Geotechnical Investigation

Pine Trace Golf Club

Michael Bylen
Bylen Golf Company LLC
3600 Pine Trace Boulevard.
Rochester Hills Michigan 48309

PEA Group Project No. 2024-0516

This geotechnical investigation report indicates that it is regarding a proposed development for a "*new larger clubhouse, a banquet area, new parking lot and a driving range(d) moved to the adjacent residential property*".
The Building Department site plan review comments noted on the drawings address information provided for the driving range relocation only.

PEA GROUP

PEA GROUP

1849 Pond Run
Auburn Hills, MI 48326

844.813.2949
peagroup.com

July 1, 2024
Project No.: 2024-0518

via email: michaelbylen@gmail.com

Michael Bylen
Bylen Golf Company LLC
3600 Pine Trace Boulevard.
Rochester Hills Michigan 48309

RE: Geotechnical Investigation Services
Pine Trace Golf Club
Rochester Hills, Oakland County, Michigan

Dear Mr. Bylen:

PEA Group has performed a geotechnical investigation for the redevelopment of the existing clubhouse building at Pine Trace Golf Club in Rochester Hills, Michigan. The purpose of our investigation was to determine the general subsurface conditions at the building and parking lot locations in order to provide foundation and related site preparation recommendations.

Based on our investigation, the site soils generally consist of a topsoil layer blanketing the surface of the boring locations which overlays granular layers of alternating sand and silt. Fill consisting of dark gray silty clay and brown sand was encountered at 3 of the 8 borings.

Water was encountered in seven (7) of the eight (8) soil borings during drilling activities at depths ranging from 3.5 feet bgs to 9.5 feet bgs. Water was encountered after drilling in five (5) of the eight (8) borings at depths ranging from 4 to 9 feet bgs. In two (2) of the borings water was added during drilling to combat sand heave and water levels were not obtained. We do expect any significant groundwater to be encountered during foundation construction if excavations are proposed above the water table. However, some water can be expected during utility installation or in excavations deeper than the encountered water levels. This water and any surficial runoff should easily be controllable with properly constructed sumps and pumps.

At this time, final grades have not been provided. The site generally slopes downwards from southwest to the northeast with approximately 2 feet of slope in the new club house area. The rest of the site has significant elevation changes. Therefore, we anticipate a minimal amount of earthwork will be required to balance the site and to match the adjacent parking lot grades.

The data obtained during this investigation along with our evaluations, analysis and recommendations are presented in the subsequent portions of this report.

SITE CONDITIONS AND PROPOSED CONSTRUCTION

The site for the proposed development is located at 3600 Pine Trace Boulevard, Michigan. The site is currently golf course with a club house, 18 holes and a driving range.

As the site was developed within established neighborhoods, we understand that underground utilities, such as storm and sanitary sewers, water mains and gas lines exist immediately around the proposed development. Refer to the Test Boring Location Plan for the existing site features.

The proposed development will be a new larger clubhouse, a banquet area, new parking lot and a driving ranged moved to the adjacent residential property.

Although no specific loading information was available for the proposed building, we anticipate slab-on grade construction with no basement areas or below-grade pits. We assume typical light construction loads for the proposed building. We anticipate that the proposed building will be a one-story building with a new outdoor driving range, a parking lot, and loads not exceeding 75 kips for interior columns and 3,000 pounds per liner foot for walls.

Since the site is relatively flat within the proposed building envelope, we anticipate minimal cuts and fills to achieve design grades for the area where the proposed building will be constructed. We also understand that any existing underground utilities would be reused, if applicable. Bituminous concrete pavement will be added to the site for parking areas..

REGIONAL GEOLOGY AND SEISMIC ACTIVITY

A review of available sources indicates that several ice sheets (i.e. glaciers) advanced and retreated over the site with the most recent being during the late Wisconsin period. Hydrogeologic Atlas of Michigan, the site soils were generally deposited as end moraines of medium-textured till. According to the 1981 Hydrogeologic Atlas of Michigan, the top of rock is at approximately Elevation 600 feet, about 225 feet bgs.

Southern Michigan and Rochester Hills are considered to have a relatively low seismic risk. The appropriate geotechnical design considerations for seismic conditions should be applied based on the Michigan Building Code. Based on our interpretation of the test borings and understanding of the soil conditions below the depth of exploration, we recommend the site be classified as a Class D Site.

FIELD INVESTIGATION

We investigated subsurface conditions at the site by drilling 8 test borings, designated TB-1 to TB-8. DLZ Drilling Company drilled the test borings on May 8, 2024. TB-1 and TB-2 were drilled to a depth of 20 feet bgs within the proposed building envelope. TB-3 through TB-8 were drilled to a depth of 10 feet bgs within the proposed parking lot and new driving range. The test borings were located in the field by measuring from existing surface features. The locations are shown on the Test Boring Location Plan. Ground surface elevations were estimated from Google Earth.

The borings were advanced with 3 ¼ inch outside-diameter hollow stem auger. Soil samples were taken at intervals of generally 2.5 feet within the upper 10 feet and at 5-foot intervals below 10 feet. Samples were taken in accordance with the Standard Penetration Test method (ASTM D-1586).

The soil samples obtained with the split-barrel sampler were sealed in containers and transported to our laboratory for further classification and testing. We will retain these soil samples for 60 days after the date of this report. At that time, we will dispose of the samples unless otherwise instructed.

PRESENTATION OF DATA

We evaluated the soil and groundwater conditions encountered in the test borings and have presented these conditions in the form of individual Logs of Test Borings on Figures 1 through 8. The nomenclature used on the boring logs and elsewhere are presented on the Soil Terminology sheet, Figure 9. The stratification shown on the test boring logs represents the soil conditions at the actual boring locations. Variations may occur between the borings. The stratigraphic lines represent the approximate boundary between the soil types, however, the transition may be more gradual than what is shown.

The thickness of pavements and base courses should be considered approximate. Mixing of these materials occur in the drilling process, and deteriorated asphalt can appear as base. Pavement cores should be performed to obtain accurate thicknesses and condition of asphalt pavement and base courses if such information is needed. We have prepared the logs included with the report on the basis of field classification supplemented by laboratory classification and testing.

LABORATORY TESTING

The soil samples obtained from the test borings were also classified in our laboratory. Selected samples were tested to determine natural moisture contents. Testing was performed in accordance with current ASTM standards. The results of these tests are presented on the individual Logs of Test Borings.

In addition to the laboratory testing, pocket penetrometer measurements were made on the cohesive soil samples obtained from the test boring as an aid in evaluating their unconfined compressive strengths. The pocket penetrometer readings are indicated on the boring logs.

SOIL CONDITIONS AND EVALUATIONS

From the information obtained during this investigation, subsoil conditions are generally similar throughout the site. A topsoil layer blankets the surface of the boring locations which overlays granular layers of alternating sand and silt. Fill consisting of dark gray silty clay and brown sand was encountered at 3 of the 8 borings.

The topsoil encountered was black, silty sand. It ranged from 4 to 12 inches thick. We do not consider the topsoil suitable for support of foundations floor slabs, pavement or engineered fill. It should be removed from these areas. It can be reused in landscaped areas.

Fill is present at 3 of the borings locations. The fill consists of brown sandy clay and dark gray silty clay and sand. The fill was encountered at depths ranging from 3.5 to 6 feet bgs. The encountered fill is variable composition and consistency. The fill material can be reused for the support of floor slabs, pavement or to be reused as engineered fill providing the earthwork recommendations in the Site Preparation section of this report are followed. The existing fill is not suitable for foundation support or for the support of engineered fill for foundation supports. Reuse of the fill as common fill below pavements or floor slabs is acceptable, if some potential for settlement of the pavement surface can be tolerated. If settlement is to be virtually eliminated, the fill material must be removed and replaced with properly placed and compacted engineered fill.

Underlying the topsoil and fill, native granular soils were encountered and generally consist of silty sands and sandy silts. These granular soils were in a compact to loose condition.

Underlying the topsoil and in some cases, upper fill soils, a granular soil stratum was encountered and extended through the termination of the borings. The granular soil stratum comprises of loose to compact

sands and silts with varying amounts of clay and gravel. The granular soils encountered contain N-Values ranging from 4 to 37. In general, the relative density of the native granular soils decrease with depth. The native soils underlying the pavement section and existing fill are considered suitable for the direct support of foundations, floor slabs, pavement, and for reuse as compacted fill.

At boring TB-7, underlying the fill and topsoil, silty clay was encountered. The silty clay was in a stiff to hard condition and included some sand.

SITE PREPARATION

We recommend that all earthwork operations be performed under adequate specifications and be properly monitored in the field. We expect the earthwork to consist of minimal cuts and fills to bring the site to grade preparing for floor slabs and pavement. We recommend the following earthwork operations be performed.

- Any surface vegetation should be cleared. Topsoil or any other organic soils, if encountered, should be removed in their entirety from the building and parking areas.

- If fill is excavated in the area of the building envelope and it appears the soil underneath is wet, pumping may be required, and open graded stone and separator fabric be placed as part of the backfill.

- The existing pavement should be pulverized and removed in its entirety within the proposed building envelope.

- Abandoned utilities inside the proposed building should be removed in their entirety. Outside the building area, the abandoned utilities should either be removed or bulkheaded.

- Where cohesive soils are present prior to fill placement in fill areas, and after rough grade has been achieved in cut areas, the cohesive subgrade should be thoroughly proof-rolled. A heavy rubber-tired vehicle such a loaded dump truck should be used for proof-rolling.

- Where granular soils are exposed prior to fill placement in fill areas, and after rough grade has been achieved in cut areas (if any), the subgrade should be thoroughly compacted with vibratory roller by making a minimum of 10 passes in each of two perpendicular directions covering the proposed floor area. In addition to detecting unstable areas, the proof-compaction operation should serve to densify the shallow granular deposits that overlie the site.

- We expect that some areas of the site will not proof-roll satisfactorily. Any areas that exhibit excessive pumping and yielding during proof-rolling and compaction should be stabilized by aeration, drying, and compaction if weather conditions are favorable, or removal and replacement with engineered fill (undercutting).

- Undercutting can include the use of geotextiles and geogrids. Removing wet pumping soils to find suitable stable soil may not work on this site. Thus, in order to backfill an undercut excavation, 1-inch by 3-inch concrete or a geogrid is recommended to stabilize the bottom before the refilling process begins. Using 1-inch by 3-inch aggregate may require the installation of underdrain from the undercut to the nearest drainage structure. Soil Stabilization by chemical methods may also be an option.

- Following proof rolling and repair of unsuitable subgrade areas, the upper foot of the subgrade should be compacted to 90 percent of the maximum dry density as determined by the Modified Proctor Compaction Test, (ASTM D-1557) prior to placement of engineered fill.

We recommend materials meeting the following criteria be used for backfill or engineered fill to achieve design grades:

- The material should be non-organic and free of debris.

- Frozen material should not be used as fill nor should fill be placed on a frozen subgrade.

- The on-site soils may be used for engineered fill provided that they are approximately at the optimum moisture content. The silty clay soils may require aeration and drying before they can be properly compacted.

- Some of the granular deposits on the site may meet the requirements for granular fill, and may be re-used accordingly. Due to the varying nature of the soil on this site, the soil should be inspected for its conformance to MDOT gradation requirements before being used in an application with restricted granular fill requirements.

- Free-draining granular soils should be used for trench backfill and in confined spaces.

- Pea gravel is not recommended as engineered fill. Although pea gravel can easily be compacted, since it is rounded and very narrowly graded, it is unstable under wheel loads. In order to support loads, it must be confined laterally.

- Common Fill: The on-site soils may be used for common fill material. Common fill should be used in large areas that can be compacted by large earth moving equipment.

- Granular Fill: Granular fill should be used in confined areas such as trenches and backfill around foundations. Granular fill should meet the following gradation:

Sieve Size	**Percent Passing**
6 inch	100
3 inch	95-100
Loss by Wash	0-15

MDOT Class III meets the requirements for Granular Fill.

Alternately the following also can be used:

Sieve Size	**Percent Passing**
3 inch	100
1 inch	60-100
No. 30	0-30
Loss by Wash	0-10

MDOT Class II meets the requirements for Granular Fill. Some restrictions apply to some applications

- Sand-Gravel Fill: Sand-gravel fill should be used where free-draining material is required. Free-

draining material is recommended for underfloor fill and retaining wall backfill. Sand and gravel fill should meet the following gradation:

Sieve Size	Percent Passing
2 inch	100
1/2 inch	45-85
No. 4	20-85
No. 30	5-30
Loss by Wash	0-5

MDOT Class I material meets the requirements for sand and gravel.

- Crushed Stone Fill: Crushed stone fill should be used for aggregate base and for any over-excavated foundations. Crushed stone should meet the following gradations:

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	85-100
1/2 inch	50-75
No. 8	20-45
Loss by Wash	0-10

MDOT 21AA meets the gradation.

The fill should be placed in uniform horizontal layers. The thickness of each layer should be in accordance with the following:

Compaction Method	Maximum Loose Lift Thickness
Hand-operated vibratory plate or light roller In confined areas	4 inches
Hand-operated vibratory roller weighing at Least 1,000 pounds	6 inches
Vibratory roller drum roller, minimum dynamic Force, 2,000 pounds	9 inches
Vibratory drum roller, minimum dynamic force, 30,000 pounds	12 inches
Sheeps-foot roller	8 inches

The vibrating roller thicknesses indicated are for compacting granular soils. The lift thicknesses may be increased if field compaction testing demonstrates the specified compaction is achieved throughout the lift.

The fill should be compacted to achieve the specified compaction percentage of the maximum dry density as determined by the Modified Proctor compaction test (ASTM D-1557). The specified compaction for fill placed in various area should be as follows:

Area	Percent Compaction

Within building	95
Below foundations	95
Pavement base	95
Within one foot of pavement subgrade	95
Below one foot of pavement subgrade	92
Landscaped area	88

Trench backfill shall also be compacted to the above standards. The building is considered to extend 10 feet beyond the foundations of the structure. Pavement is considered to extend 5 feet beyond the edge plus a one-on-one slope to the original grade.

The site conditioning procedures discussed above are expected to result in fairly stable subgrade conditions throughout most of the site. However, the on-site silty cohesive soils are sensitive to softening when wet or disturbed by construction traffic. Depending on weather conditions and the type of equipment and construction procedures used, surface instability may develop in parts of the site. If this occurs, additional corrective procedures may be required, such as in-place stabilization or undercutting. Surface instability for pavement preparation commonly results from poor surface water management as the building is constructed, underground utilities are installed, and when sensitive subgrades are not protected from excessive construction traffic. Corrective procedures can be limited by careful attention to water management and construction traffic.

If site conditioning and earthwork operations are to be performed during wet or cold weather (i.e. any time other than late spring to early fall), significant difficulty should be anticipated in drying or stabilizing the on-site silty cohesive clay soils. Under such circumstances, it may become necessary to undercut the wet soils and backfill with clean granular soils to achieve proper stabilization.

If site preparation operations are performed during dry summer months, it may be possible to stabilize wet soils in place and to use cohesive soils as fill with proper conditioning and moisture control in the field. However, using on-site cohesive soils that require moisture conditioning as engineered fill may not be cost effective.

FOUNDATION RECOMMENDATIONS

Based on an evaluation of the subsurface data obtained and successful completion of the earthwork procedures previously outlined, we recommend that the proposed building be supported on shallow spread and/or strip footings. Foundation excavations adjacent to utilities, streets, driveways, and sidewalks require caution, and care shall be given. Care must be exercised when making excavations adjacent to the existing structure to minimize lateral soil movements and the potential undermining of existing foundations. In addition, the new and existing building sections should be structurally separate to allow for independent movements.

Exterior footings should be founded at a depth of at least 3.5 feet below the exposed finished grade for protection against frost penetration. Interior footings not exposed to frost penetration during or after construction can be installed at shallower depths provided that suitable bearing soils are present. Our borings in the building did not encounter fill depth greater than 42”, however, should fill be encountered at a depth greater than 42”, the foundation will need to extend deeper than 42” or engineered fill will need to be used to replace the existing fill based on the methods described in the site preparation section of this

report. To help mitigate frost heave, the sides of all footings should be vertical, and not be allowed to be larger at the top.

Adjacent spread footings at different levels should be designed and constructed so that the least lateral distance between them is equivalent to or more than the difference in their bearing levels. To achieve a change in the level of a strip footing, the footing should be gradually stepped at a grade no steeper than two units horizontal to one unit vertical.

We recommend a uniform net allowable soil bearing pressure of 2,000 pounds per square foot (psf) be used for the design of footings bearing on undisturbed native soil and engineered fill. In using a net allowable soil pressure, the weight of the footing, backfill over the footing, or floor slabs need not be included in the structural loads for sizing footings. However, strip footings should be at least 12 inches in width, and isolated spread footings should be at least 18 inches in their dimension, regardless of the resulting bearing pressure. All foundation excavations should be observed and tested to verify that adequate in-situ bearing pressures, compatible with the design value, are achieved.

If the recommendations outlined in this report are adhered to, total and differential settlements for the completed structure should be within approximately 1 inch and 1/2 inches, respectively. We recommend that all strip footings be suitably reinforced to minimize the effects of differential settlements associated with local variations in subsoil conditions.

GROUNDWATER CONDITIONS AND CONTROL

Water was encountered in seven (7) of the eight (8) soil borings during drilling activities at depths ranging from 3.5 feet bgs to 9.5 feet bgs. Water was encountered after drilling in five (5) of the eight (8) borings at depths ranging from 4 to 9 feet bgs. In two (2) of the borings water was added during drilling to combat sand heave and water levels were not obtained. We expect some groundwater to be encountered during any construction below the groundwater surface. However, some water can be expected during utility installation or in excavations deeper than the encountered water levels. This water and any surficial runoff should easily be controllable with properly constructed sumps and pumps.

The results of the individual water level measurements are shown on the respective Logs of Test Borings. Fluctuations in groundwater levels should be anticipated due the seasonal variations and following periods of prolonged precipitation or drought.

FLOOR SLABS

The subgrade resulting from the satisfactory completion of site preparation operations can be used for the support of concrete floor slabs. Based on the proposed / anticipated finish floor grade, the slab may be supported by existing fill, engineered fill, and or native soils. A modulus of subgrade reaction, k, of 100 pounds per cubic inch may be used for design. We recommend that all concrete floor slabs be suitably reinforced and separated from the foundation system to allow for independent movement. If floor settlement is to be virtually eliminated, the existing fill deposits would have to be removed in their entirety and replaced with engineered backfill.

We recommend a porous granular blanket consisting of MDOT Class I/II sand or 21AA aggregate base at least 4 inches thick under the floor slab. We also recommend a vapor barrier for floor covering materials affected by moisture from the subgrade, such as us typically found in office areas. Where warranted, the slab designer and contractor should refer to American Concrete Institute (ACI) 302 and 360 for guidance in use and placement.

PAVEMENT CONSIDERATIONS

The subgrade resulting from the satisfactory completion of site preparation operations can also be used for the support of pavements. The shallow granular subgrade soils consist of silt and sand which can be classified as SM or ML, according to the Unified Soil Classification System (USCS). Soils of these types tend to have poor drainage characteristics, are frost susceptible, and can be unstable under repeated loading. Although sand was encountered throughout most of the site, the clay soils control the design of the pavement due to its proximity to the ground surface. Based on the results of our investigation and the anticipated frost and moisture conditions, these soils may be assigned an estimated California Bearing Ratio (CBR) value of 3 for the design of pavements.

Criteria for an engineered design has not been furnished. In addition to traffic loads, criteria also includes the design life, reliability and defining the condition at the end of the design period. We anticipate that both a light and heavy duty conventional pavement section consisting of asphalt with aggregate base will be used. In addition, a concrete pavement may be used for parking and truck traffic areas.

Typical pavements for similar projects have included:

Conventional Asphalt on Aggregate Base

Parking:	1.5 inches of 5E1 Asphalt Surface Course 2.5 inches of 4E1 Asphalt Leveling Course 8 inches of Aggregate Base
Heavy Duty Drive Areas:	1.5 inches of 5E1 Asphalt Surface Course 1.5 inches of 4E1 Asphalt Leveling Course 2 inches of 4E1 Asphalt Base Course 10 inches of Aggregate Base

Portland Cement Concrete on Aggregate Base

Parking:	6 inches of Portland Cement Concrete 4 inches of Aggregate Base
Heavy Duty Drive Areas:	8 inches of Portland Cement Concrete 4 inches of Aggregate Base

Acceptable asphalt pavement mixes should be sourced from a registered and approved Michigan Department of Transportation (MDOT) supplier and meet the specifications for MDOT Low Volume Super Pave mixes. The aggregate base should meet criteria for MDOT 21AA.

The above aggregate base thicknesses are based on using natural aggregate as discussed in the Site Preparation Section. At present the readily available natural aggregate is limestone. If crushed concrete is used, it should meet all the MDOT requirements for gradation that includes the loss by wash and percent building material. **We recommend increasing the aggregate layer thickness by 20% when using crushed concrete instead of natural stone.**

For pavements, we recommend that “stub” or “finger” drains be provided around catch basins and other low parts of the site to minimize the accumulation of water above and within the frost susceptible subgrade soils. We also recommend edge drains along parking perimeters where upgrade surface water can flow onto or under pavement. Consideration should also be given to providing subdrains around the perimeter of any proposed landscaped islands within the parking area since they can become a source of water

infiltration into the pavement. Such subdrains could be connected to nearby catch basins. The pavement should be properly sloped to promote effective surface drainage and prevent water ponding.

The pavement recommendations provided in this report are intended to provide serviceable pavement for about 20 years. However, all pavements require regular maintenance and occasional repairs. The need for such maintenance is not necessarily indicative of premature pavement failure. If such activities are not performed in a timely manner, the service life of the pavement can be substantially reduced. Most pavements require preservation treatments about 5 years into their life from environmental causes.

In trash dumpster pick-up areas within the asphalt pavement areas, heavy concentrated wheel loads will be subjected upon the pavement. This type of activity frequently results in rutting of asphalt pavement and ultimately can lead to premature failure. Therefore, we recommend that suitably reinforced concrete pavement at least 8 inches in thickness be given consideration in these areas. Asphalt pavement in truck unloading areas may also experience rutting due to forklift traffic and/or truck turning movements. We recommend that concrete pavement also be placed in such areas.

FIELD MONITORING

Soil conditions at the site could vary from those generalized on the basis of test borings made at specific locations. We recommend that a qualified geotechnical engineer be retained to provide soil engineering services during the site preparation, excavation, and foundation phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations. Also, this allows modifications to the made in the event that subsurface conditions differ from those anticipated prior to the start of construction. Additionally, material testing should be done prior to and during subgrade preparation and utility construction (i.e. materials suitability assessment of on-site and imported fill, compaction testing, asphalt and concrete testing, etc.).

The foundation installations should also be monitored and evaluated by a qualified engineer or soils technician to ensure that the bearing material is consistent with the design bearing intended by the geotechnical report engineer. The on-site review of the condition of the bearing soils as the foundations are constructed is an integral part of the geotechnical design function.

LIMITATIONS OF THE REPORT

This report is intended solely for the use of Bylen Golf Company LLC and other parties explicitly identified in this report. It is prohibited for others to use this report without the explicit written consent of PEA. Any unauthorized reuse, redistribution of or reliance on this report shall be at Bylen Golf Company LLC and recipient’s sole risk without liability to PEA. Bylen Golf Company LLC shall defend, indemnify and hold PEA Group harmless from any liability arising from or related to Client’s unauthorized distribution of the report. No portion of this report may be used as a separate entity; it is to be read in its entirety and shall include all supporting drawings and attachments.

The recommendations made in this report are in accordance with our present understanding of the project and the current site use, conditions and ground surface elevations. Our recommendations are based on the work scope approved by Bylen Golf Company LLC and described in this report. The services were performed in a manner consistent with the level of analysis typically exercised by geotechnical engineering professionals currently practicing under similar conditions in the same locality. No other representations and no warranties or representations of any kind, either expressed or implied, are made. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

By issuing this report, PEA Group is the geotechnical engineer of record. It is recommended that PEA Group be retained during construction and earthwork operations to confirm the conditions of the subsoil are actually similar to those observed during construction and our interpolations were correct. The intent of this requirement is to verify that conditions encountered during construction are consistent with the findings in the report and that inherent knowledge developed as part of our study is correctly carried forward to the construction phases.

It is important to emphasize that a subsurface investigation is a random sampling of the site and the comments included in this report are based on the results obtained at the test locations only. The subsurface conditions may vary at other locations than what was observed in our soil borings. The subsurface conditions can be significantly altered due to construction activities or by exposing the soils to humidity, dry periods or frost. Soil and groundwater conditions between and beyond the soil boring locations may differ both horizontally and vertically from those encountered at the soil borings; these conditions may become apparent during construction which could not be detected or anticipated at the time of our investigation. Should any conditions at the site encountered during construction differ than those encountered during this investigation, we request that we be notified immediately in order to reassess our recommendations. If changed conditions are encountered during construction, no matter how minor, the recommendations in this report shall be considered invalid until a sufficient review is completed by PEA Group and is documented in a written form.

GENERAL COMMENTS

We have formulated the evaluations and recommendations presented in this report, relative to site preparation and building foundations, on the basis of data provided to us relating to the location of the proposed building and parking lot. Any significant change to this data should be brought to our attention for review and evaluation with respect to the prevailing subsurface conditions.

The scope of the present investigation was limited to evaluation of subsurface conditions for the support of building foundations, pavements, and other related aspects of development. No chemical, environmental, or hydrogeological testing or analysis was included in the scope of this investigation.

If you have any questions regarding this report, or if we may be of further assistance to you in any respect, please feel free to contact us. We appreciate the opportunity to have been of service to you.

Sincerely,
PEA Group

Brendon Junge, PE
Project Manager

D. Jack Sattelmeier, PE
Director of Geotechnical Engineering

Attachments: Log of Test Boring
Soil Terminology
Boring Location Map

PEA GROUP

LOG OF TEST BORING NO. TB-1

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard, Rochester Hills, Michigan*

PEA Job No.: *2024-0518*
Reviewed by: *DJS*

GROUND SURFACE ELEVATION 835

Elevation	Depth (Feet)	Subsurface Profile	Sample	Blows /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
	0	TOPSOIL: Black Silty Sand							
834	0.4	FILL: Dark Gray Sand, Little to Some Clay and Silt	1-S	6 12 6	18	10			
	3								
831		FILL: Gray Silty Clay, Trace Gravel and Sand	2-S	3 13 12	25	13			
	6								
828	6.0	Stiff Brown SANDY CLAY, Little to Some Silt, Trace Gravel	3-S	2 1 3	4	13			
	8.5								
	9		4-S	2 5 6	11				
825		Medium Compact Brown SILTY SAND							
	12								
822		Compact Brown SILTY SAND	5-S	11 17 15	32				
	15								
819		Compact Gray SILTY SAND							
	18								
816	18.5	Compact Gray SILT, Little Sand	6-S	14 16 26	32	20			
		End of Boring							
	21								

Total Depth: *20*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/8/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *6 ft.*
After drilling: *N/A*

Notes: **Pocket Penetrometer*
Water added to hole to combat heave @ 7.5 ft.

PEA GROUP

LOG OF TEST BORING NO. TB-2

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard, Rochester Hills, Michigan*

PEA Job No.: *2024-0518*
Reviewed by: *DJS*

SUBSURFACE PROFILE — **GROUND SURFACE ELEVATION 834**

Elevation	Depth Feet	Description
834	0	TOPSOIL: Black Silty Sand
	0.6	
		FILL: Dark Gray Silty Clay, Trace Gravel and Sand
831	3	
		FILL: Black and Brown Sand, Trace to Little Silt
828	6	
	6.0	
		Medium Compact Gray SILTY SAND
	8.5	
825	9	
		Loose Brown SAND, Little to Some Silt
822	12	
	13.5	
		Medium Compact Gray SANDY SILT
819	15	
816	18	
	18.5	
		Compact Gray SILT
		End of Boring
813	21	

SOIL SAMPLE DATA

DEPTH FEET	SAMPLE	BLOWS /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
0							
	1-S	6 7 4	11	12			
3							
	2-S	2 1 5	6	19			
6							
	3-S	4 8 8	16				
9							
	4-S	2 4 4	8				
12							
	5-S	7 10 13	23	24			
15							
18							
	6-S	12 20 17	37	15			
21							

Total Depth: *20*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/7/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *6 ft.*
After drilling: *N/A*

Notes: **Pocket Penetrometer*
Water added to hole to combat heave @ 10 ft.

PEA GROUP

LOG OF TEST BORING NO. TB-3

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard*
Rochester Hills, Michigan

PEA Job No.: *2024-0518*
Reviewed by: *DJS*

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION 833

Elevation	Depth (ft)	Description
	0	TOPSOIL: Black Silty Sand
	0.5	
831		Hard Brown SILTY CLAY, Trace Gravel, Occasional Sand Seams
	3	
		Hard Gray SILTY CLAY, Trace Gravel and Sand
	4.5	
828		
	6	Medium Compact Brown SAND, Trace to Little Silt
825		
	8.5	
	9	Loose Gray SILT
		End of Boring
822		
	12	
819		
	15	
816		
	18	
813		
	21	

SOIL SAMPLE DATA

DEPTH FEET	SAMPLE	BLOWS /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
0							
	1-S	4 6 9	15	13		*9000	
3							
	2-S	3 10 9	19	17		*9000	
6							
	3-S	2 7 6	13				
9							
	4-S	5 5 2	7	24			
12							
15							
18							
21							

Total Depth: *10*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/7/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *4.5 ft.*
After drilling: *4 ft.*

Notes: **Pocket Penetrometer*

LOG OF TEST BORING NO. TB-4

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard*
Rochester Hills, Michigan

PEA Job No.: *2024-0518*
Reviewed by: *DJS*

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION 839

Elevation	Depth (Feet)	Description
	0	TOPSOIL: Black Silty Sand
	0.5	
837		FILL: Dark Gray Silty Clay
	3.5	
834		Very Stiff Brown SILTY CLAY, Trace Gravel and Sand
	6.0	
831		Medium Compact Gray SILTY SAND
	8.5	
		Very Stiff Gray SILTY CLAY, Trace to Little Gravel and Sand
		End of Boring
828		
825		
822		
819		

SOIL SAMPLE DATA

DEPTH FEET	SAMPLE	BLOWS /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
0							
	1-S	3 4 4	8	20			
3							
	2-S	2 5 5	10	14		*4000	
6							
	3-S	3 7 8	15				
9	4-S	3 5 7	12	9		*8000	
12							
15							
18							
21							

Total Depth: *10*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/7/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *6 ft.*
After drilling: *9 ft.*

Notes: **Pocket Penetrometer*
Collapse @ 7 ft.

PEA GROUP

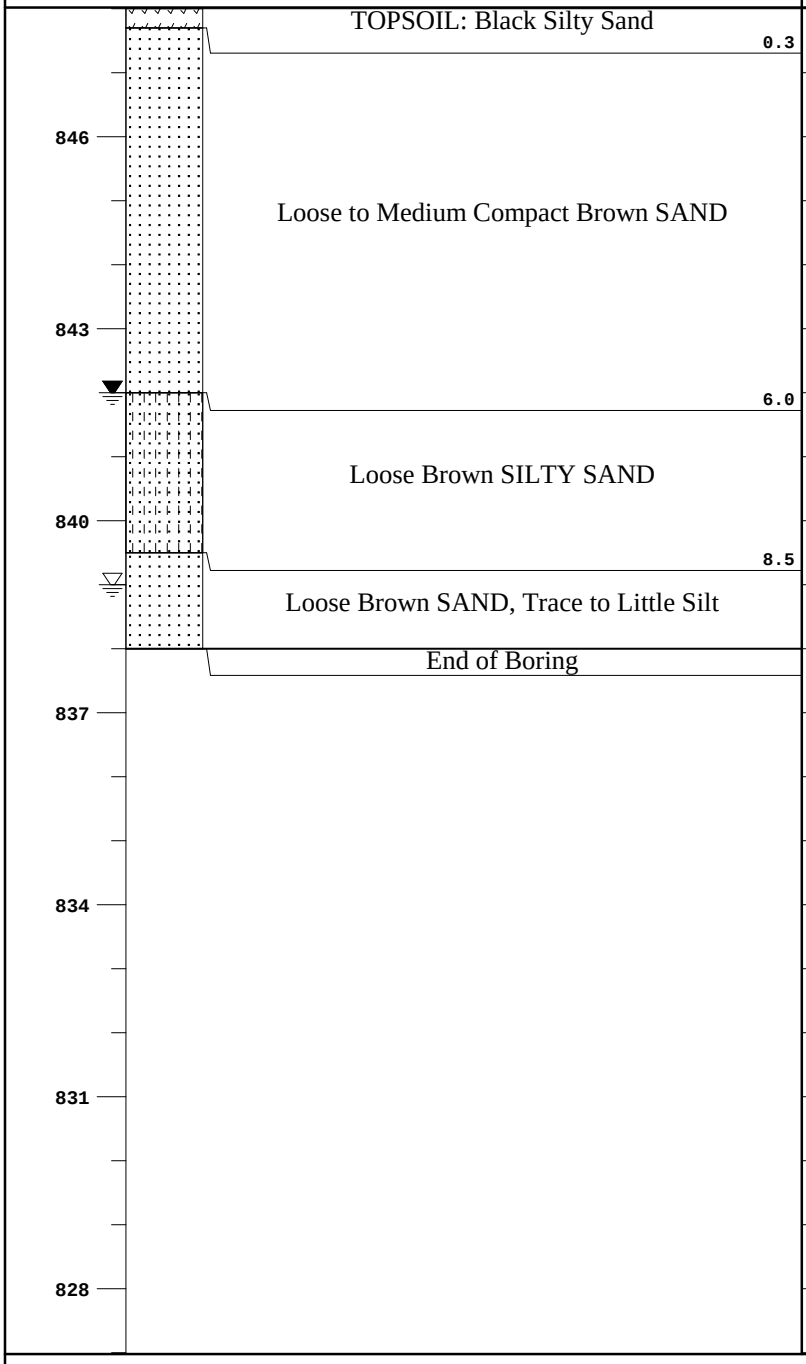
LOG OF TEST BORING NO. TB-5

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard*
Rochester Hills, Michigan

PEA Job No.: *2024-0518*
Reviewed by: *DJS*

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION 848



SOIL SAMPLE DATA

DEPTH FEET	SAMPLE	BLOWS /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
0							
	1-S	2 5 6	11	4			
3							
	2-S	2 2 3	5	12			
6							
	3-S	3 5 4	9				
9	4-S	2 4 5	9				

Total Depth: *10*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/7/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *6 ft.*
After drilling: *9 ft.*

Notes: **Pocket Penetrometer*

PEA GROUP

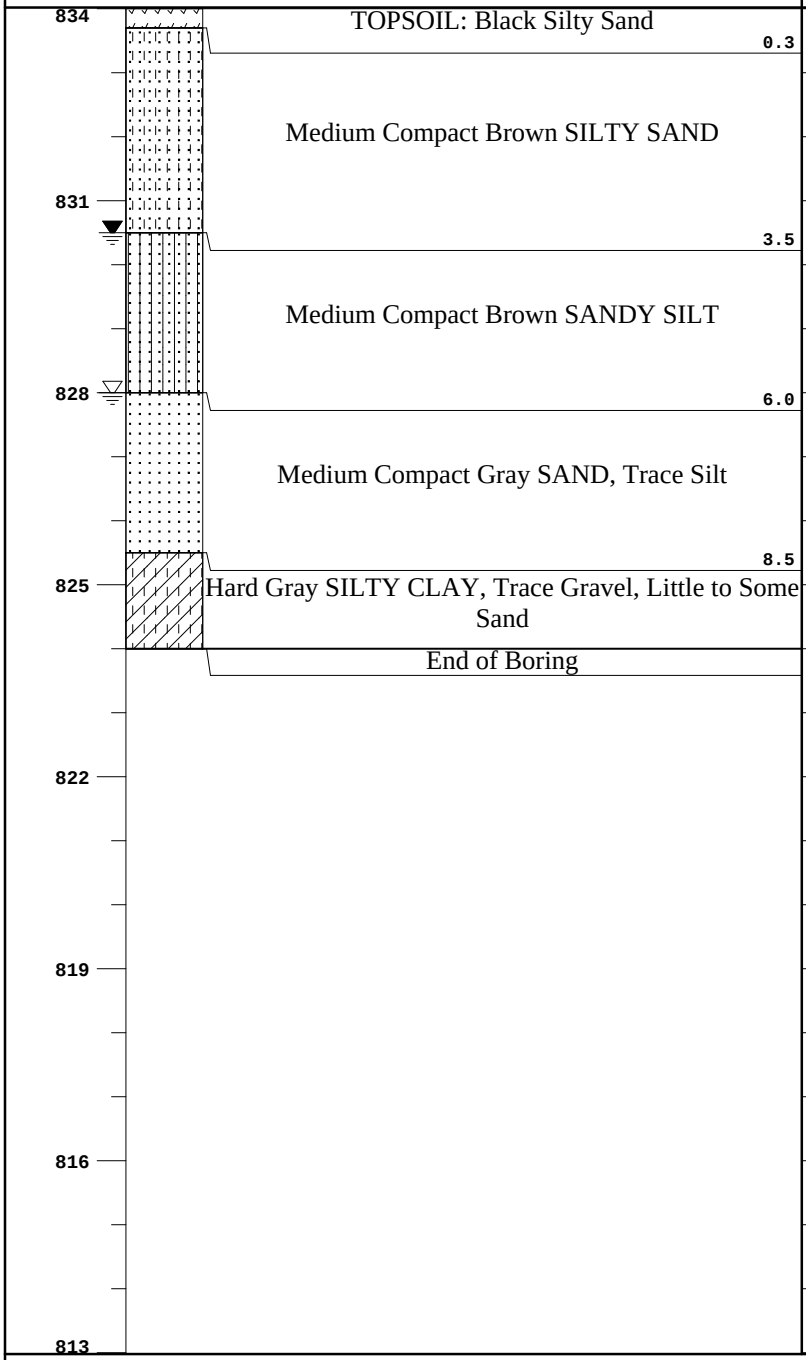
LOG OF TEST BORING NO. TB-6

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard*
Rochester Hills, Michigan

PEA Job No.: *2024-0518*
Reviewed by: *DJS*

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION 834



SOIL SAMPLE DATA

DEPTH FEET	SAMPLE	BLOWS /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
0							
	1-S	4 6 6	12	22			
3							
	2-S	5 9 10	19	22			
6							
	3-S	5 9 11	20				
9							
	4-S	11 12 11	23	12		*9000	
12							
15							
18							
21							

Total Depth: *10*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/7/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *3.5 ft.*
After drilling: *6 ft.*

Notes: **Pocket Penetrometer*

PEA GROUP

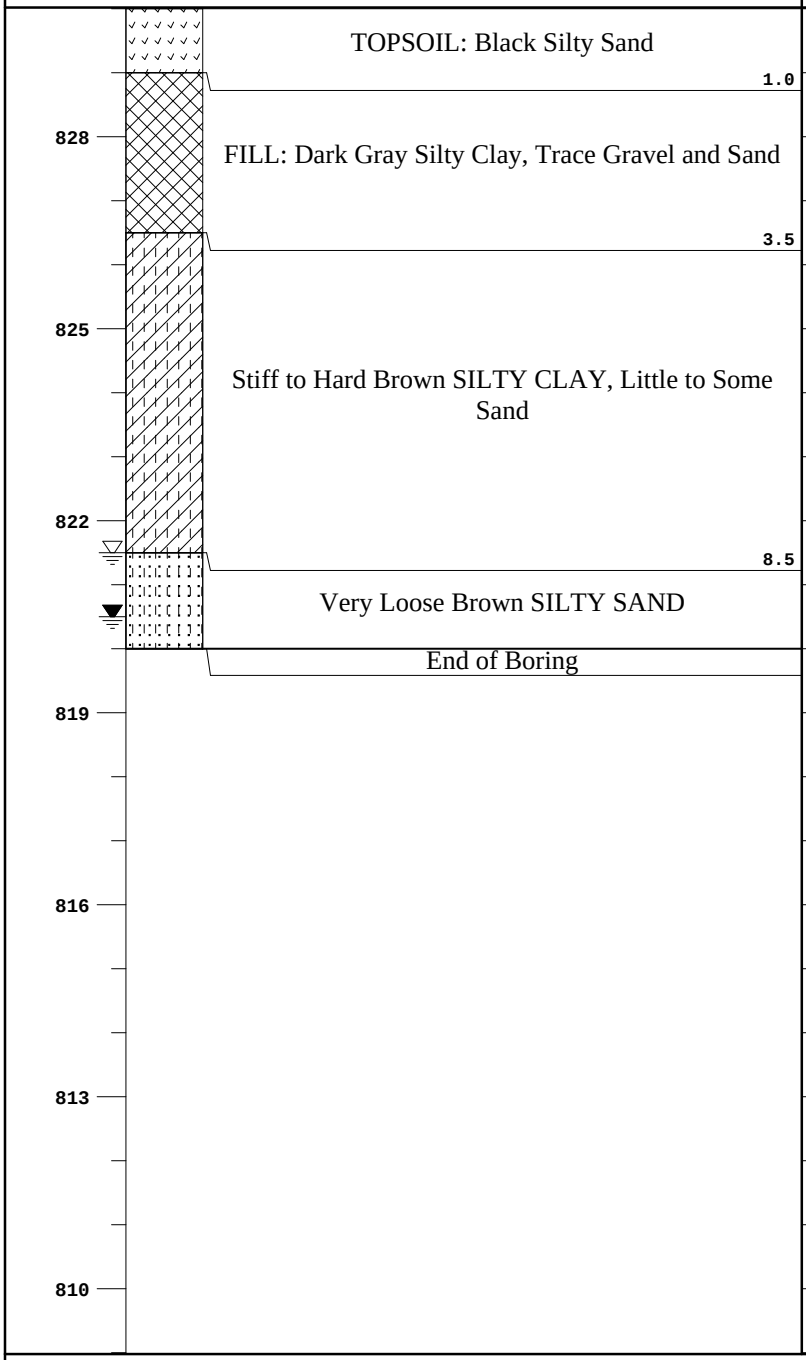
LOG OF TEST BORING NO. TB-7

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard*
Rochester Hills, Michigan

PEA Job No.: *2024-0518*
Reviewed by: *DJS*

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION 830



SOIL SAMPLE DATA

DEPTH FEET	SAMPLE	BLOWS /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
0							
	1-S	1 3 3	6	23			
3							
	2-S	5 13 15	28	9		*9000	
6							
	3-S	2 3 3	6	10		*3500	
9	4-S	1 2 2	4				

Total Depth: *10*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/8/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *9.5 ft.*
After drilling: *8.5 ft.*

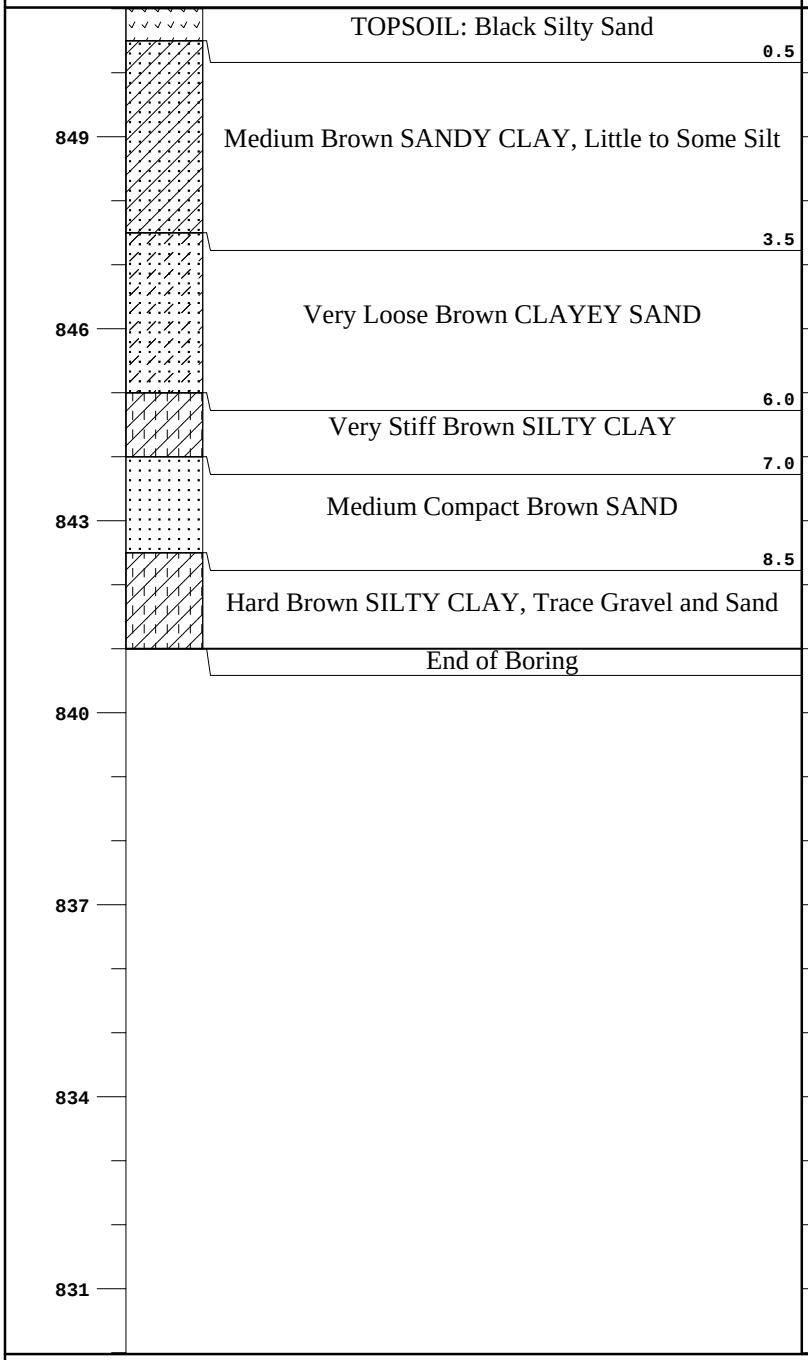
Notes: **Pocket Penetrometer*
Collapse @ 7 ft.

PEA GROUP

LOG OF TEST BORING NO. TB-8

PROJECT NAME: *Pine Trace Golf Course*
LOCATION: *3600 Pine Trace Boulevard*
Rochester Hills, Michigan

PEA Job No.: *2024-0518*
Reviewed by: *DJS*



SOIL SAMPLE DATA							
DEPTH FEET	SAMPLE	BLOWS /6"	SPT "N"	Moisture Content (%)	Dry Density (pcf)	Unconf. Comp. Str. (psf)	Failure Strain (%)
0							
	1-S	WH 1 1	2	14		*1500	
3							
	2-S	WH WH 2	2	20			
6							
	3-S	2 7 8	15	14		*4000	
9	4-S	3 8 10	18	15		*9000	
12							
15							
18							
21							

Total Depth: *10*
Drilling Method: *3-1/4" Hollow Stem Augers*
Drilling Date: *5/8/24*
Inspector: *SGA*
Plugging procedure: *Soil Cuttings/Bentonite Chips*
Contractor: *DLZ Drilling Company*

Water Level Observations:
During drilling: *Did Not Encounter*
After drilling: *Dry Upon Completion*

Notes: **Pocket Penetrometer*
Collapse @ 8 ft.

PEA GROUP

SOIL TERMINOLOGY

Unless otherwise noted, all terms utilized herein refer to the Standard Definitions presented in ASTM D-653.

PARTICLE SIZES

Boulders - Greater than 12 inches (305 mm)

Cobbles - 3 inches (76.2 mm) to 12 inches (305 mm)

Gravel:

- Coarse - 3/4 inches (9.05 mm) to 3 inches (76.2 mm)
- Fine - No. 4 (4.75 mm) to 3/4 inches (19.05 mm)

Sand:

- Coarse - No. 10 (2.00 mm) to No. 4 (4.74 mm)
- Medium - No. 40 (0.425 mm) to No. 10 (2.00 mm)
- Fine - No .200 (0.074 mm) to No. 40 (0.425 mm)

Silt - 0.005 mm to 0.074 mm

Clay - Less than 0.005 mm

CLASSIFICATION

The major soil constituent is the principal noun (i.e., clay, silt, sand, gravel). The minor constituents are reported as follows:

Modifiers to Main Constituent
(Percent by Weight)

Trace	-	1 to 10%
Little	-	10 to 20%
Some	-	20 to 30%
Adjective	-	Over 30%

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier (i.e., silty clay). Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils (i.e., silty clay, trace of sand, little gravel).

Consistency	Unconfined Compressive Strength (PSF)	Approximate Range of N
Very Soft	Below 500	0 to 2
Soft	500 to 1,000	3 to 4
Medium	1,000 to 2,000	5 to 8
Stiff	2,000 to 4,000	9 to 15
Very Stiff	4,000 to 8,000	16 to 30
Hard	8,000 to 16,000	31 to 50
Very Hard	Over 16,000	Over 50

Consistency of cohesive soils is based upon as elevation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

COHESIONLESS SOILS

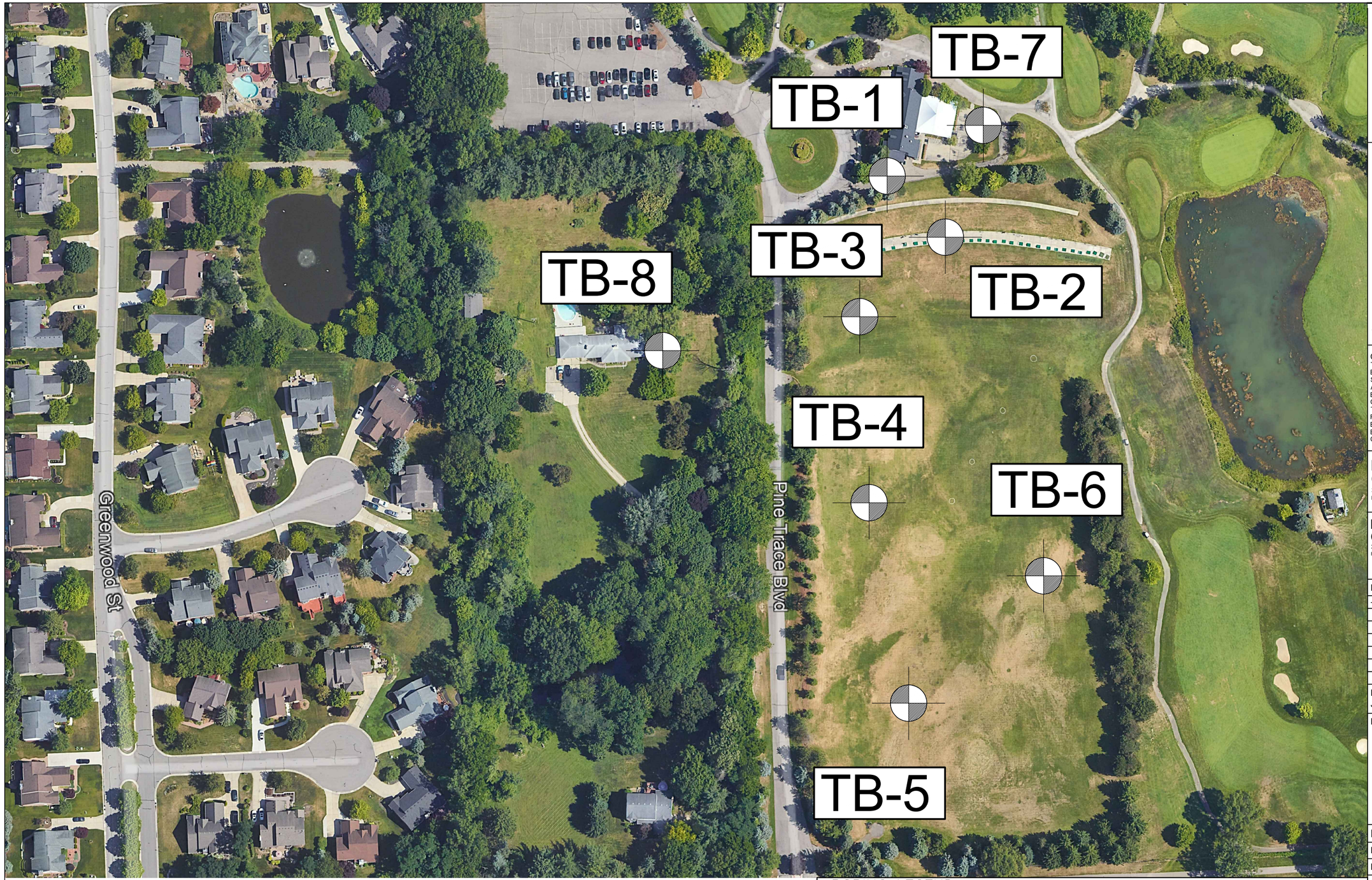
Density Classification	Relative Density %	Approximate Range of N
Very Loose	0 to 15	0 to 4
Loose	16 to 35	5 to 10
Medium Compact	36 to 65	11 to 30
Compact	66 to 85	31 to 50
Very Compact	86 to 100	Over 50

Relative Density of Cohesionless Soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

SAMPLE DESIGNATIONS

C - Core
D - Directly from Auger Flight or Miscellaneous Sample
S - Split Spoon Sample - ASTM D-1586
LS - S - Sample with liner insert
ST - Shelby Tube Sample - 3-inch diameter unless otherwise noted
PS - Piston Sample - 3-inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D-1586) - a 2.0-inch outside diameter, 1-3/8-inch inside diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely.



BORING LEGEND

TB-#

TEST BORINGS PERFORMED BY DLZ DRILLING COMPANY UNDER SUPERVISION OF PEA GROUP, MAY 7, 2024

PEA GROUP
AUBURN HILLS ■ BRIGHTON
WASHINGTON TWP. ■ DETROIT
t: 844.813.2949
www.peagroup.com

N

811. Know what's below. Call before you dig.

CAUTION!!
THE LOCATIONS AND ELEVATIONS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THIS DRAWING ARE ONLY APPROXIMATE. NO GUARANTEE IS EITHER EXPRESSED OR IMPLIED AS TO THE COMPLETENESS OR ACCURACY THEREOF. THE CONTRACTOR SHALL BE EXCLUSIVELY RESPONSIBLE FOR DETERMINING THE EXACT UTILITY LOCATIONS AND ELEVATIONS PRIOR TO THE START OF CONSTRUCTION.

BYLEN GOLF COMPANY, LLC
3600 PINE TRACE BOULEVARD,
ROCHESTER HILLS, MICHIGAN

PINE TRACE GOLF CLUB
3600 PINE TRACE BOULEVARD
ROCHESTER HILLS, MICHIGAN

REVISIONS
- -

DRAFT ISSUE DATE:
JUNE 28, 2024

DRAWING TITLE
TEST BORING LOCATION MAP

PEA JOB NO. 2024-0518
P.M.
DN.
DES.

DRAWING NUMBER:
TBM