Professional Service Industries, Inc.
45000 Helm Street, Suite 200
Plymouth, Michigan 48170
Phone: (248) 957-9911

January 14, 2025

Ms. Tina G. Gapshes, PE, City Engineer
City of Warren
One City Suare, Suite 300
Warren, MI 48093

RE: Geotechnical Exploration and Engineering Report
New Library in Underwood Park
13700 Sidonie Avenue
Warren, Macomb County, Michigan
PSI Report **No. 0381-1482**

Dear Ms. Gapshes:

As requested, **Professional Industry Services, Inc. (PSI), an Intertek Company**, has developed a geotechnical engineering exploration and pertinent report for the referenced project planned in Warren, Michigan. The results of this exploration, together with our recommendations, are presented in the accompanying report, a copy of which is being transmitted herewith.

After plans and specifications are complete, PSI should review the final design and specifications to verify that the earthwork and pavement recommendations are properly interpreted and implemented. **It is considered imperative that the geotechnical engineer and/or its representative** be present during earthwork operations and pavement installations to observe the field conditions with respect to the design considerations and specifications. PSI will not be responsible for interpretations and field quality control observations made by others. Scheduling for our nearest Construction Materials Testing and Inspection location in Lansing, Michigan is available at (248) 957-9911.

PSI appreciates the opportunity to provide geotechnical engineering and consulting services for your project and looks forward to working with you during the construction phase. PSI provides additional services, which include construction materials testing and observation services, environmental services, roof consulting and observation services, pavement and asphalt testing services and specialty engineering and testing. If you have any questions regarding this report, or if we may be of further service, please feel free to contact this office at your convenience.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC

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GEOTECHNICAL EXPLORATION AND ENGINEERING REPORT

FOR THE:

NEW LIBRARY IN UNDERWOOD PARK
13700 SIDONIE AVENUE
WARREN, MACOMB COUNTY, MICHIGAN

PREPARED FOR:

CITY OF WARREN
ONE CITY SUARE, SUITE 300
WARREN, MI 48093

PREPARED BY:

PROFESSIONAL SERVICE INDUSTRIES, INC.
45000 HELM STREET, SUITE 200
PLYMOUTH, MICHIGAN 48170

JANUARY 14, 2025

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PROJECT INFORMATION

Project Authorization

This engineering report presents the results of our geotechnical engineering exploration performed relative to the proposed New Library planned in Underwood Park that will be located at 13700 Sidonie Avenue in the City of Warren, Macomb County, Michigan. The following table provides Project Authorization information.

Table 1: Project Authorization

Project Name	New Library in Underwood Park
Project Location	13700 Sidonie Avenue, City of Warren, Macomb County, MI
Proposal (Contract) Signed By	Ms. Tina G. Gapshes, City Engineer
Authorization Company	City of Warren
Authorization Date	October 15, 2024
PSI Proposal No.	0381-436724
PSI Proposal Contents	Scope of Service, Lump Sum Fee, and PSI’s General Conditions

This geotechnical exploration was performed for the City of Warren in accordance with PSI Proposal No. 0381-436724 dated October 15, 2024. The authorization to perform this exploration and evaluation was in the form of acceptance of PSI’s proposal by Ms. Tina G. Gapshes, City Engineer of City of Warren, on October 15, 2024.

Project Description

Project information was provided by Ms. Tina G. Gapshes, City Engineer at City of Warren, via email on October 8, 2024. The correspondence included the following documents:

- Request for Proposal
- Project drawing with proposed boring locations titled “PRELIMINARY SET” created by PLY+.

Briefly, PSI understands that the City of Warren is planning to construct a new library in Underwood Park that will be located at 13700 Sidonie Avenue in the City of Warren, Macomb County, Michigan. The new library will comprise a partial single-story building with approximately area of 5,420 Sq. Ft. PSI anticipate that the partial single-story building will be wood/steel framed with masonry bearing walls. The maximum anticipated design column loads are up to 75 kips and the maximum design wall loads are from two to four kips per lineal foot.

The finished floor elevation was not provided by the City of Warren. PSI anticipates approximately +/- 2 feet of cut/engineered fill will be required to achieve the proposed building’s finished floor elevation (exclusive of any additional cut/fill associated with removal of any unsuitable soil sections).

Based on information provided by Ms. Tina G. Gapshes, City Engineer at City of Warren, via email on October 8, 2024, PSI’s review of site plan with the requested boring locations and project site plans for the new library, a summary of our understanding of the proposed new library project is provided below in the following Project Description table.

Table 2: General Project Description

Building Construction Types	Single-story buildings with approximately an area of 5,420 Sq. Ft. Wood/Steel framed with masonry bearing walls. Associated perimeter parking lot and driveways.
Existing Grade Change within Building Pads	± 1 feet estimate (Google Earth Pro)
Existing Grade Change within Project Site	± 1 feet estimate (Google Earth Pro)
Finished Floor Elevations	± 2 feet of current grade (894.75 ft)
Anticipated Foundation Types	Shallow foundation system, i.e., spread, and wall footings.
Anticipated Maximum Design Column Loads	Up to 75 kips
Anticipated Maximum Design Wall Loads	Two to four kips per lineal foot
Pavement for Parking and Drives	Flexible Asphalt (HMAC)
Design Traffic Load	30,000 ESALs for 20-Year Pavement Life for Light Duty Pavement 100,000 ESALs for 20-Year Pavement Life for Medium Duty Pavement

The geotechnical recommendations presented in this report are based on the available project information and results of our geotechnical exploration and evaluations. If any of the noted information including structural loads are considered incorrect or are changed, please inform PSI in writing at your earliest convenience so that we may amend the recommendations presented in this report if appropriate and if desired by City of Warren. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project. PSI should be consulted once the structure design has been finalized. Additional subsurface exploration may need to be performed by PSI at that time.

Purpose and Scope of Services

The purpose of this field geotechnical exploration was to evaluate the subsurface conditions at the site and to develop geotechnical design criteria for support of foundations and pavement for the planned new library project. The scope of the exploration and analysis included a reconnaissance of the project site, completion of three Standard Penetration Test-SPT soil borings, two infiltration tests with test pits, field and laboratory testing of representative portions of the recovered split spoon SPT samples, and corresponding engineering analysis and evaluation of the subsurface materials encountered.

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

As directed by the scope of work/service provided by City of Warren, PSI did not provide any service to evaluate or detect the presence of moisture, mold or other biological contaminates in or around any structure or any service that was designed or intended to prevent or lower the risk of the occurrence of the amplification of the same. The City of Warren acknowledges that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. The City of Warren further acknowledges that site conditions are outside of PSI's control and that mold amplification will likely occur or continue to occur in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

PSI also provides an array of complementary environmental and industrial hygiene services to assist you or your design team in successfully assessing and developing properties such as the one referenced in this report. PSI's environmental consultants apply their experience, local geologic knowledge and thorough understanding of **ASTM** standards, environmental risk, and regulatory knowledge to conduct due diligence assessments of a wide range or property types and proposed developments.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The project site is located at 13700 Sidonie Avenue in the City of Warren, Macomb County, Michigan. The project site consists of light grass cover and trees. The following table provides a generalized description of the existing site conditions based on visual observations during the field activities, as well as other available information.

Table 3: Site Description

Site Location	Latitude: 42.45466; Longitude: -82.98427; Warren, Michigan
Site History	Park
Existing Site Ground Cover	Lawn area (see **Figure No. 1** in **Appendix**)
Existing Site Features	Relatively flat
Existing Grade/Elevation Changes	±1 feet; slopping downward from north to south
Site Boundaries/Neighboring Development	North: Sidonie Ave East: Residential development South: Residential development West: Residential development
Ground Surface Soil Support Capability	Anticipated to be firm enough for field equipment

The terrain across the project site was relatively level with grades varying on the order of approximately ± 1 feet, according to Google Earth Pro. The ground surface of the project site was firm at the time of the field services as indicated by the fact that the drilling rig experienced little difficulty in accessing the boring locations.

Field Exploration and Laboratory Testing

The site subsurface conditions were determined by completion of three Standard Penetration Test-SPT soil borings and advanced depths ranged between approximately 25 and 40 feet below the existing ground surface within or near the proposed new single building footprint. Two borings were advanced to a depth of approximately seven and ten feet below the existing ground surface for conducting percolation tests. The boring design element, boring labels, approximate depths, and drilling footage are provided in the following table.

Table 4: Field Exploration Summary

Design Element	Number of Borings	Boring Depth (ft)	Drilling Footage (feet)
Proposed New Building	1	25	25
	2	40	80
Percolation Test	1	10	10
	1	7	7
TOTAL:	**5**	**---**	**122**

The boring locations and depths were established by City of Warren and located and marked in the field by PSI in accordance with the project drawing with proposed boring locations titled “PRELIMINARY SET” created by PLY+. The approximate boring locations are depicted in the Boring Location Diagram, **Figure No. 2** included in the **Appendix.**

The soil borings were performed on December 3, 2024, by means of a CME-75 truck-mounted drilling rig equipped with a rotary head utilizing 3¼ and 2¼ inch hollow-stem augers to advance the boreholes. Representative soil samples were recovered employing split-barrel sampling procedures in general accordance with "Penetration Test and Split-Barrel Sampling of Soils" **(ASTM D1586)**. After completion of the test borings the holes were backfilled with the excavated soils. The field exploration description is provided on the table below.

Table 5: Field Exploration Description

Drilling Equipment	Truck Mounted Drilling Equipment
Drilling Method	Continuous Hollow-Stem Augers
Field Testing	Standard Penetration Test – SPT (**ASTM D1586**)
Sampling Procedure	Soils: **ASTM 1586**
Sampling Frequency	2.5-foot Intervals to a depth of 10 feet and at 5-foot Intervals thereafter
Frequency of Groundwater Level Measurements	During and after drilling
Boring Backfill Procedures	Soil cuttings
Sample Preservation and Transportation Procedure	General Accordance with **ASTM D4220**

Determination of the ground surface elevations by survey at the test boring positions was not within the scope of PSI's services. The approximate ground surface elevations at the boring locations performed were obtained from Google Earth Pro. Prior to final design and construction, field measurement at the boring locations should be made by a professional land surveyor registered in the State of Michigan. References to depths in this report and on the attached boring logs are from the existing ground surface unless otherwise noted.

In addition to the field exploration, a representative laboratory-testing program was conducted to evaluate engineering characteristics and geotechnical parameters of the subsurface materials. The laboratory-testing program included visual classification and moisture content tests on all the material recovered. The unconfined compression strength of the plastic/cohesive soils encountered was approximately estimated utilizing a calibrated hand penetrometer. The results of these tests are indicated on the boring logs which are included in the **Appendix**. The laboratory testing program was conducted in general accordance with applicable **ASTM** specifications. The unused portion of the soil samples will be placed in storage at PSI's Lansing, Michigan facility. Unless otherwise requested in writing, the samples will be discarded 60 days after the submission of the final report.

Surface/Subsurface Conditions

At the time of our field geotechnical exploration conducted in early December 2024, the surface and subsurface general conditions encountered at the project site can be described and summarize in the following table:

Table 6: Existing Surface/Subsurface Summary

Soil Boring	Approx. Elevation, feet	Surface Material and Thickness	Major Native Strata
SB-01 (25ft)	627	7" Topsoil	Yellow mottled Brown CLAYEY SAND Yellow mottled Brown/Gray LEAN CLAY Gray SANDY LEAN CLAY
SB-02 (40ft)	627	6" Topsoil	Yellow mottled Brown/Gray LEAN CLAY Yellow mottled Brown/Gray SANDY LEAN CLAY
SB-03 (40ft)	627	7" Topsoil	Yellow mottled Brown/Gray LEAN CLAY Brown/Gray SANDY LEAN CLAY Yellow mottled Brown CLAYEY SAND Gray SILT

At the time of our field subsurface exploration with boring logs assessed included in the **Appendix**, and as summarized in the above table, the surface of all soil borings consisted of a topsoil layer ranging between approximately six and seven inches in thickness. Native soils were encountered below the topsoil layer at all boring locations which generally may be characterized as silt, clayey sand, and lean clay to sandy lean clay as described in the following paragraphs.

Brown/Gray Lean Clay to Sandy Lean Clay: A stratum of native brown/gray lean clay to sandy lean clay with variable percentages of silt and gravel was encountered below clayey sand strata at soil boring SB-01 and below topsoil layer at soil borings SB-02 and SB-03. The brown/gray lean clay to sandy lean clay stratum extended to depths ranging between approximately six feet and final depths of exploration of 25 and 40 feet below the existing ground surface. The SPT-N values of the lean clay to sandy lean clay stratum ranged from six to twenty blows per foot (bpf). Unconfined compressive strength values estimated using a hand penetrometer ranged between ¾ and greater than 4½ tsf indicating firm to hard consistencies. The moisture content of the tested lean clay to sandy lean clay samples ranged from ten to 22 percent. The samples visually appeared to be in moist to very moist condition when examined in the laboratory. The Atterberg limit tests performed on representative composite samples of the native brown/gray lean clay stratum indicates the soil to be moderate in plasticity with Liquid Limit (LL) ranging from 21 to 27 and Plastic Limits (PL) ranging from 12 to 15; based on the low moisture contents indicated in the boring logs and the deep groundwater table below the maximum exploration depth, this stratum appears to be slightly over consolidated.

Yellow Mottled Brown Clayey Sand: A native yellow mottled brown clayey sand with particle size ranged between fine to coarse and consists variable percentages of silt and gravel, was encountered underneath topsoil layer at soil boring SB-01 and interbedded the lean clay stratum at soil boring SB-03 at a depth of approximately six feet below the existing ground surface. The native clayey sand stratum extended to depths ranging between approximately six and 8.5 feet beneath the existing ground surface. The Standard Penetration Test – SPT value (N values) of the clayey sand layer ranged from nine to 18 blows per foot (bpf), indicating relative densities of loose to medium dense. The moisture content of the tested clayey sand samples ranged from 14 to 27 percent. The samples visually appeared to be in a very moist condition when examined in the laboratory. The moisture content of the tested silt sample was nine percent. The samples visually appeared to be in a moist condition when examined in the laboratory.

Cobbles and/or boulders were not encountered during drilling operations. The boring logs included in the **Appendix** should be referenced with respect to this information. The presence of boulders and cobbles in the profile is a result of the geologic method of deposition of the soil materials at this site. Even where cobbles or boulders were not noted within the profile they could be encountered between the boring positions. The Contractor should be equipped for this condition.

The above subsurface descriptions are of a generalized nature and are provided to highlight the major soil strata encountered. The **Boring Logs** included in the **Appendix** should be reviewed for specific information as to individual boring locations. The stratification shown on the Boring Logs represents the conditions encountered at the specific boring locations. Variations may occur and should be expected between boring locations. The stratification represents the approximate boundary between subsurface materials; however, the actual transition may be gradual, abrupt, or not clearly defined. In the absence of foreign substances or debris, it is often difficult to distinguish between native soils and clean fill soil.

Groundwater Information

Free groundwater was not encountered during drilling nor observed upon completion of drilling operations at any of the soil boring locations, during early December 2024. Collapse of the soils above groundwater (i.e., "dry cave") was not observed during drilling operations. The **Boring Logs** included in the **Appendix** should be reviewed for specific information as to depths of groundwater and dry caves.

The change in color of the soil from brown to gray may indicate the long-term minimum piezometric level in the area. Based on the color change from brown to gray at the borings performed, it appears that the long term piezometric level at this site may be located at a depth of approximately 6.5 to 8.5 feet below the existing ground surface.

Groundwater levels on this site are likely to vary because of seasonal conditions and fluctuations should be anticipated. Groundwater quantities and flow volumes will largely depend on the permeability of the soil profile. It is recommended that the Contractor determine the actual groundwater levels at the time of the construction to evaluate groundwater impact on construction procedures.

Infiltration Rate

To evaluate the infiltration rate, PSI performed two percolation tests at the maximum depths of approximately 7 and 10 feet at the boring location shown in Figure No. 2 of the Appendix. Based on the hole depth, hole diameter, and the measured percolation rate of the soils at the test location, the infiltration rate was estimated as shown in the table below.

Table 7: Percolation Test Results*

Test Location	Approx. Boring Depth	Approx. Initial/Final Elevation	Test Depth/Elevation	Soil Type at Test Depth	Estimated Infiltration Rate (in./hr.)
IF1	10’	627/617	10’/617	Gray Lean Clay	0.0483
IF2	7’	627/620	7’/620	Gray Lean Clay	0.0681

**This is an estimated rate and will be impacted due to soil variability.*

PSI observed native soils within the exploration depth of the soil boring and therefore completed field percolation testing.

References to depths in this report are from the existing ground surface unless otherwise noted. PSI generally encountered brown/gray lean clay with variable percentage of silt and gravel at the tested elevations. The relative soil boring logs should be reviewed for specific soils information at the percolation testing locations. These records include soil descriptions and stratification of the soils. The soil boring logs are presented in the **Appendix**.

The stratification shown on the soil boring logs represent the conditions only at the actual observed locations. Variations may occur and should be expected across the project footprint. The stratification represents the approximate boundary between subsurface materials; however, the actual transition may be gradual. The soil descriptions were prepared based on visual engineering classification of the soil conditions encountered in the field and sieve analysis completed on representative sample of soils collected at the infiltration elevation.

Site Seismic Classification

Macomb County in Michigan lies in the Central Stable Tectonic Region and in Seismic Zone Area 0 of probable seismic activity of the Building Officials Congress of America (BOCA), National Building Code, and the Uniform Building Code (UBC). This zone indicates that minor damage due to occasional earthquakes might be expected in this area.

In the 2015 Michigan Building Code (MBC), the State of Michigan has adopted the provisions of the International Building Code (IBC). The Site Class is based on a weighted average of known or estimated soil properties for the uppermost 100 feet of the subsurface profile. Soil borings at the project site extended to a maximum depth of approximately 40 feet below the existing ground surface. Based on the regional geologic mapping, as well as data available on the Water Well Record Retrieval System of the Department of Environmental Quality in the State of Michigan, PSI anticipates that the subsurface conditions below the explored depth may consist of alternating deposits of sand, gravel, and clay with bedrock located at a depth of approximately 100 feet or more below the existing ground surface. Bedrock most likely is part of the Saginaw formation. Based on our review of the available data, knowledge of regional geology and the Standard Penetration Test (SPT) N-values and approximated soil shear strength PSI estimates that the seismic design for this project, based on the upper 100 feet of the subsurface soil profile, would be **Site Class D.**

The 2015 International Building Code requires a site class for the calculation of earthquake design forces. This class is a function of soil type (i.e., depth of soil and stratum types). Based on the depth of the rock (i.e., weathered rock) and the estimated shear strength of the soil at the boring locations, **Site Class "D"** is also recommended.

The **USGS-NEHRP** probabilistic ground motion values near Latitude 42.4544333N, and -82.9830138W are as follows:

Table 8: USGS-NEHRP Probabilistic Ground Motion Values

Period (seconds)	2% Probability of Event in 50 years (%g)	Site Coefficients	Max. Spectral Acceleration Parameters	Design Spectral Acceleration Parameters	
0.2 (S_s)	9.3	$F_a = 1.6$	$S_{ms} = 0.149$	$S_{Ds} = 0.099$	$T_0 = 0.149$
1.0 (S_1)	4.6	$F_v = 2.4$	$S_{m1} = 0.111$	$S_{D1} = 0.074$	$T_s = 0.747$

$S_{ms} = F_aS_s$ $S_{Ds} = 2/3*S_{ms}$ $T_0 = 0.2*S_{D1}/S_{Ds}$
$S_{m1} = F_vS_1$ $S_{D1} = 2/3*S_{m1}$ $T_s = S_{D1}/S_{Ds}$

The Site Coefficients, F_a and F_v were interpolated from **2015 IBC Tables 1613.3.3(1)** and **1613.3.3(2)** as a function of the site classification and the mapped spectral response acceleration at the short (Ss) and one second (S1) periods. The development of shear strains tending to cause liquefaction of sand deposits is governed by the character of the ground motion (i.e., acceleration and frequency), soil type, groundwater level, and in-situ stress conditions. PSI believes the risk of liquefaction occurring at this site is very low based on the upper site soils being an unsaturated mixed of mostly fine grain particles, and the site being in a low seismic activity area.

EVALUATION AND RECOMMENDATIONS

Site Preparation

Prior to site grading activities or excavation for foundation elements, existing underground utilities, and any structures, should be identified and rerouted or properly abandoned in-place. Existing underground utilities that are not re-routed or abandoned should be adequately marked and protected to minimize the potential for damage during construction activities.

Although undocumented old fill was not encountered at any of the soil boring locations, topsoil, existing pavement, undocumented fill, and soils containing organics can potentially undergo high and variable volume changes when subjected to loads, resulting in detrimental performance of floor slabs, pavements, structural fills, and shallow foundations placed on them. **Therefore, PSI recommends that topsoil, as well as any old fill soils or apparent old fill soils,** be stripped from the planned construction areas and under PSI' s supervision.

Proofroll. After the topsoil, old fill soils, and loose/soft soils have been removed from the areas of construction and any cut sections are performed, exposed subgrades should be observed and be thoroughly proof rolled/compacted with a large, heavy rubber-tired vehicle prior to the placement of engineered fill or backfill required to achieve the proposed subgrade elevation. Areas that exhibit instability or are observed to rut or deflect excessively under the moving load should be further undercut, stabilized by aeration, drying (if wet) and additional compaction to attain a stable finished subgrade. The proof rolling/compacting and undercutting activities should be performed during a period of dry weather and should be performed under the supervision of the geotechnical engineer's representative. Exposed granular subgrades must be compacted to a minimum of 95 percent of the maximum dry density within three percent of the optimum moisture content as determined by **ASTM D-1557** (Modified Proctor).

Subgrade Improvement. Where subgrade conditions are not improved through aeration, drying and compaction, or where undercut and replacement is considered impractical due to the underlying soil and groundwater conditions, it may be necessary to stabilize localized areas of subgrade instability with a woven geotextile, geogrid and a layer of well graded crushed concrete or well graded coarse aggregate such as **MDOT 4AA, 6A** or **21AA**. The need for the use of geotextile, geogrid and the thickness and gradation requirements of the crushed aggregate layer required should be determined at the time of the subgrade preparation, based on the condition of the exposed subgrade at the time of construction. The subgrade should be stabilized prior to placement of engineered fill or aggregate base course. New engineered fill supporting at-grade structures should be an environmentally clean material, free of organic matter, frozen soil, or other deleterious material. The material proposed to be used as engineered fill should be evaluated and approved for use by a PSI geotechnical engineer or his representative prior to placement in the field.

Selected Fill. After the subgrade has been stabilized, any engineered fill required may then be placed. PSI should monitor proper control of the placement and compaction of new fill soils. The new materials must be free of organic matter. Fill materials are to be placed in individual lifts not exceeding eight inches in loose thickness. Each lift is to be compacted to 95 percent of the maximum dry density within three percent of the optimum moisture content as determined in accordance with **ASTM Method D-1557** (Modified Proctor). A minimum of one test per 2,000 square feet of building(s) should be performed for each lift, unless otherwise specified by the engineer. The moisture/density relationship (Proctor) of the material to be used as engineered fill should be evaluated by a PSI geotechnical engineer or his representative prior to placement in the field. PSI recommends one Proctor test for every 5,000 cubic yards (cyds) of engineering fill and one test per change of material.

Portions of native soils appear to be suitable for re-use as engineered fill provided the soils are free of organics and miscellaneous debris and particle sizes do not exceed 3 inches in diameter. PSI must be on site prior to re-use of the existing native and fill materials to document and verify that these soils are suitable for the intended use as engineered fill. Imported materials to be utilized as structural fill should meet (or be similar to) the requirements of **MDOT Class II** granular soil. Construction traffic should be restricted from the exposed subgrade to help reduce the potential for loosening of the subgrade soils, particularly where excess moisture is present from groundwater and/or precipitation. PSI recommends that the fill be strategically placed so that the construction equipment remains on newly placed fill soils and not on the exposed subgrade during fill placement.

Foundation Recommendations

Although undocumented old fill and organics were not encountered at any of the soil boring locations, undocumented fill and buried native soils with organics may be present in un-explored areas of the site. The bottoms of the undercut excavations must be continuously evaluated under PSI supervision prior to the placement of engineered backfill. Structural fill placement should be performed in accordance with the Site Preparation Section of this report.

Where the removal of localized unsuitable bearing material is performed beneath the proposed footings and the excavation is backfilled with compacted fill materials, the excavation must extend laterally beyond the perimeter of the foundation for a distance equal to one-half of the thickness of the engineered backfill placed below the footing bottom. This over excavation is necessary for proper support of lateral loads exerted through the fill by the foundations.

Bearing Capacity/Settlements. Following proper site preparation as outlined above and previously in *Site Preparation Section* of this report, PSI recommends that proposed building be supported on conventional shallow spread footings, continuous walls, and/or isolated foundations. The shallow foundation system offers a net allowable soil bearing capacity of up to **3,000 pounds per square foot** for three-by-three-foot square footings, where they bear on suitable native soils or on engineered fill placed over suitable native soils. Following the previous bearing capacity value, estimated total settlements after construction should be less than one inch or less with differential settlement of half of the total settlement, provided the following foundation design and construction details are incorporated.

Footings Geometry. In order to protect against frost action, perimeter footings, exterior footings and footings located in unheated areas must bear at a minimum depth of three and one-half feet below final surface grades. Interior footings not subject to frost action may be found at a depth of at least 18 inches below the floor slab, provided that these foundations will be bearing on properly placed engineered backfill or suitable native soils. Footing supporting individual columns should have a minor dimension of no less than 30 inches and a minimum wall footing width of no less than 18 inches, even if those dimensions result in stresses below the allowable bearing capacity. The purpose of limiting the footing size is to prevent "punching" shear deformation and to provide for vertical stability.

Foundation Considerations. Where bearing soils are granular in nature, PSI recommends that the foundation inverts be compacted in place by several passes of a vibratory compactor, prior to placement of formwork or cast-in-place foundation concrete, to densify any disturbed soils during excavation as well as to densify the underlying native granular soils. The compaction should continue until no additional densification is observed with additional passes.

Unsuitable soils may be present at the bearing surface. Therefore, PSI recommends that the foundation excavations be observed and tested by a representative of PSI to verify that the observed conditions are consistent with the geotechnical report; this is especially important at this site due to the presence of old fill material and relatively wet native soils encountered at the soil boring locations. Where bearing surfaces are not suitable to support foundations, they should be undercut and replaced with engineered fill or flowable fill, or foundations should be extended to bear directly on suitable native soils.

Depending on the soil and groundwater conditions at the time of construction, it may be necessary to stabilize the foundation bottoms with free drainage crushed stone. To reduce the effects of differential movement that may occur due to variations in the character of the supporting soils and variations in seasonal moisture contents, it is recommended that building and wall footings be suitably reinforced.

Concrete Slab-on-Grade

The apparent lean clay soils (CL) encountered at this site are considered to be poor for the support of concrete slab on grade in case they are saturated. PSI recommends **a modulus of subgrade reaction for imported fills specified and conditioned as described in this report of 115 psi/in may be used concrete slab on grade**. This value may be confirmed in the field by performing a 1-foot by 1-foot plate load test. However, depending on how the slab load is applied, the value must be geometrically modified with the understanding there may be areas of the site where subgrade stabilization will be required.

Because the subgrade soils at this site contain a high percentage of fines (silt and clay) and are moderate plastic, they will shrink and swell with the loss and addition of water. They will also be susceptible to frost action. PSI recommends concrete slab on grade should be at least 6 inches thick and should be placed over a compacted crushed stone base of at least 10 inches in thickness and be properly compacted as recommended in this report. The crushed stone materials should comply with the current version of **ACI 302.1.**

The grain bin slab should be suitably reinforced to make them as rigid as necessary. Proper joints should be provided at the junctions of the slab and the foundation system so that a small amount of independent movement can occur without causing damage. The bottom slab areas should be provided with joints at frequent intervals to compensate for concrete volume changes during curing.

Pavement Section Recommendations

Based on the scope of service requested by City of Warren, California Bearing Ratio (CBR) analysis was not performed on samples of the expected subgrade soils. In lieu of extensive testing for determination of pavement subgrade support characteristics, we have made considerations based on our experience and the results from the Standard Penetration Test (SPT), and laboratory testing performed. These considerations are based on the removal and replacement of any existing fill soils affecting the pavement areas or subgrade as discussed in the Site Preparation Section of this report.

Estimated Soil Parameters

- Estimated Cohesive Subgrade CBR 3 to 4 percent.
- Design Cohesive Subgrade Resilient Modulus (M_R) = 4,000 to 5,000 psi

Recommended Design Inputs

- Reliability = 85% flexible & 95% rigid
- Standard Deviation = 0.49 flexible & 0.39 rigid
- Initial Serviceability Index = 4.2
- Terminal Serviceability Index = 2.0
- New HMA Layer Coefficient = 0.42
- New Aggregate Base Layer Coefficient = 0.14

Traffic Considerations (20-year Design Life)

- Light Duty - 30,000 ESAL's (Construction and Service; automobile parking areas)
- Medium Duty - 100,000 ESAL's (Construction and Service; automobile roadways)

The CBR value should be verified by the most updated version of the ASTM laboratory test method **D1883,** and specific traffic frequencies and axle loading determined prior to pavement design acceptance. In accepting the following pavement designs based on the correlated CBR value, City of Warren. must then accept a greater risk of over-design or pavement failure and/or higher maintenance costs.

In view of the available soil information, the recommended site preparation activities, and from experience on similar projects, PSI is providing the following pavement sections for the pavement areas on this site. The first flexible profile will consist of a "light duty" pavement, to be used by passenger vehicles in the main parking areas. The second flexible profile will be a "medium duty" pavement, which should be utilized in areas of channeled traffic (i.e. entrance and exit drives and areas of heavy loading). The third section will be a rigid concrete pavement, which may be a more suitable alternative for the medium-duty areas, and for areas supporting dumpsters, or where garbage and delivery trucks are turning and/or parking.

For the subgrade conditions and anticipated traffic loads, we have calculated a minimum required flexible design structural number 2.05 and 2.50 for standard-duty and heavy-duty pavement sections, respectively. Based on the PAVEXpress software design outputs and local practices, PSI recommends the following minimum pavement sections:

Table 9: Pavement Sections

Pavement Section	**Light Duty – Flexible (30,000 ESAL’s)**	**Medium Duty – Flexible (100,000 ESAL’s)**	**Medium Duty – Rigid (100,000 ESAL’s)**
Wearing Course	1½" MDOT 36A	1½" MDOT 36A	6" MDOT S1 Concrete
Leveling Course	2½" MDOT 13A	2½" MDOT 13A	
Aggregate Course	6” MDOT 21AA	10” MDOT 21AA	10" MDOT 21AA

The flexible pavement designs should incorporate high quality; high stability plant mixes being supplied with design properties; and aggregate gradation meeting or exceeding the requirements as outlined in the 2012 MDOT Standard Specification Section 501. The crushed aggregate base course should conform to the requirements of **MDOT Class 21AA.**

The above pavement sections are based on the **AASHTO** design methods for flexible and rigid pavement design and are based on a design life of 20 years and the estimated subgrade support values. The sections represent typical medium and heavy-duty type pavement sections for use in design. Final pavement section design should be provided by the design civil engineers based on actual traffic volumes and axle loads, laboratory determined CBR tests, and the owner's design life requirements. Periodic maintenance should be expected and performed on all pavements during service life. All pavement materials and construction procedures should conform to (Michigan Department of Transportation) MDOT or appropriate local requirements.

Placement of geogrid below flexible pavements may be a suitable alternative to utilizing a rigid pavement section in heavy-duty areas (particularly near the entrances and exits). The geogrid reinforcement should be placed immediately below the aggregate base (**MDOT 21AA**) stratum. Construction equipment should not be permitted on the geogrid reinforcement; otherwise, damage may occur to the geogrid product. Furthermore, all other recommendations regarding the transportation, stockpiling, and installation of the geogrid reinforcement by the manufacturer should be followed. PSI should observe and document the installation of the geogrid product.

These pavements may be placed after the subgrade has been properly prepared as outlined in this report. Unstable areas should be treated as outlined therein. Appropriate drainage, including finger drains around catch basins and perimeter drainage must be incorporated into the pavement design. **Inadequate drainage will result in heaving and significant distress to the pavement.**

The aggregate base should comply with the gradation requirements of an MDOT 21AA (or similar) dense-graded aggregate. It should be compacted to 95 percent of the maximum dry density as determined by **ASTM D1557** (Modified Proctor). The asphalt leveling and wearing courses and concrete for the development should comply with the master composition requirements of **MDOT 2012** Standard Specifications for Construction and Supplemental Specifications. The placement of the pavement should also comply with MDOT construction specifications.

It is recommended that rigid concrete pavement be provided. This will provide for the proposed dumpster pad. Concrete design parameters include: (a) a 28-day mean modulus of rupture of 670 psi, and (b) a 28-day mean modulus of elasticity of approximately 4,200,000 psi. In addition, the concrete mix design should consist of normal weight concrete with a minimum 28-day compressive strength of

4,000 psi when tested in accordance with **ASTM C39**. The concrete should contain an air-entraining admixture to resist the effects of freezing and thawing. The design of joints, joint spacing, doweling and steel/wire mesh reinforcement was not included in PSI's Scope-of-Services, but should conform to the applicable local or MDOT requirements.

Vehicle traffic or the loading of a partially constructed pavement section will likely cause premature pavement failure. All vehicle traffic or pavement loading should be restricted until the pavement section has been completely constructed or the partial pavement section must be designed for this purpose, particularly if construction traffic will use the partial pavement.

It should be recognized that all pavements require regular maintenance and occasional repairs to keep the pavements in a serviceable condition. Of particular value, is a timely sealing of joints and cracks, which if left un-repaired, can serve to permit water to enter the pavement section and cause rapid deterioration of the pavement during freeze-thaw cycles. The need for such maintenance and repair is not necessarily indicative of premature pavement failure. However, if appropriate maintenance and repairs are not performed on a timely basis, the serviceable life of the pavement can be reduced significantly.

CONSTRUCTION CONSIDERATIONS

Drainage and Groundwater Considerations

Free groundwater was not encountered during drilling nor observed upon completion of drilling operations at any of the soil boring locations, during early December 2024. Due to the depths where GWT was encountered, difficulty with groundwater seepage and subgrade instability may not be anticipated during earthwork, foundation excavation, and construction associated with the proposed project. It is possible for the groundwater table to vary within the depths explored during other times of the year depending upon climatic conditions (seasonal fluctuation). PSI recommends that the Contractor verify the actual groundwater and seepage conditions at the time of the construction activities and propose groundwater control methods for the Engineer's approval, including the disposal of discharge water complying with county requirements.

Every effort should be made to keep the excavations and any other prepared subgrades dry if water is encountered or if rainfall or snowmelt occurs during construction. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

Water should not be allowed to collect in foundation or subsurface level excavations or other prepared subgrades of the construction area, either during or after construction. Water accumulation should be removed from shallow excavations by pumping from sump pits placed around the perimeter of the excavation. Positive site surface drainage should be provided to reduce infiltration of surface water. The grades should be sloped away from the proposed structures and surface drainage should be collected and discharged.

Excavation Safety Considerations

Care must be taken so that all excavations are properly backfilled with suitable material compacted in accordance with the procedures outlined in this report. Before the backfill is placed, all water and loose debris should be removed from these excavations. Materials removed from the excavation should not be stockpiled immediately adjacent to the excavation, because this load may cause a sudden collapse of the excavation wall. The Contractor should establish a minimum lateral distance from the crest of the slope for all vehicles and spoil piles. Likewise, the contractor should establish protective measures for exposed slope faces and preventative measures for the buildup of moisture in the excavation sidewalls, which can cause slope instability. A slope stability analysis should be performed to determine the factor of safety for cut and fill depths if the depth of the excavations warrant. If temporary shoring of excavation sidewalls is performed, a qualified registered professional engineer must design it. Formed foundations will be required if placed on or within granular soils.

In Federal Register, Volume 54. No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (**OSHA**) amended its "Construction Standards for Excavations, 29 CFR, part 1926, subpart P". This document was issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches or footing excavations, be constructed in accordance with the current OSHA guidelines. It is PSI's understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the Contractor could be liable for substantial penalties.

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

All earthwork and operations should be conducted in accordance with the project specifications and under the observation of a representative of the geotechnical engineer. We provide this information solely as a service to the City of Warren. PSI does not assume responsibility for construction site safety or the Contractor’s or other parties’ compliance with local, state, and federal safety or other regulations. Such responsibility is not being implied and should not be inferred.

GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment, experience and regular observation during construction activities. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding sections constitute PSI’s professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and PSI’s experience in working with these conditions.

REPORT LIMITATIONS

The recommendations submitted in this report are based on the available soil information and the design details furnished by **City of Warren** for the proposed Holt Series 3 Sycamore Elementary project. If there are any revisions to the plans for this project, considered structural loads, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI must be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, PSI cannot be responsible for the impact of those conditions on the performance of the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are complete, PSI should be retained to review the final design plans and specifications. This review is required to verify that the engineering recommendations are appropriate for the final configuration, and that they have been properly incorporated into the design documents. This report has been prepared for the exclusive use of the City of Warren for specific application to the proposed New Library in Underwood Park that will be located at 13700 Sidonie Avenue in the City of Warren, Macomb County, Michigan.

APPENDIX

SITE LOCATION DIAGRAM

New Library in Underwood Park
13700 Sidonie Avenue
Warren, Macomb County, Michigan

FIGURE NO. 1

PSI Project No. 03811482
Prepared By: Mary Vandecar
Prepared On: November 19, 2024

BORING LOCATION DIAGRAM

New Library in Underwood Park

13700 Sidonie Avenue

Warren, Macomb County, Michigan

FIGURE NO. 2

PSI Project No. 03811482

Prepared By: Mary Vandecar

Prepared On: November 19, 2024

DATE STARTED: 12/3/24
DATE COMPLETED: 12/3/24
COMPLETION DEPTH 25.0 ft
BENCHMARK: N/A
ELEVATION: 627 ft
LATITUDE: 42.454659°
LONGITUDE: -82.984483°
STATION: N/A **OFFSET:** N/A
REMARKS: borehole backfilled with auger cuttings

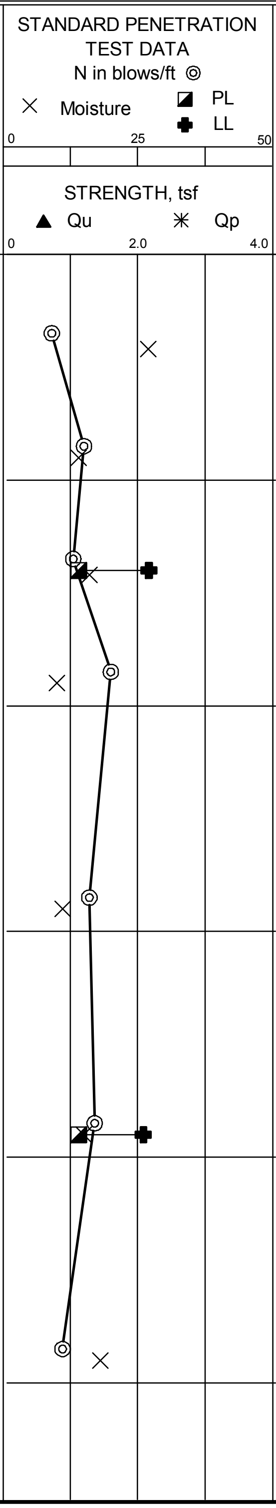
DRILL COMPANY: PSI, Inc.
DRILLER: H. Pace **LOGGED BY:** M. Vitale
DRILL RIG: CME-75 Truck Rig
DRILLING METHOD: 2.25' HSA
SAMPLING METHOD: SS
HAMMER TYPE: Automatic
EFFICIENCY 92%
REVIEWED BY: K. Jaradat

BORING SB-01

Water		
∇ While Drilling		Dry
▼ Upon Completion		Dry
∇ Cave In Depth		N/A

BORING LOCATION:
See Boring Location Diagrams

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0				Approximately 7" Black topsoil				
625		☒	1	16	Yellow mottled brown CLAYEY SAND - trace gravel, moist, loose to medium dense *p200 Analysis 3.5' - 5.0'	SC	3-4-5 N=9	27	Qp= 2.0 tsf
	5	☒	2	17			3-6-9 N=15	14	Qp= 2.0 tsf p200: 20%
620		☒	3	18	Yellow mottled brown LEAN CLAY - with sand and trace gravel, moist, stiff	CL	4-5-8 N=13	16	LL = 27 PL = 14 Qp= 4.5+ tsf
	10	☒	4	18	Gray sandy LEAN CLAY - trace sand and gravel, moist, very stiff *p200 Analysis 8.5' - 10.0'	CL	5-9-11 N=20	10	Qp= 4.5+ tsf p200: 61%
615									
	15	☒	5	18			5-6-10 N=16	11	Qp= 4.5+ tsf
610									
	20	☒	6	16	Gray LEAN CLAY - with sand, trace gravel, moist, firm to very stiff	CL	5-8-9 N=17	15	LL = 26 PL = 14 Qp= 3.0 tsf
605									
	25	☒	7	16			3-5-6 N=11	18	Qp= 4.5+ tsf
					END OF BORING 25 FEET				



Professional Service Industries, Inc.
45000 Helm Street, Suite 200
Plymouth, MI 48170
Telephone: (248) 957-9911

PROJECT NO.: 03811482
PROJECT: Library at Underwood Park
LOCATION: City of Warren
Macomb County, Michigan

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

BORING SB-02

DATE STARTED: 12/3/24
DATE COMPLETED: 12/3/24
COMPLETION DEPTH 40.0 ft
BENCHMARK: N/A
ELEVATION: 627 ft
LATITUDE: 42.454666°
LONGITUDE: -82.984277°
STATION: N/A **OFFSET:** N/A
REMARKS: borehole backfilled with auger cuttings

DRILL COMPANY: PSI, Inc.
DRILLER: H. Pace **LOGGED BY:** M. Vitale
DRILL RIG: CME-75 Truck Rig
DRILLING METHOD: 2.25' HSA
SAMPLING METHOD: SS
HAMMER TYPE: Automatic
EFFICIENCY 92%
REVIEWED BY: K. Jaradat

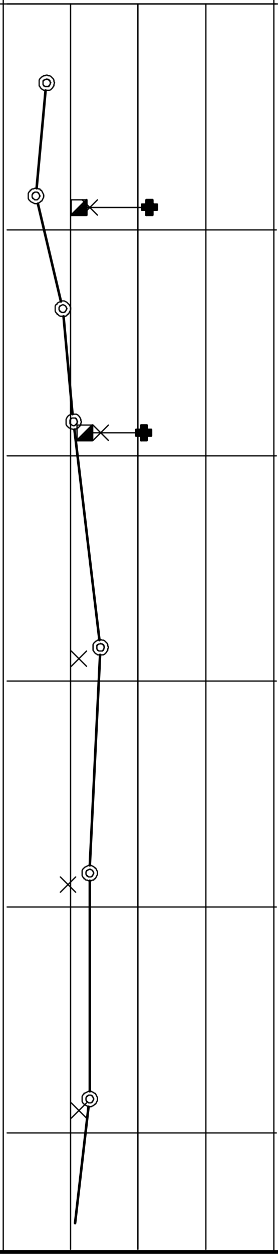
Water		
▽	While Drilling	Dry
▼	Upon Completion	Dry
▼	Cave In Depth	N/A

BORING LOCATION:
See Boring Location Diagrams

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
627	0				Approximately 6" Black topsoil				
		⊠	1	16	Brown LEAN CLAY - with sand and brick, moist, firm (Fill)	CL	3-3-5 N=8		Qp= 1.25 tsf
		⊠	2	15			4-3-3 N=6	16	LL = 27 PL = 14 Qp= 0.75 tsf
	5					CL			
		⊠	3	17	Gray LEAN CLAY - with sand, trace gravel, moist, stiff	CL	3-4-7 N=11		Qp= 4.5+ tsf
		⊠	4	18			3-6-7 N=13	18	LL = 26 PL = 15 Qp= 1.5 tsf
	10				Gray sandy LEAN CLAY - trace gravel, moist, stiff to very stiff *p200 Analysis 18.5' - 20.0' *p200 Analysis 23.5' - 25.0'	CL			
		⊠	5	17			3-8-10 N=18	14	Qp= 4.5+ tsf
	15								
		⊠	6	18			4-7-9 N=16	12	Qp= 4.5+ tsf p200: 62%
	20								
		⊠	7	18			3-8-8 N=16	14	Qp= 1.75 tsf p200: 70%
	25								
600									

Elevation scale: 625, 620, 615, 610, 605, 600

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



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Professional Service Industries, Inc.
45000 Helm Street, Suite 200
Plymouth, MI 48170
Telephone: (248) 957-9911

PROJECT NO.: 03811482
PROJECT: Library at Underwood Park
LOCATION: City of Warren
Macomb County, Michigan

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

DATE STARTED: 12/3/24
DATE COMPLETED: 12/3/24
COMPLETION DEPTH 40.0 ft
BENCHMARK: N/A
ELEVATION: 627 ft
LATITUDE: 42.454666°
LONGITUDE: -82.984277°
STATION: N/A **OFFSET:** N/A
REMARKS: borehole backfilled with auger cuttings

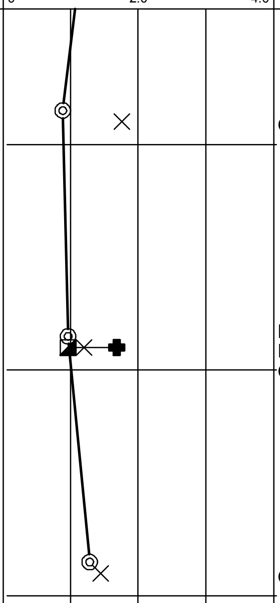
DRILL COMPANY: PSI, Inc.
DRILLER: H. Pace **LOGGED BY:** M. Vitale
DRILL RIG: CME-75 Truck Rig
DRILLING METHOD: 2.25' HSA
SAMPLING METHOD: SS
HAMMER TYPE: Automatic
EFFICIENCY 92%
REVIEWED BY: K. Jaradat

BORING SB-02

Water		
▽	While Drilling	Dry
▼	Upon Completion	Dry
▽	Cave In Depth	N/A

BORING LOCATION:
See Boring Location Diagrams

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL 0 25 50 STRENGTH, tsf ▲ Qu ✳ Qp 0 2.0 4.0	Additional Remarks
		▨	☒	8	18	Gray sandy LEAN CLAY - trace gravel, moist, stiff to very stiff *p200 Analysis 18.5' - 20.0' *p200 Analysis 23.5' - 25.0'	CL	3-5-6 N=11	22		Qp= 1.0 tsf
595	30	▨									
		▨	☒	9	18	Gray LEAN CLAY - with sand, trace gravel, moist, stiff to very stiff	CL	3-5-7 N=12	15		LL = 21 PL = 12 Qp= 2.5 tsf
590	35	▨									
	40	▨	☒	10	18			4-8-8 N=16	18		Qp= 0.75 tsf
						END OF BORING 40 FEET					



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Telephone: (248) 957-9911

PROJECT NO.: 03811482
PROJECT: Library at Underwood Park
LOCATION: City of Warren
Macomb County, Michigan

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

BORING SB-03

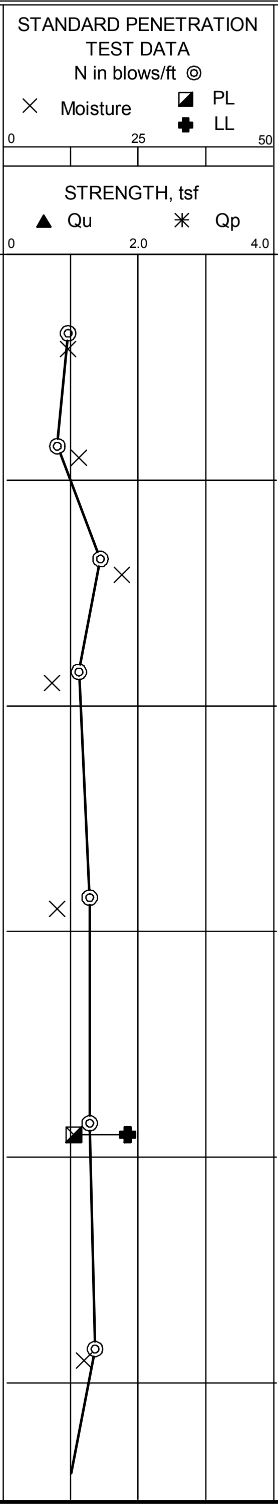
DATE STARTED: 12/3/24
DATE COMPLETED: 12/3/24
COMPLETION DEPTH 40.0 ft
BENCHMARK: N/A
ELEVATION: 627 ft
LATITUDE: 42.454664°
LONGITUDE: -82.984101°
STATION: N/A **OFFSET:** N/A
REMARKS: borehole backfilled with auger cuttings

DRILL COMPANY: PSI, Inc.
DRILLER: H. Pace **LOGGED BY:** M. Vitale
DRILL RIG: CME-75 Truck Rig
DRILLING METHOD: 2.25' HSA
SAMPLING METHOD: SS
HAMMER TYPE: Automatic
EFFICIENCY 92%
REVIEWED BY: K. Jaradat

Water		
▽	While Drilling	Dry
▼	Upon Completion	Dry
▽	Cave In Depth	N/A

BORING LOCATION:
See Boring Location Diagrams

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Approximately 6" Black topsoil				
625				1	17	Brown LEAN CLAY - trace sand and gravel, moist, stiff (Fill)	CL	4-6-6 N=12	12	Qp= 4.5+ tsf
	5			2	18	Yellow mottled brown LEAN CLAY - with sand and trace gravel, moist, stiff *p200 Analysis 3.5' - 5.0'	CL	4-4-6 N=10	14	Qp= 4.5+ tsf p200: 71%
620				3	16	Yellow mottled brown CLAYEY SAND - trace gravel, moist, medium dense *p200 Analysis 6.0' - 7.5'	SC	4-7-11 N=18	22	p200: 36% Qp= 3.0 tsf
				4	18	Gray SILT - with sand, trace gravel, moist, stiff	ML	4-7-7 N=14	9	Qp= 4.5+ tsf
	10					Gray LEAN CLAY - with sand and trace gravel, moist, stiff to very stiff *p200 Analysis 28.5' - 30.0'				
615										
				5	18			5-8-8 N=16	10	Qp= 4.5+ tsf
	15									
610										
				6	18		CL	4-7-9 N=16	13	LL = 23 PL = 13 Qp= 2.5 tsf
	20									
605										
				7	17			5-9-8 N=17	15	Qp= 2.25 tsf
	25									
600										



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PROJECT NO.: 03811482
PROJECT: Library at Underwood Park
LOCATION: City of Warren
Macomb County, Michigan

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

DATE STARTED: 12/3/24
DATE COMPLETED: 12/3/24
COMPLETION DEPTH 40.0 ft
BENCHMARK: N/A
ELEVATION: 627 ft
LATITUDE: 42.454664°
LONGITUDE: -82.984101°
STATION: N/A **OFFSET:** N/A
REMARKS: borehole backfilled with auger cuttings

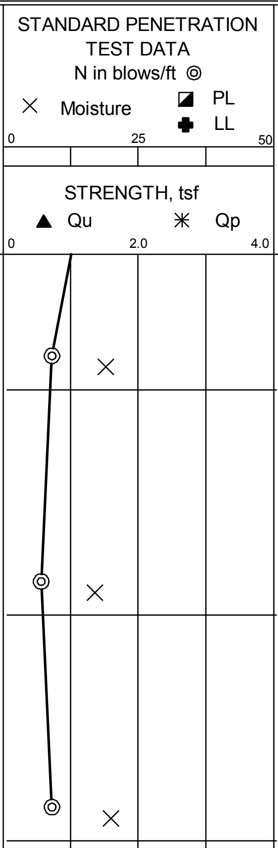
DRILL COMPANY: PSI, Inc.
DRILLER: H. Pace **LOGGED BY:** M. Vitale
DRILL RIG: CME-75 Truck Rig
DRILLING METHOD: 2.25' HSA
SAMPLING METHOD: SS
HAMMER TYPE: Automatic
EFFICIENCY 92%
REVIEWED BY: K. Jaradat

BORING SB-03

Water		
▽	While Drilling	Dry
▼	Upon Completion	Dry
▽	Cave In Depth	N/A

BORING LOCATION:
See Boring Location Diagrams

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA	Additional Remarks
		▨				Gray LEAN CLAY - with sand and trace gravel, moist, stiff to very stiff *p200 Analysis 28.5' - 30.0'	CL				
	30	▨	☒	8	18			4-4-5 N=9	19		Qp= 1.75 tsf p200: 77%
595		▨									
	35	▨	☒	9	18			3-3-4 N=7	17		Qp= 1.75 tsf
590		▨									
	40	▨	☒	10	18			3-4-5 N=9	20		Qp= 0.75 tsf
						END OF BORING 40 FEET					



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45000 Helm Street, Suite 200
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Telephone: (248) 957-9911

PROJECT NO.: 03811482
PROJECT: Library at Underwood Park
LOCATION: City of Warren
Macomb County, Michigan

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

intertek psi

GENERAL NOTES

SAMPLE IDENTIFICATION

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

DRILLING AND SAMPLING SYMBOLS

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

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

SOIL PROPERTY SYMBOLS

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

RELATIVE DENSITY OF COARSE-GRAINED SOILS

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

ANGULARITY OF COARSE-GRAINED PARTICLES

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

GRAIN-SIZE TERMINOLOGY

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

PARTICLE SHAPE

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

RELATIVE PROPORTIONS OF FINES

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

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

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

MOISTURE CONDITION DESCRIPTION

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

RELATIVE PROPORTIONS OF SAND AND GRAVEL

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

STRUCTURE DESCRIPTION

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

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

SCALE OF RELATIVE ROCK HARDNESS

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

ROCK BEDDING THICKNESSES

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

ROCK VOIDS

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

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

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

ROCK QUALITY DESCRIPTION

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

DEGREE OF WEATHERING

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

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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

Graphic Symbols for Materials and Rock Deposits

▨	CONCRETE Portland Cement Concrete
■	BITUMINOUS CONCRETE
▤	CLAYSTONE
▨	COAL Coal, Anthracite Coal
🟩	CONGLOMERATE/BRECCIA Conglomerate, Breccia
⊞	IGNEOUS ROCK Anorthsite, Basalt, Metabasalt, Diabase (Gabbro), Gabbro, Granite/Granodionite, Homfels, Pegmatite, Rhyolite/Metarhyolite
▦	LIMESTONE Limestone, Dolomite
▧	METAMORPHIC ROCK Amphibolite, Gneiss, Marble, Phyllite, Quartzite, Schist, Serpentinite, Slate
▦	CHERT
▤	SANDSTONE Sandstone, Orthoquarzite (Sandstone)
▤	SHALE
▤	SILTSTONE
□	NO RECOVERY
⊠	VOID

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Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-01
Project Number:	3811482	Sample Number:	SS2
Sample Date:	12/3/2024	Sample Depth:	3.5' - 5.0'
Test Date:	12/5/2024	Tested By:	RA/SS
		Checked By:	

Sample Description: **Yellow mottled brown CLAYEY SAND - trace gravel**

Tare Number / Tare Weight (g):	171.69
Dry Weight of Sample and Tare before Wash (g):	291.32
Dry Weight of Sample and Tare after Wash (g):	266.96
Loss By Wash (g):	24.4
% Loss By Wash:	20.4%

The speciman was soaked for: 3 hrs.

Oven: 381-OV-01 ☐
381-OV-02 ☑
Scale 381-PS-05 ☑
381-PS-02 ☐
Sieve: 381-SV-15 ☐

ATTERBERG LIMITS (ASTM D4318)

Client:	City of Warren
Project Name:	Library in Underwood Park
Project No.:	03811482
Location:	City of Warren, Michigan
Source:	SB-01
Sample No.:	SS3
Sample Depth:	6.0' - 7.5'
Date:	12/6/2024
Tested by:	RA/SS
Checked by:	

Estimated % Soil retained on No. 40: 16.37% **Air-dried Sample** ☑

Sample Description: Gray LEAN CLAY - with sand, trace gravel

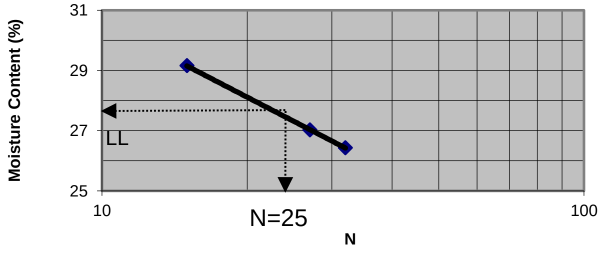
LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
432	11.47	21.85	19.68	32	**26.4**
187	12.35	25.37	22.60	27	**27.0**
158	12.36	25.34	22.41	15	**29.2**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
186	12.47	25.58	23.91	**14.6**
7	11.02	22.03	20.66	**14.2**
				14.4

Plot of Moisture Content versus Number of Blows for the Liquid Limit Test



y = -3.602ln(x) + 38.905

Liquid Limit (LL) = 27
Plastic Limit (PL) = **14**
Plasticity Index (PI) = **13**
PI = LL - PL

Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-01
Project Number:	3811482	Sample Number:	SS4
Sample Date:	12/3/2024	Sample Depth:	8.5' - 10.0'
Test Date:	12/5/2024	Tested By:	RA/SS
		Checked By:	

Sample Description: **Gray sandy LEAN CLAY - trace gravel**

Tare Number / Tare Weight (g):	184.24
Dry Weight of Sample and Tare before Wash (g):	353.00
Dry Weight of Sample and Tare after Wash (g):	250.44
Loss By Wash (g):	102.6
% Loss By Wash:	60.8%

The speciman was soaked for: 3 hrs.

Oven:	381-OV-01	☐
	381-OV-02	☑
Scale	381-PS-05	☑
	381-PS-02	☐
Sieve:	381-SV-15	☐

ATTERBERG LIMITS (ASTM D4318)

Client: City of Warren
Project Name: Library in Underwood Park
Project No.: 03811482
Location: City of Warren, Michigan
Source: SB-01
Sample No.: SS6
Sample Depth: 18.5' - 20.0'
Date: 12/6/2024
Tested by: RA/SS
Checked by:
Estimated % Soil retained on No. 40: 27.30% **Air-dried Sample** ☑

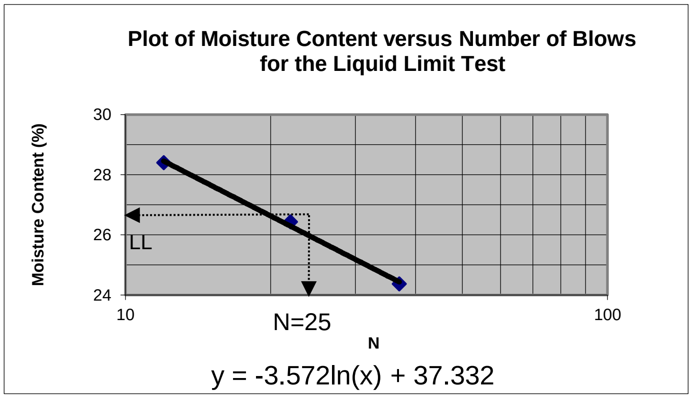
Sample Description: Gray LEAN CLAY - with sand, trace gravel

LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
345	11.67	23.87	21.48	37	**24.4**
127	12.42	25.96	23.13	22	**26.4**
5a	11.01	23.49	20.73	12	**28.4**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
334	11.64	23.41	21.99	**13.7**
34a	11.23	24.30	22.74	**13.6**
				13.6



Liquid Limit (LL) = 26
Plastic Limit (PL) = **14**
Plasticity Index (PI) = **12**
PI = LL - PL

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ATTERBERG LIMITS (ASTM D4318)

Client: City of Warren
Project Name: Library in Underwood Park
Project No.: 03811482
Location: City of Warren, Michigan
Source: SB-02
Sample No.: SS2
Sample Depth: 3.5' - 5.0'
Date: 12/6/2024
Tested by: RA/SS
Checked by:
Estimated % Soil retained on No. 40: 23.08% **Air-dried Sample** ☑

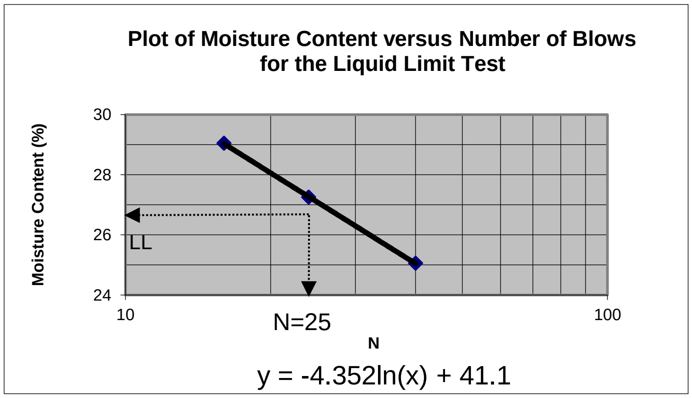
Sample Description: Brown LEAN CLAY - with sand and brick

LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
367	11.50	23.48	21.08	40	**25.1**
153	12.43	23.45	21.09	24	**27.3**
387	11.49	24.42	21.51	16	**29.0**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
363	11.70	25.24	23.58	**14.0**
406	11.50	26.31	24.45	**14.4**
				14.2



Liquid Limit (LL) =	27
Plastic Limit (PL) =	**14**
Plasticity Index (PI) =	**12**

PI = LL - PL

ATTERBERG LIMITS (ASTM D4318)

Client:	City of Warren
Project Name:	Library in Underwood Park
Project No.:	03811482
Location:	City of Warren, Michigan
Source:	SB-02
Sample No.:	SS4
Sample Depth:	8.5' - 10.0'
Date:	12/6/2024
Tested by:	RA/SS
Checked by:	

Estimated % Soil retained on No. 40: 19.02% **Air-dried Sample** ☑

Sample Description: Gray LEAN CLAY - with sand and trace gravel

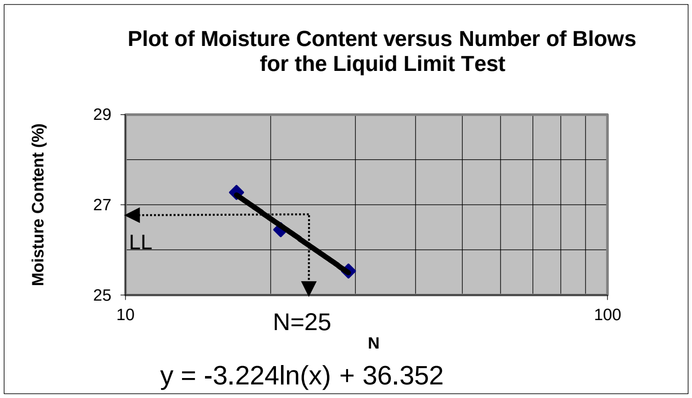
LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
331	11.40	24.38	21.74	29	**25.5**
407	11.56	23.37	20.90	21	**26.4**
203	12.34	25.50	22.68	17	**27.3**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
15	10.96	23.32	21.74	**14.7**
468	11.77	24.38	22.77	**14.6**

14.6



Plot of Moisture Content versus Number of Blows for the Liquid Limit Test

y = -3.224ln(x) + 36.352

Liquid Limit (LL) =	26
Plastic Limit (PL) =	**15**
Plasticity Index (PI) =	**11**

PI = LL - PL

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Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-02
Project Number:	3811482	Sample Number:	SS6
Sample Date:	12/3/2024	Sample Depth:	18.5' - 20.0'
Test Date:	12/5/2024	Tested By:	RA
		Checked By:	

Sample Description: **Gray sandy LEAN CLAY - trace gravel**

Tare Number / Tare Weight (g):	208.13
Dry Weight of Sample and Tare before Wash (g):	392.93
Dry Weight of Sample and Tare after Wash (g):	279.13
Loss By Wash (g):	113.8
% Loss By Wash:	61.6%

The speciman was soaked for: 3 hrs.

Oven:	381-OV-01	☐
	381-OV-02	☑
Scale	381-PS-05	☑
	381-PS-02	☐
Sieve:	381-SV-15	☐

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Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-03
Project Number:	3811482	Sample Number:	SS6
Sample Date:	12/3/2024	Sample Depth:	18.0' - 20.0'
Test Date:	12/30/2024	Tested By:	RA/SS
		Checked By:	

Sample Description: **Gray sandy LEAN CLAY - trace gravel**

Tare Number / Tare Weight (g):	234.09
Dry Weight of Sample and Tare before Wash (g):	495.63
Dry Weight of Sample and Tare after Wash (g):	319.9
Loss By Wash (g):	175.7
% Loss By Wash:	67.2%

The speciman was soaked for: 3 hrs.

Oven: 381-OV-01 ☐
381-OV-02 ☑
Scale 381-PS-05 ☑
381-PS-02 ☐
Sieve: 381-SV-15 ☐

ATTERBERG LIMITS (ASTM D4318)

Client:	City of Warren
Project Name:	Library in Underwood Park
Project No.:	03811482
Location:	City of Warren, Michigan
Source:	SB-02 (Shelby)
Sample No.:	SS6
Sample Depth:	18.0' - 20.0'
Date:	12/30/2024
Tested by:	RA/SS
Checked by:	

Estimated % Soil retained on No. 40: 24.36% **Air-dried Sample** ☑

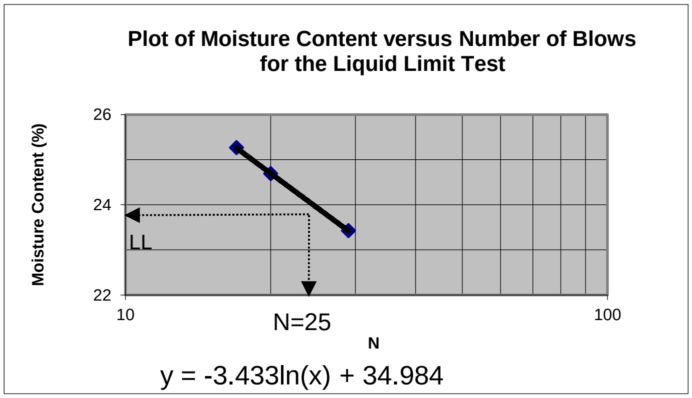
Sample Description: Gray LEAN CLAY - with sand, trace gravel

LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
132	12.45	27.36	24.53	29	**23.4**
350	11.52	25.51	22.74	20	**24.7**
414	11.73	24.72	22.10	17	**25.3**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
69	11.12	17.81	17.04	**13.0**
21	11.11	18.33	17.49	**13.2**
				13.1



Liquid Limit (LL) =	24
Plastic Limit (PL) =	**13**
Plasticity Index (PI) =	**11**

PI = LL - PL

Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-02
Project Number:	3811482	Sample Number:	SS7
Sample Date:	12/3/2024	Sample Depth:	23.5' - 25.0'
Test Date:	12/5/2024	Tested By:	RA/SS
		Checked By:	

Sample Description: **Gray sandy LEAN CLAY - trace gravel**

Tare Number / Tare Weight (g):	210.69
Dry Weight of Sample and Tare before Wash (g):	396.52
Dry Weight of Sample and Tare after Wash (g):	266.44
Loss By Wash (g):	130.1
% Loss By Wash:	70.0%

The speciman was soaked for: 3 hrs.

Oven:	381-OV-01	☐
	381-OV-02	☑
Scale	381-PS-05	☑
	381-PS-02	☐
Sieve:	381-SV-15	☐

ATTERBERG LIMITS (ASTM D4318)

Client: City of Warren
Project Name: Library in Underwood Park
Project No.: 03811482
Location: City of Warren, Michigan
Source: SB-02
Sample No.: SS9
Sample Depth: 33.5' - 35.0'
Date: 12/6/2024
Tested by: RA/SS
Checked by:
Estimated % Soil retained on No. 40: 28.52% **Air-dried Sample** ☑

Sample Description: Gray LEAN CLAY - with sand, trace gravel

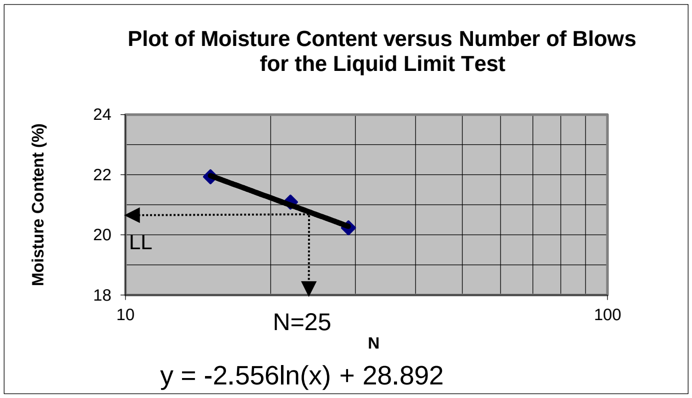
LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
145	12.49	23.90	21.98	29	**20.2**
17a	11.06	24.27	21.97	22	**21.1**
28	11.09	23.21	21.03	15	**21.9**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
457	11.51	22.26	21.10	**12.1**
475	11.54	21.46	20.41	**11.8**
				12.0

Plot of Moisture Content versus Number of Blows for the Liquid Limit Test



y = -2.556ln(x) + 28.892

Liquid Limit (LL) =	21
Plastic Limit (PL) =	**12**
Plasticity Index (PI) =	**9**

PI = LL - PL

Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-03
Project Number:	3811482	Sample Number:	SS2
Sample Date:	12/3/2024	Sample Depth:	3.5' - 5.0'
Test Date:	12/5/2024	Tested By:	RA/SS
		Checked By:	

Sample Description: **LEAN CLAY - with sand and trace gravel**

Tare Number / Tare Weight (g):	232.21
Dry Weight of Sample and Tare before Wash (g):	410.23
Dry Weight of Sample and Tare after Wash (g):	284.11
Loss By Wash (g):	126.1
% Loss By Wash:	70.8%

The speciman was soaked for: 3 hrs.

Oven:	381-OV-01	☐
	381-OV-02	☑
Scale	381-PS-05	☑
	381-PS-02	☐
Sieve:	381-SV-15	☐

Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-03
Project Number:	3811482	Sample Number:	SS3
Sample Date:	12/3/2024	Sample Depth:	6.0' - 7.5'
Test Date:	12/5/2024	Tested By:	RA/SS
		Checked By:	

Sample Description: **Yellow mottled brown CLAYEY SAND - trace gravel**

Tare Number / Tare Weight (g):	184.15
Dry Weight of Sample and Tare before Wash (g):	404.04
Dry Weight of Sample and Tare after Wash (g):	324.94
Loss By Wash (g):	79.1
% Loss By Wash:	36.0%

The speciman was soaked for: 3 hrs.

Oven: 381-OV-01 ☐
381-OV-02 ☑
Scale 381-PS-05 ☑
381-PS-02 ☐
Sieve: 381-SV-15 ☐

Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-03
Project Number:	3811482	Sample Number:	SS4
Sample Date:	12/3/2024	Sample Depth:	8.0' - 10.0'
Test Date:	12/30/2024	Tested By:	RA/SS
		Checked By:	

Sample Description: **Gray sandy LEAN CLAY - trace gravel**

Tare Number / Tare Weight (g):	216.6
Dry Weight of Sample and Tare before Wash (g):	564.17
Dry Weight of Sample and Tare after Wash (g):	387.96
Loss By Wash (g):	176.2
% Loss By Wash:	50.7%

The speciman was soaked for: 3 hrs.

Oven:	381-OV-01	☐
	381-OV-02	☑
Scale	381-PS-05	☑
	381-PS-02	☐
Sieve:	381-SV-15	☐

ATTERBERG LIMITS (ASTM D4318)

Client: City of Warren
Project Name: Library in Underwood Park
Project No.: 03811482
Location: City of Warren, Michigan
Source: SB-03 (Shelby)
Sample No.: SS4
Sample Depth: 8.0' - 10.0'
Date: 12/30/2024
Tested by: RA/SS
Checked by:
Estimated % Soil retained on No. 40: 32.09% **Air-dried Sample** ☑

Sample Description: Gray sandy LEAN CLAY - trace gravel

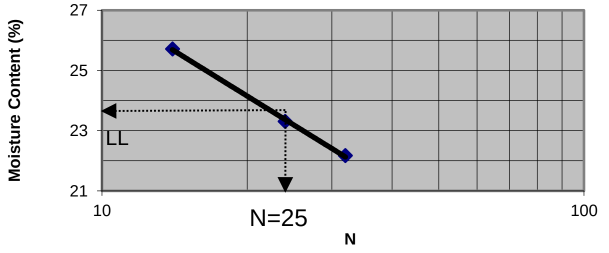
LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
131	12.36	26.69	24.09	32	**22.2**
452	11.69	24.44	22.03	24	**23.3**
478	11.62	26.24	23.25	14	**25.7**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
110	12.40	19.39	18.61	**12.6**
431	11.56	16.95	16.36	**12.3**
				12.4

Plot of Moisture Content versus Number of Blows for the Liquid Limit Test



y = -4.309ln(x) + 37.06

Liquid Limit (LL) = 23
Plastic Limit (PL) = **12**
Plasticity Index (PI) = **11**
PI = LL - PL

ATTERBERG LIMITS (ASTM D4318)

Client: City of Warren
Project Name: Library in Underwood Park
Project No.: 03811482
Location: City of Warren, Michigan
Source: SB-03
Sample No.: SS6
Sample Depth: 18.5' - 20.0'
Date: 12/6/2024
Tested by: RA/SS
Checked by:
Estimated % Soil retained on No. 40: 25.18% **Air-dried Sample** ☑

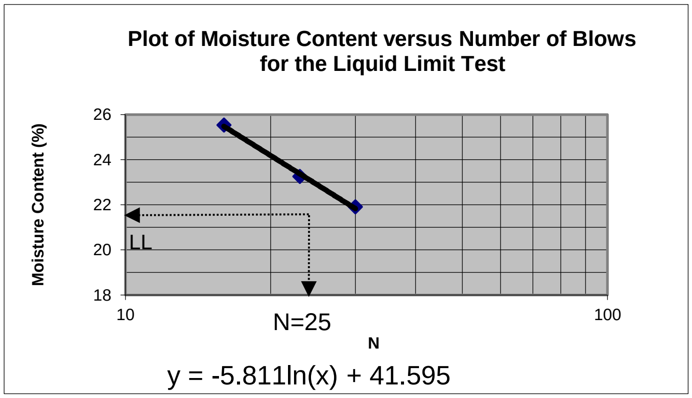
Sample Description: Gray LEAN CLAY - with sand, trace gravel

LIQUID LIMIT TEST (Method A)

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Number of Blows (N)	Moisture Content w (%)
3	11.03	23.22	21.03	30	**21.9**
28a	11.15	22.97	20.74	23	**23.3**
42a	11.08	22.83	20.44	16	**25.5**

PLASTIC LIMIT TEST

Can No.	Weight of Can W_1 (g)	Weight of Can + Wet Soil W_2 (g)	Weight of Can + Dry Soil W_3 (g)	Plastic Limit w (%)
181	12.44	26.85	25.24	**12.6**
35	11.04	24.56	23.05	**12.6**
				12.6



Liquid Limit (LL) =	23
Plastic Limit (PL) =	**13**
Plasticity Index (PI) =	**10**

PI = LL - PL

intertek psi

Materials in Solid Finer than the No. 200 Sieve
(ASTM D1140)

Project Name:	Library at Underwood Park	Boring Number:	SB-03
Project Number:	3811482	Sample Number:	SS8
Sample Date:	12/3/2024	Sample Depth:	28.5' - 30.0'
Test Date:	12/5/2024	Tested By:	RA
		Checked By:	

Sample Description: **Gray LEAN CLAY - with sand and trace gravel**

Tare Number / Tare Weight (g):	235.18
Dry Weight of Sample and Tare before Wash (g):	384.04
Dry Weight of Sample and Tare after Wash (g):	269.63
Loss By Wash (g):	114.4
% Loss By Wash:	76.9%

The speciman was soaked for: 3 hrs.

Oven:	381-OV-01	☐
	381-OV-02	☑
Scale	381-PS-05	☑
	381-PS-02	☐
Sieve:	381-SV-15	☐

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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Intertek

For more than 135 years, companies around the world have depended on Intertek to help ensure the quality and safety of their products, processes and systems.

We go beyond testing, inspecting and certifying products; we are a Total Quality Assurance provider to industries worldwide. Through our global network of state-of-the-art facilities and industry-leading technical expertise we provide innovative and bespoke Assurance, Testing, Inspection and Certification services to customers. We provide a systemic approach to supporting our customers' Quality Assurance efforts in each of the areas of their operations including R&D, raw materials sourcing, components suppliers, manufacturing, transportation, distribution and retail channels, and consumer management.

Intertek is an industry leader with more than 42,000 employees in 1,000 locations in over 100 countries. We deliver Quality Assurance expertise 24 hours a day, 7 days a week with our industry-winning processes and customer-centric culture. Whether your business is local or global, we can help to ensure that your products meet quality, health, environmental, safety, and social accountability standards for virtually any market around the world. We hold extensive global accreditations, recognitions, and agreements, and our knowledge of and expertise in overcoming regulatory, market, and supply chain hurdles is unrivaled.

Our Mission

To exceed our customers' expectations with innovative and bespoke Assurance, Testing, Inspection and Certification services for their operations and supply chain.
Globally. 24/7.

Intertek can sharpen your competitive edge

- With reliable testing and certification for faster regulatory approval
- Through rapid, efficient entry to virtually any market in the world
- With Total Quality Assurance across your supply chain
- Through innovative leadership in meeting social accountability standards
- By reducing cost and minimizing health, safety, and security risks
- By becoming a TRUSTED BRAND

PSI

Professional Service Industries, Inc. (PSI), an Intertek company, nationally recognized consulting engineering and testing firm providing integrated services in several disciplines, including environmental consulting, building envelope consulting and testing, geotechnical engineering, construction materials testing and engineering, asbestos management and facilities engineering and consulting. We are recognized as one of the largest engineering design consulting companies in the US. We have been providing engineering consulting services to Fortune 500 clients and governmental agencies for over 100 years. However, our proudest accomplishment is the large number of clients that we have serviced for many years that keep coming back because of our responsiveness, commitment to listening to our clients, and consistent quality of service.

PSI has been providing business and industry with objective, accurate and useful information for more than 100 years. Today, we employ approximately 2,300 skilled personnel in 100 offices nationwide.

Distinguished as both a local and a national leader in engineering and environmental services, PSI is recognized in several disciplines including the following:

- Geotechnical Engineering
- Construction Materials Testing and Special Inspection
- Environmental Consulting
- Industrial Hygiene
- Nondestructive Examination
- Pavement Evaluation Services
- Building Science Solutions
    - Building Envelope
    - Curtainwall
    - Acoustic
    - Fire/Life Safety
    - Technology
    - Roof Consulting

PSI can provide outstanding consulting engineering and testing services; however, most of all we desire to demonstrate our commitment to excellence.

PSI provides its clients with ***Information To Build On*** in making knowledgeable, cost-effective business decisions that help their clients reduce expenses, improve quality and decrease liabilities.

A Commitment To Excellence

PSI maintains the highest professional and ethical standards, which include an economic awareness to provide the highest quality of personnel and service at a reasonable cost to our clients. Our unique combination of local, independent offices and nationwide resources means our project managers have the full responsibility for managing your local projects, and also have the national resources to handle the most challenging and complex projects, regardless of size.

While PSI's growth has been notable, even more impressive has been our ability to grow without sacrificing our technical knowledge or personalized attention to our clients. Recognition of the importance of our clients and repeat business has been a key factor in PSI's success. PSI will not sacrifice quality, value, or service to our clients.

A Commitment To Excellence (continued)

Our staff of professionals consists of the following:

- Professional Engineers (PE/PEng)
- Registered Roof Consultants (RRC)
- Registered Architects (AIA)
- Certified Industrial Hygienists (CIH)
- Registered Soil Scientists
- Engineers-In-Training (EIT)
- Registered Geologists

Our field and laboratory technicians are trained in-house and at special schools and seminars. Our project managers and technicians are certified by associations such as the following and also work with other specialized organizations within each discipline.

- Roofing Industry Educational Institute (RIEI)
- Roof Consultants Institute (RCI)
- American Concrete Institute (ACI)
- National Institute for the Certification of Engineering Technicians (NICET)
- American Welding Society (AWS)
- International Code Council (ICC)
- International Fire Council (IFC)

Since our founding, we have dedicated ourselves to excellence both in our technical expertise and in customer service. It is this principal upon which we have based our organization and established a national reputation as a leader in the field of professional engineering, testing and consulting services.

PSI's Vision… is to be the most trusted, integrated provider of "Information To Build On" for clients that buy, sell, design, construct, develop, finance and manage properties and infrastructure. By being safe 24/7/365, hiring and retaining the best employees, efficiently managing projects, and building close client relationships, we will be successful in growing PSI and in balancing the needs of our employees, clients and investors.