		WATER LEVEL	FIELD TESTS	
Auger	**Split Spoon**	Water Initially Encountered	**(HP)**	**Hand Penetrometer**
Shelby Tube	**Macro Core**	Water Level After a Specified Period of Time	**(T)**	**Torvane**
Ring Sampler	**Rock Core**	Water Level After a Specified Period of Time	**(b/f)**	**Standard Penetration Test (blows per foot)**
Grab Sample	**No Recovery**		**(PID)**	**Photo-Ionization Detector**
			(OVA)	**Organic Vapor Analyzer**
			(DCP)	**Dynamic Cone Penetrometer**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Subsurface water level variations will occur over time. In low permeability soils, accurate determination of subsurface water levels is not possible with short term water level observations.

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve) Consistency determined by laboratory shear strength testing, field visual-manual procedures, or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, tsf**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 – 3	Very Soft	Less than 0.25	0 – 1
Loose	4 – 9	Soft	0.25 to 0.50	2 – 4
Medium Dense	10 – 29	Medium Stiff	0.50 to 1.00	4 – 8
Dense	30 – 50	Stiff	1.00 to 2.00	8 – 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 – 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive term(s) of other constituents	Percent (%) of dry weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major component of sample	Particle size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive term(s) of other constituents	Percent (%) of dry weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

Unified Soil Classification System

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:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**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:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					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] 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.
[D] Sands with 5 to 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.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[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 plots below "A" line.