Geotechnical Engineering Report

Medina Lake Trail Project
Medina, Medina County, Ohio
May 11, 2023
Terracon Project No. N6225271

Prepared for:
Medina County Park District
Medina, Ohio

Prepared by:
Terracon Consultants, Inc.
Parma, Ohio

May 11, 2023

Medina County Park District
6364 Deerview Lane
Medina, Ohio 44256

Attn: Mr. Isaac D. Smith – Planning & Operations Manager
P: (330) 722-9364
E: ismith@medinaco.org

Re: Geotechnical Engineering Report
Medina Lake Trail Project
Between Rt 18 and West Smith Road
Medina, Medina County, Ohio
Terracon Project No. N6225271

Dear Mr. Smith:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PN6225271 with a revised date of April 7, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, retaining walls and pavements for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

STATE OF OHIO
RICHARD SULLIVAN
E-74861
REGISTERED PROFESSIONAL ENGINEER

Richard Sullivan, P.E.
Project Engineer – Geotechnical Services

Thomas F. McDonnell, P.E.
Principal

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Medina Lake Trail Project
Between Rt 18 and West Smith Road
Medina, Medina County, Ohio
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INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Medina Lake Trail Project to be located at Between Rt 18 and West Smith Road in Medina, Medina County, Ohio. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per IBC
- Pavement design and construction
- Excavation considerations
- Foundation design and construction
- Site preparation and earthwork
- Lateral earth pressures
- Frost considerations

The geotechnical engineering Scope of Services for this project included the advancement of 8 test borings to depths of either approximately 6 or 25 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

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

Item	Description
Parcel Information	The project is located along a generally north to south alignment from Rt. 18 to East Smith Road, between River Styx Road and Glenmoore Way in Medina, Medina County, Ohio. Latitude 41.1329 /Longitude -81.8277 (approximate) See **Site Location**

Item	Description
Existing Improvements	Existing concrete and asphalt pavement areas in the north portion of the project area.
Current Ground Cover	Moderately-heavily vegetated, mostly grass covered with some brush, shrubs and trees.
Existing Topography (from Google Earth ™)	Surface grades along the project alignment vary from approximately 1032 feet MSL in the southern portion of the project area to approximately 952 feet MSL in the northern portion of the project area.
Geology	A review of geologic literature indicates that the site is located within a glaciated area consisting of a heterogeneous mixture of clay, silt, sand, gravel and rock fragments overlying shale bedrock at a depth greater than 50 feet below ground surface. The findings of our field exploration were similar to those noted above.

PROJECT DESCRIPTION

Our understanding of the project conditions is as follows:

Item	Description
Information Provided	An email request for proposal that included a Trail Concept Plan were provided to Terracon from CESO on October 13, 2022. On March 23, 2023 a revised Trail Concept Plan with additional bore locations was provided to Terracon via e-mail from CESO.
Project Description	Medina Lake Trail Connector Project
Proposed Structure	The project includes a multi-use pedestrian trail and associated pedestrian bridge.
Pavements	We assume both rigid (concrete) and flexible (asphalt) pavement sections should be considered. At the time of this report design parameters were not provided to Terracon.

GEOTECHNICAL CHARACTERIZATION

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

Model Layer	Layer Name	General Description

1	**Surface Cover**	Topsoil: 2 to 4 inches
2	**Cohesive Soil – 1**	Soft to medium stiff clay
3	**Cohesive Soil – 2**	Stiff or better clay

GEOTECHNICAL OVERVIEW

The subsoils are expected to offer suitable support for the planned trail project providing the recommendations reported herein are observed and met.

The near-surface soils of this site have become unstable on account of the site clearing activities and will need to be dried and recompacted as part of the earthwork procedures. It should be noted that even when remedied, these fine-grained soils will retain their propensity to become unstable with typical earthwork and construction traffic, especially after precipitation events. As such, positive drainage should be established early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The **Shallow Foundations**, **Lateral Earth Pressures** and **Pavements** sections address support of properly designed and constructed foundations, retaining walls and pavements upon naturally deposited soils having a stiff or better consistency or new engineered fill bearing upon such soils.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations and pavements.

Site Preparation

Once at grade or prior to placing any fill, the subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck having a minimum gross vehicle weight (GVW) of 20 tons. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

If an area is unable to be proofrolled because it is too small or there is limited access, a geotechnical engineer should make other assessments of these areas to determine their suitability for construction.

Fill Material Types

Engineered fill should meet the following material property requirements:

Fill Type [1]	Unified Soil Classification	Acceptable Location for Placement
On-Site Lean Clay Soils	CL	All locations and elevations
Imported Granular Materials [2]	GW, GM, GC SW, SM, SC	All locations and elevations

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation and approval prior to use.
2. Imported granular fill, if required, should consist of natural sand and/or gravel or durable, crushed stone with a maximum dimension of 3 inches and be submitted to the geotechnical engineer for evaluation and approval prior to use.

Fill Compaction Requirements

Engineered fill should meet the following compaction requirements.

Item	Description
Maximum Lift Thickness	8 inches or less in loose thickness when heavy (8 tons or more), tamping foot or vibratory drum compaction equipment is used 4 inches or less in loose thickness when hand-guided equipment (i.e., jumping jack or plate compactor) or equipment less than 8 tons is used
Minimum Compaction Requirements [1]	98% of the material's standard Proctor maximum dry density (ASTM D 698)
Water Content Range [1]	Cohesive: -2% to +2% of optimum of the standard Proctor. Granular: -3% to +3% of optimum of the standard Proctor or at a suitable level to provide sufficient compaction without the material pumping when proof rolled

1. We recommend that compacted engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Grading and Drainage

All grades must provide effective drainage away from the structures during and after construction and should be maintained throughout the life of the structures. Water retained next to the structures can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable foundation movements.

Earthwork Construction Considerations

Shallow excavations for the proposed structures are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of surface features. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill or one density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

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

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

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

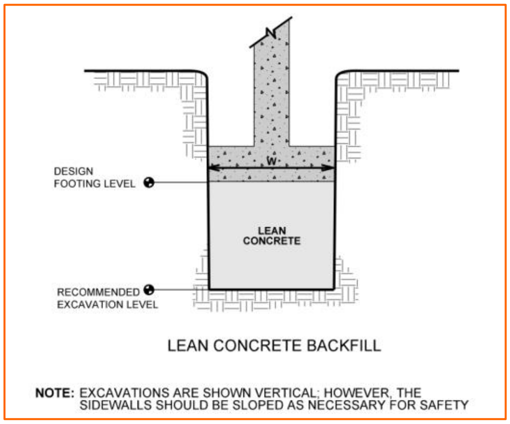
Item	Description
Maximum Net Allowable Bearing pressure [1,2]	4,000psf
Required Bearing Stratum	GeoModel Layer 4 : Stiff or better lean native clays or new engineered fill bearing upon these soils.
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 14 inches
Ultimate Coefficient of Sliding Friction [3]	0.35
Minimum Embedment below Finished Grade [4]	42 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. A factor of safety of 3 has been applied.
2. Values provided are for maximum loads noted in **Project Description**.
3. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
4. Embedment necessary to minimize the effects of frost and/or seasonal water content variations.

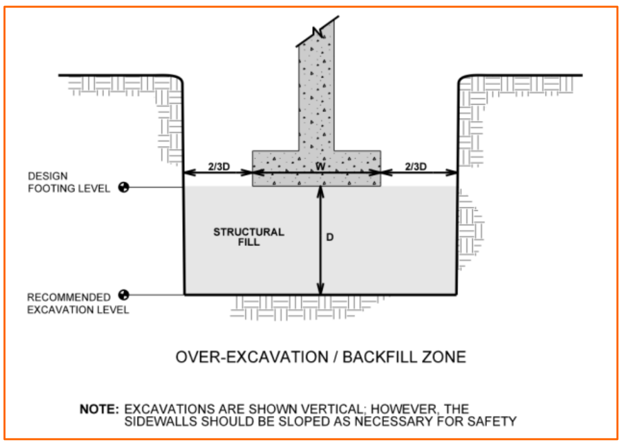
Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

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



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



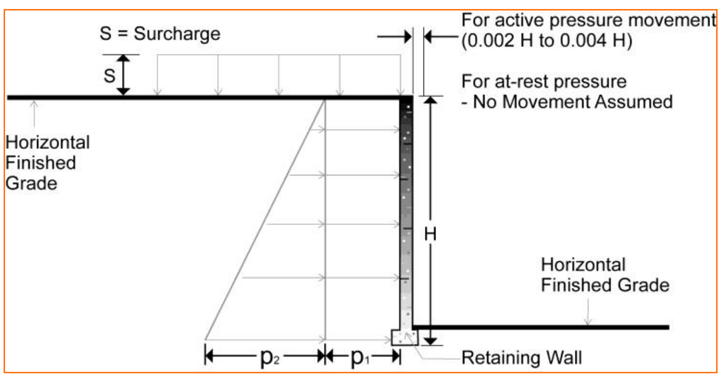
SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Subsurface explorations at this site were extended to a maximum depth of 25 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

LATERAL EARTH PRESSURES

Design Parameters

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



Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]	
			Unsaturated [6]	Submerged [6]
Active (Ka)	Granular - 0.33 Fine Grained - 0.49	(0.33)S (0.49)S	(40)H (60)H	(80)H (90)H
At-Rest (Ko)	Granular - 0.50 Fine Grained - 0.66	(0.50)S (0.66)S	(60)H (80)H	(90)H (100)H
Passive (Kp)	Granular - 3.00	---	(360)H	(235)H

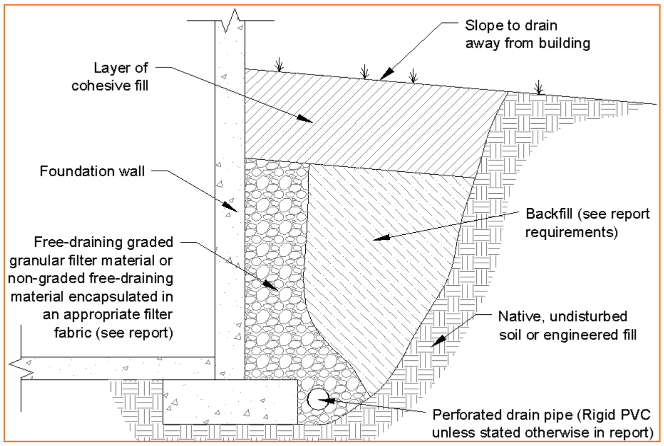
Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	**Coefficient for Backfill Type**[2]	**Surcharge Pressure** [3, 4, 5] **p_1 (psf)**	**Effective Fluid Pressures (psf)** [2, 4, 5]	
			Unsaturated [6]	**Submerged** [6]
	Fine Grained - 2.04	---	(245)H	(180)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95% of the ASTM D 698 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. To achieve “Unsaturated” conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. “Submerged” conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around an exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



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

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

Design of Asphaltic Concrete (AC) pavements are based on the procedures outlined in the National Asphalt Pavement Association (NAPA) Information Series 109 (IS-109). Design of Portland Cement Concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330; Guide for Design and Construction of Concrete Parking Lots.

A subgrade California Bearing Ratio (CBR) of 4 can be used for the AC pavement designs, and a modulus of subgrade reaction of 125 pci can be used for the PCC pavement designs. The values were empirically derived based upon our experience with the clay subgrade soils and our understanding of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. A modulus of rupture of 600 psi was used for pavement concrete.

Pavement Drainage

Subdrainage should be a primary consideration in the proposed pavement areas to prevent water from accumulating within the aggregate base course and causing weakening of the subgrade or frost heave. To this end, we recommend the installation of pipe underdrains (finger drains) radiating from all catch basins within the pavement. Where surrounded by pavement, the finger drains should be installed on all four sides of the catch basins. At catch basins located along the edge of the pavement, the finger drains should be installed on the sides that abut pavement. Subgrade surfaces should be fine graded so that water seepage under the pavements will flow to the underdrains or to other suitable drainage outlets. Establishing subgrade slopes during site grading to promote rapid surface and base course drainage away from the pavement will extend its useful life.

Final surrounding surface grades should be sloped away from the pavement on all sides to prevent ponding of water along the pavement edge. Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration.

Pavement Maintenance

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

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

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

FROST CONSIDERATIONS

The soils on this site are frost susceptible, and small amounts of water can affect the performance of the slabs on-grade, sidewalks, and pavements. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill. NFS materials are generally those that contain less than 20% of the material passing the number 200 sieve. Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Install drains around the perimeter of pavements, and connect them to the storm drainage system.
- Grade clayey subgrades, so groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base, slope toward a site drainage system.
- Place NFS fill as backfill beneath critical areas of this project.

GENERAL COMMENTS

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

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

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

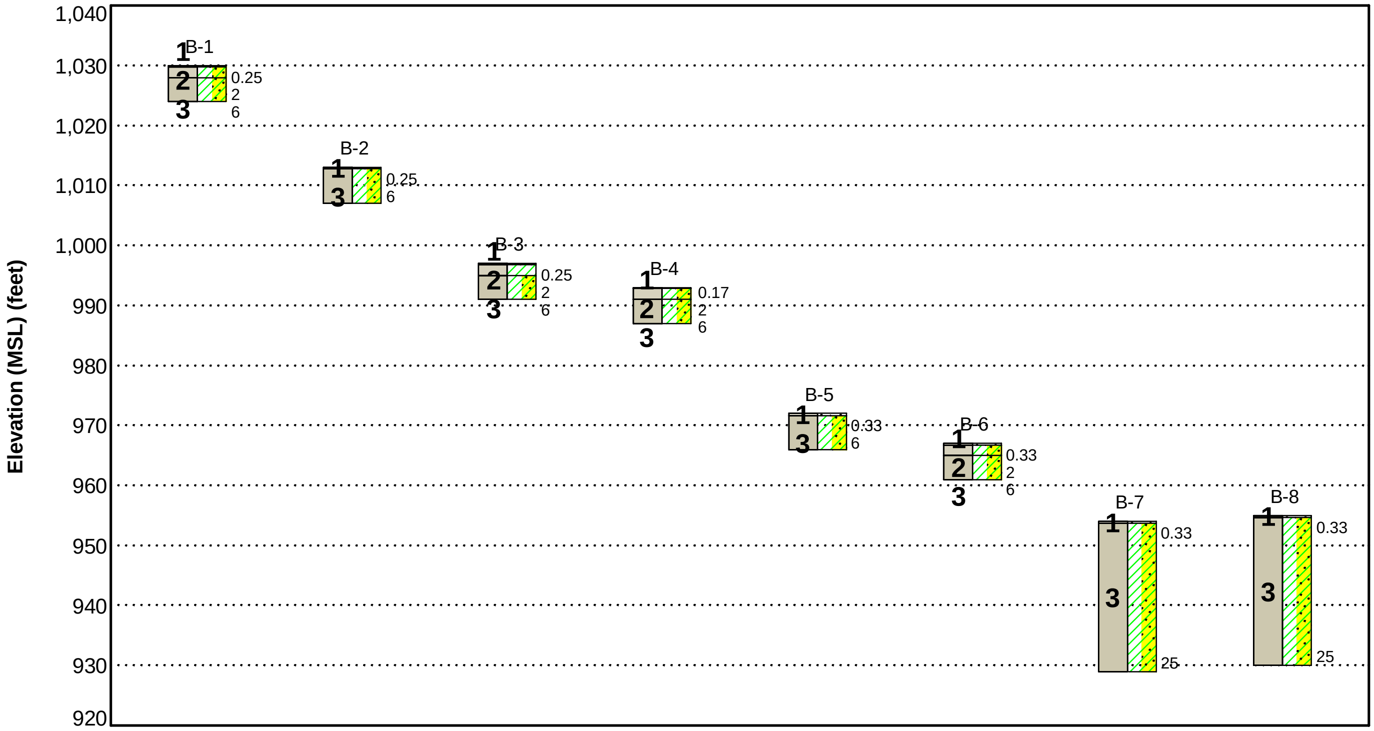
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

12460 Plaza Dr
Parma, OH

GeoModel



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

Model Layer	Layer Name	General Description
1	Surface Cover	Topsoil: 2 to 4 inches
2	Cohesive Soil - 1	Soft to medium stiff clay
3	Cohesive Soil - 2	Stiff or better clay

LEGEND

- Topsoil
- Lean Clay with Sand
- Lean Clay

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
2	25	Planned pedestrian bridge area
6	6	Planned trail/parking areas

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a recreational handheld GPS unit (estimated horizontal accuracy of ±10 feet) and approximate elevations were obtained by interpolation from Google Earth™. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted rotary drill rig using continuous flight, hollow stem augers. Four samples were obtained in the upper 10 feet of each of the bridge borings and at intervals of 5 feet thereafter and three samples in the upper six feet for the pavement/parking borings. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt and/or pre-mixed concrete, as appropriate.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The laboratory testing program included classification of soil samples by an engineer or geologist. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D2166 Unconfined Compression Test

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Medina Lake Trail Project ■ Medina, Medina County, Ohio
May 11, 2023 ■ Terracon Project No. N6225271

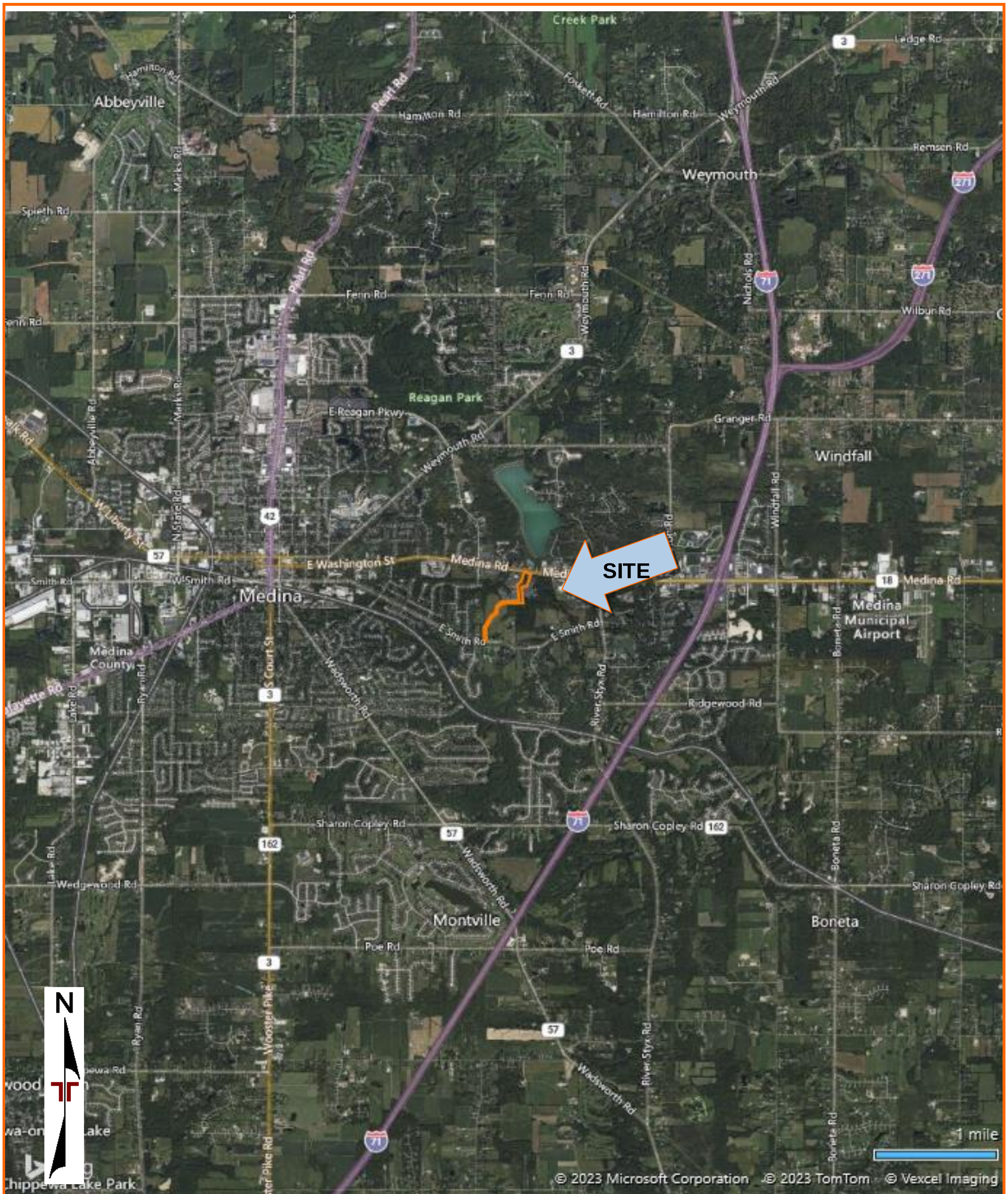


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Medina Lake Trail Project ■ Medina, Medina County, Ohio
May 11, 2023 ■ Terracon Project No. N6225271

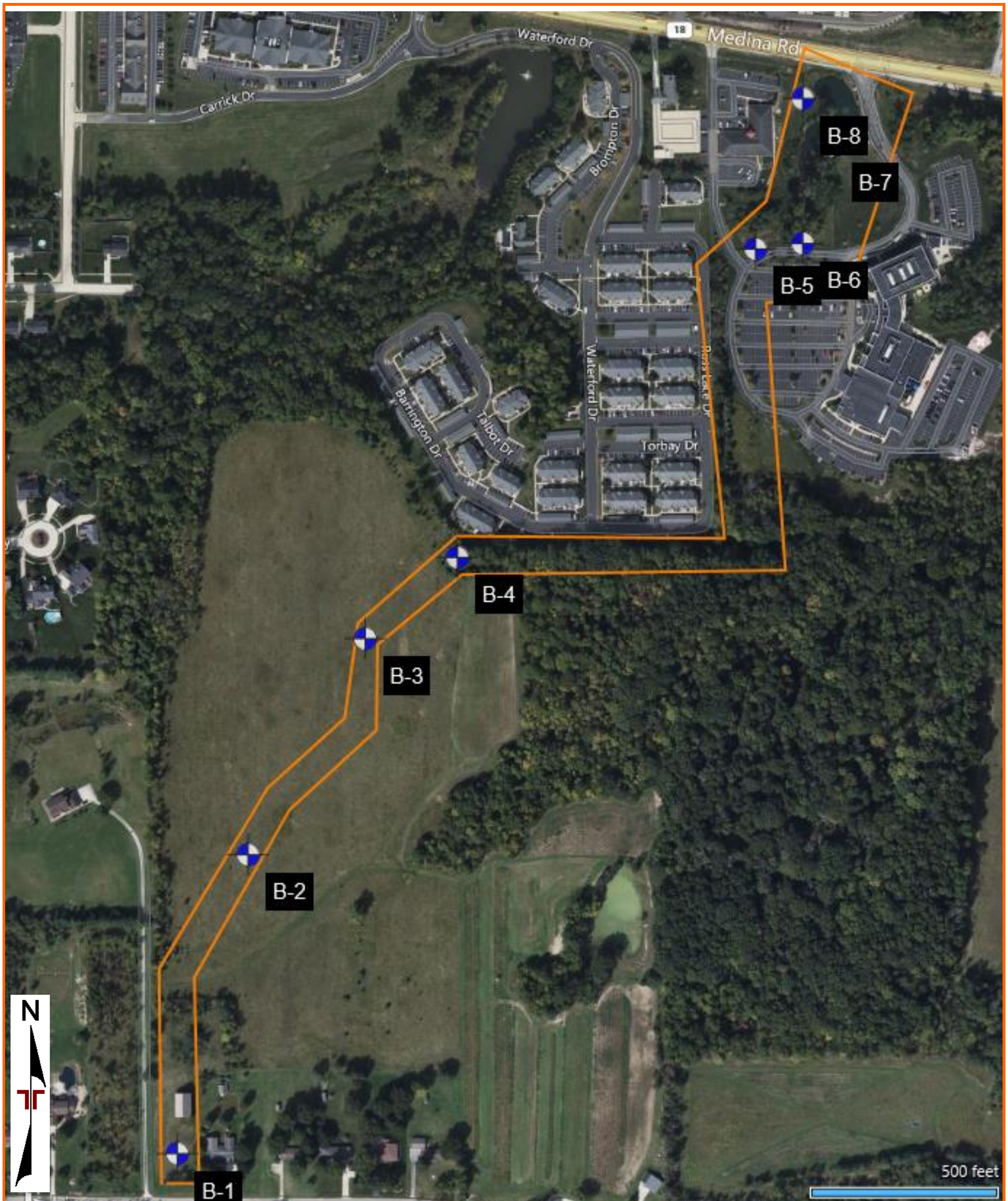


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

12460 Plaza Dr
Parma, OH

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 41.1293° Longitude: -81.8306°

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation: 1030 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.3 TOPSOIL (3") 1029.75								
2		LEAN CLAY WITH SAND (CL), brown, medium stiff			X	14	1-2-4-4 N=6	3.0 (HP)	20.3	
		2.0 1028								
3		LEAN CLAY WITH SAND (CL), brown, very stiff to hard			X	18	3-7-9-12 N=16	4.5+ (HP)		
			5		X	20	11-14-17-19 N=31	4.5+ (HP)		
		6.0 1024								
		Boring Terminated at 6 Feet								

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

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

Boring Started
04-19-2023

Boring Completed
04-19-2023

Notes
Elevation Reference: Elevations estimated from Google Earth.

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

12460 Plaza Dr
Parma, OH

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 41.1315° Longitude: -81.8299°

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation: 1013 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.3 TOPSOIL (3") 1012.75								
3		LEAN CLAY WITH SAND (CL), brown, stiff to hard				16	1-3-4-5 N=7	3.75 (HP)		
						18	6-10-13-15 N=23	4.5+ (HP)		
		6.0 1007	5			20	18-22-21-21 N=43	4.5+ (HP)		
		Boring Terminated at 6 Feet								

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

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations estimated from Google Earth.

Water Level Observations
Groundwater not encountered

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

Boring Started
04-20-2023

Boring Completed
04-20-2023

Terracon
12460 Plaza Dr
Parma, OH

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 41.1331° Longitude: -81.8288°

Elevation: 997 (Ft.) +/-

Model Layer	Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1	0.3	TOPSOIL (3")	996.75								
2	2.0	LEAN CLAY (CL), brown and gray, soft	995			X	16	1-1-2-4 N=3	2.5 (HP)	19.6	49-22-27
3		LEAN CLAY WITH SAND (CL), brown, very stiff to hard				X	16	3-5-7-10 N=12	2.75 (HP)		
3	6.0		991	5		X	18	13-13-13-13 N=26	3.5 (HP)		

Boring Terminated at 6 Feet

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

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations estimated from Google Earth.

Water Level Observations
Groundwater not encountered

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

Boring Started
04-20-2023

Boring Completed
04-20-2023

Terracon
12460 Plaza Dr
Parma, OH

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 41.1336° Longitude: -81.8279°

Depth (Ft.) Elevation: 993 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.2	TOPSOIL (2")	992.83								
2		2.0	LEAN CLAY WITH SAND (CL), brown and gray, medium stiff	991				14	1-2-3-4 N=5	1.5 (HP)	28.1	
3		6.0	LEAN CLAY WITH SAND (CL), brown, very stiff	987				18	5-6-9-11 N=15	3.0 (HP)		
					5			18	10-13-14-14 N=27	4.5+ (HP)		

Boring Terminated at 6 Feet

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

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Notes
Elevation Reference: Elevations estimated from Google Earth.

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

Boring Started
04-20-2023

Boring Completed
04-20-2023

Terracon
12460 Plaza Dr
Parma, OH

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 41.1359° Longitude: -81.8250°

Elevation: 972 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.3	TOPSOIL (4")	971.67								
3			LEAN CLAY WITH SAND (CL), brown, stiff to very stiff				X	10	3-4-5-5 N=9	4.5+ (HP)		
							X	12	2-3-4-6 N=7	2.25 (HP)	22.4	
		6.0		966	5		X	18	5-9-11-14 N=20	3.25 (HP)		

Boring Terminated at 6 Feet

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

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

Boring Started
04-19-2023

Boring Completed
04-19-2023

Notes
Elevation Reference: Elevations estimated from Google Earth.

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Terracon
12460 Plaza Dr
Parma, OH

Boring Log No. B-6

Location: See Exploration Plan

Latitude: 41.1359° Longitude: -81.8245°

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation: 967 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.3 TOPSOIL (4") 966.67								
2		LEAN CLAY WITH SAND (CL), brown, medium stiff			X	10	3-3-3-6 N=6	2.5 (HP)	19.5	
		2.0 965								
3		LEAN CLAY WITH SAND (CL), brown, very stiff to hard			X	15	3-5-7-8 N=12	4.25 (HP)		
			5		X	16	11-13-13-15 N=26	4.5+ (HP)		
		6.0 961								
		Boring Terminated at 6 Feet								

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

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations estimated from Google Earth.

Water Level Observations
Groundwater not encountered

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

Boring Started
04-19-2023

Boring Completed
04-19-2023

Terracon
12460 Plaza Dr
Parma, OH

Boring Log No. B-7

Location: See Exploration Plan

Latitude: 41.1367° Longitude: -81.8242°

Model Layer	Graphic Log	Depth (Ft.) / Material Description / Elevation: 954 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.3 TOPSOIL (4") 953.67								
3		LEAN CLAY WITH SAND (CL), brown, stiff to very stiff				10	2-3-4 N=7	4.0 (HP)	18.8	
						14	4-7-9 N=16	4.5+ (HP)		
			5			15	3-7-6 N=13	4.5+ (HP)		
		-gray below 8.5'				14		4.0 (HP)	16.3	29-17-12
			10							
			15			16	3-5-8 N=13	3.25 (HP)		
			20			12	2-3-6 N=9	2.5 (HP)	16.3	
		25.0 929	25			12	3-3-5 N=8	2.5 (HP)		
		Boring Terminated at 25 Feet								

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

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations estimated from Google Earth.

Water Level Observations

Groundwater not encountered

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

Boring Started
04-19-2023

Boring Completed
04-19-2023

Terracon
12460 Plaza Dr
Parma, OH

Boring Log No. B-8

Location: See Exploration Plan

Latitude: 41.1370° Longitude: -81.8245°

Elevation: 955 (Ft.) +/-

Model Layer	Depth (Ft.)	Material Description	Elevation	Sample Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI
1	0.3	TOPSOIL (4")	954.67								
3		LEAN CLAY WITH SAND (CL), brown, stiff to hard				Split spoon	7	4-4-3 N=7	3.5 (HP)		
						Split spoon	9	3-4-4 N=8	3.5 (HP)		
				5							
						Split spoon	12	2-3-4 N=7	2.75 (HP)	18.6	35-19-16
						Split spoon	10	3-7-11 N=18	4.5+ (HP)		
				10							
						Split spoon	12	4-14-17 N=31	4.5+ (HP)		
				15							
		-gray below 18.5'				Split spoon	12	3-4-5 N=9	2.25 (HP)		
				20							
						Shelby tube			3.5 (HP)	15.7	
						Split spoon	14	3-4-6 N=10	2.0 (HP)		
	25.0		930	25							
		Boring Terminated at 25 Feet									

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

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Notes
Elevation Reference: Elevations estimated from Google Earth.

Advancement Method
3.25" ID HSA

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
B-57

Hammer Type
Automatic

Driller
A. Fay

Logged by
S. Swyck

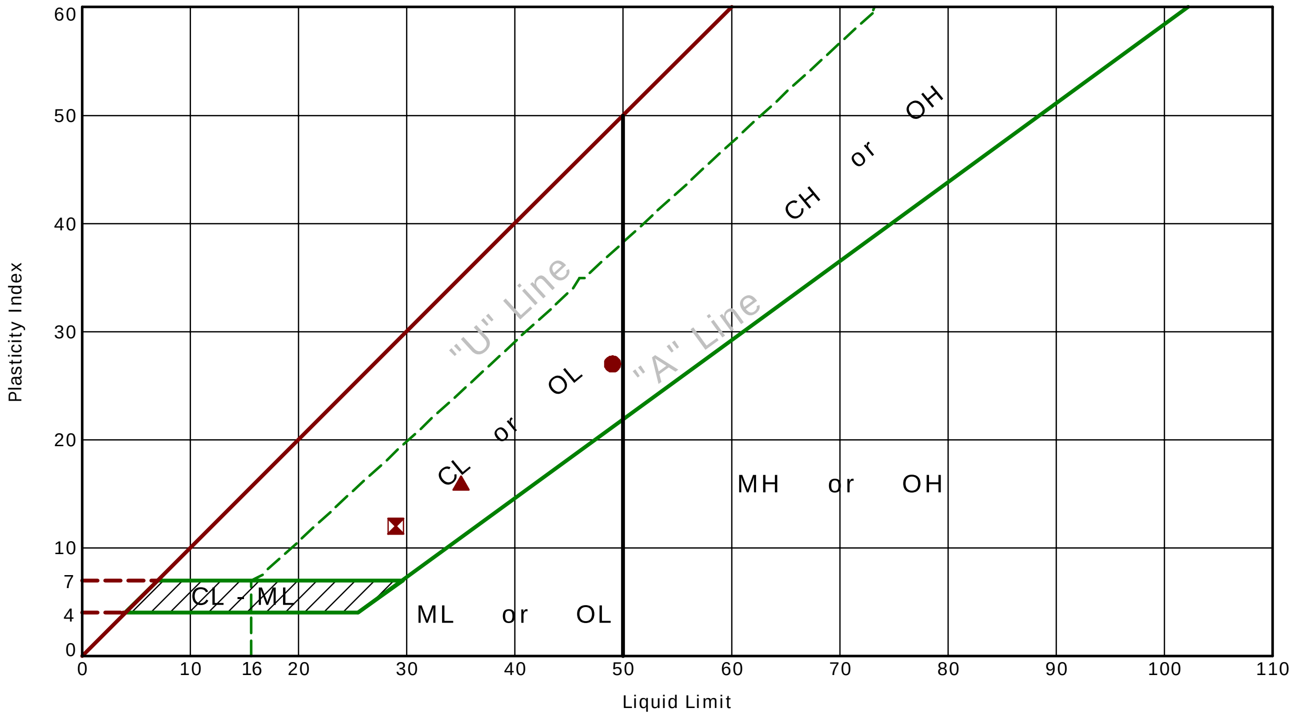
Boring Started
04-19-2023

Boring Completed
04-19-2023

12460 Plaza Dr
Parma, OH

Atterberg Limit Results

ASTM D4318

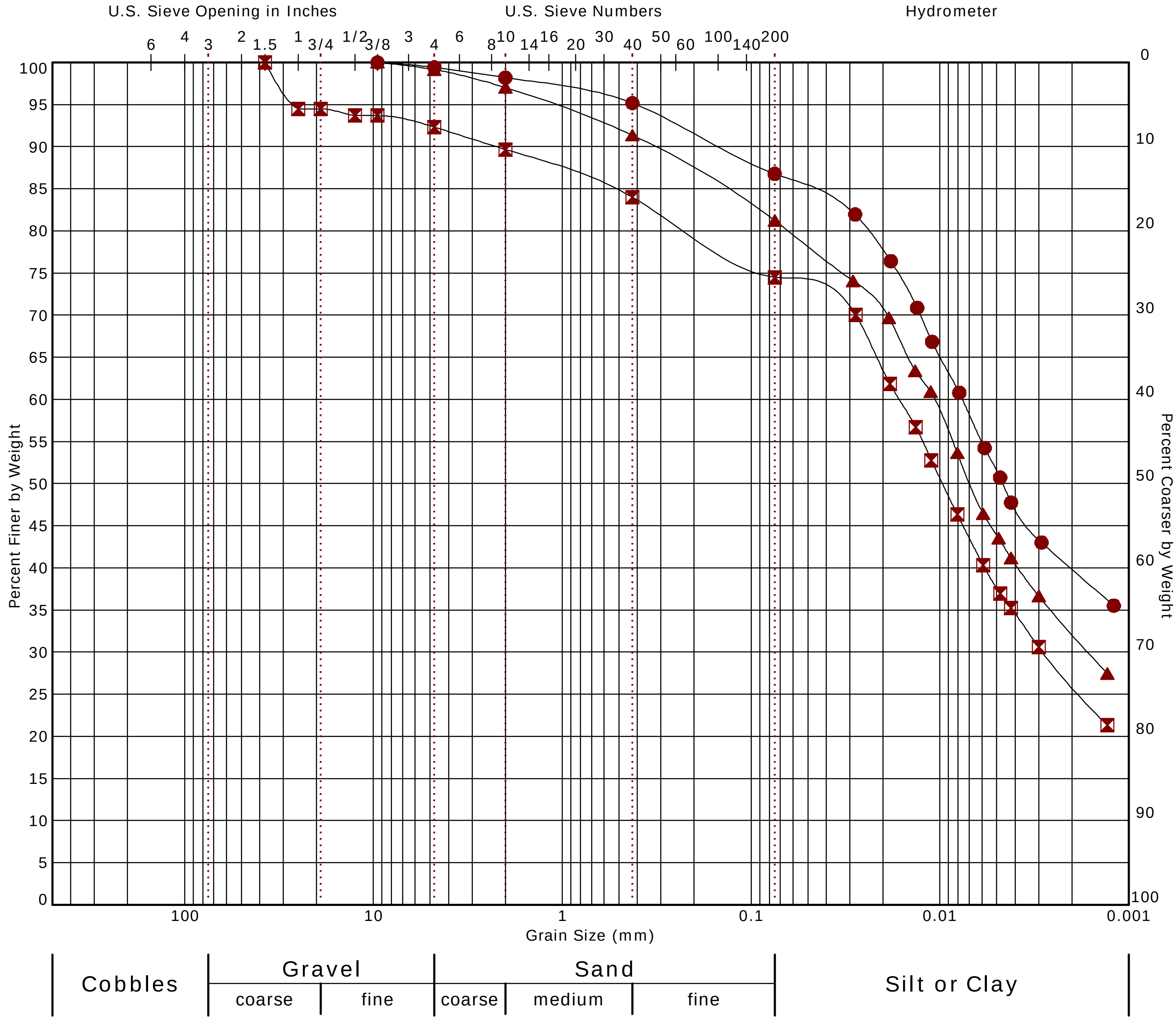


	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-3	0 - 2	49	22	27	86.8	CL	LEAN CLAY
⊠	B-7	8.5 - 10	29	17	12	74.5	CL	LEAN CLAY with SAND
▲	B-8	6 - 7.5	35	19	16	81.2	CL	LEAN CLAY with SAND

Terracon
12460 Plaza Dr
Parma, OH

Grain Size Distribution

ASTM D422 / ASTM C136



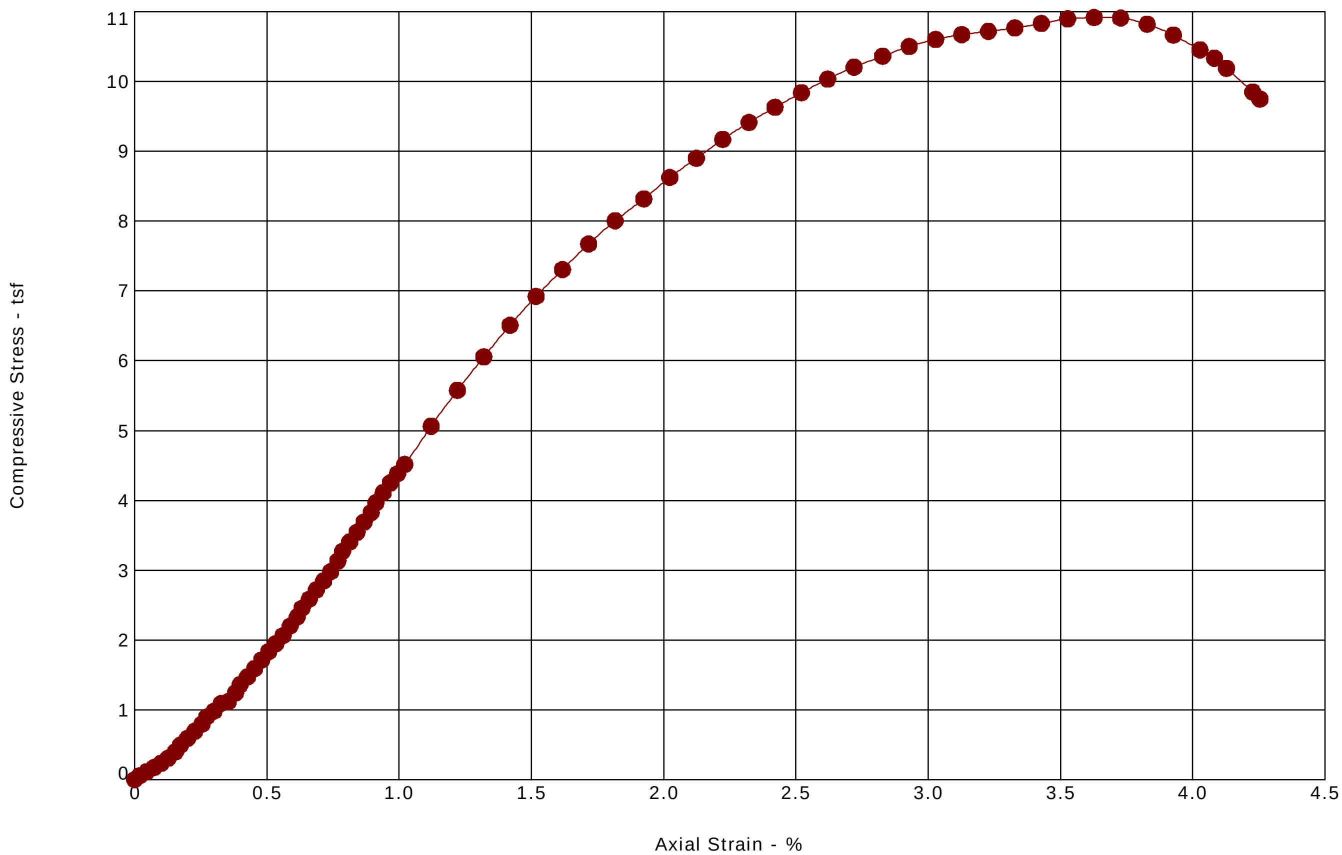
	Boring ID	Depth (Ft)	Description		LL	PL	PI	Cc	Cu
●	B-3	0 - 2	LEAN CLAY		49	22	27		
⧗	B-7	8.5 - 10	LEAN CLAY with SAND		29	17	12		
▲	B-8	6 - 7.5	LEAN CLAY with SAND		35	19	16		

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	B-3	0 - 2	9.5	0.008			0.0	0.6	12.7		35.3	51.5
⧗	B-7	8.5 - 10	37.5	0.016	0.003		0.0	7.7	17.8		36.9	37.6
▲	B-8	6 - 7.5	9.5	0.011	0.002		0.0	0.8	17.9		37.4	43.9

Terracon
12460 Plaza Dr
Parma, OH

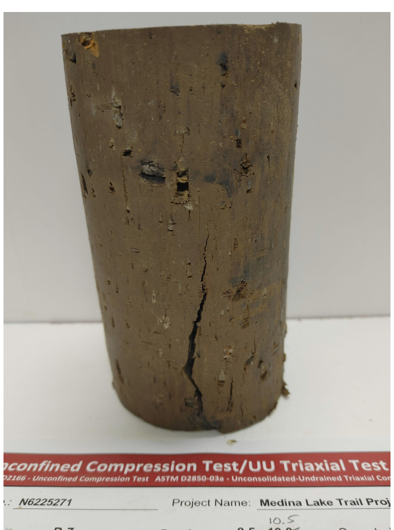
Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B-7	8.5 - 10	Shelby Tube	29	17	12	74.5	LEAN CLAY with SAND(CL)

Specimen Failure Mode



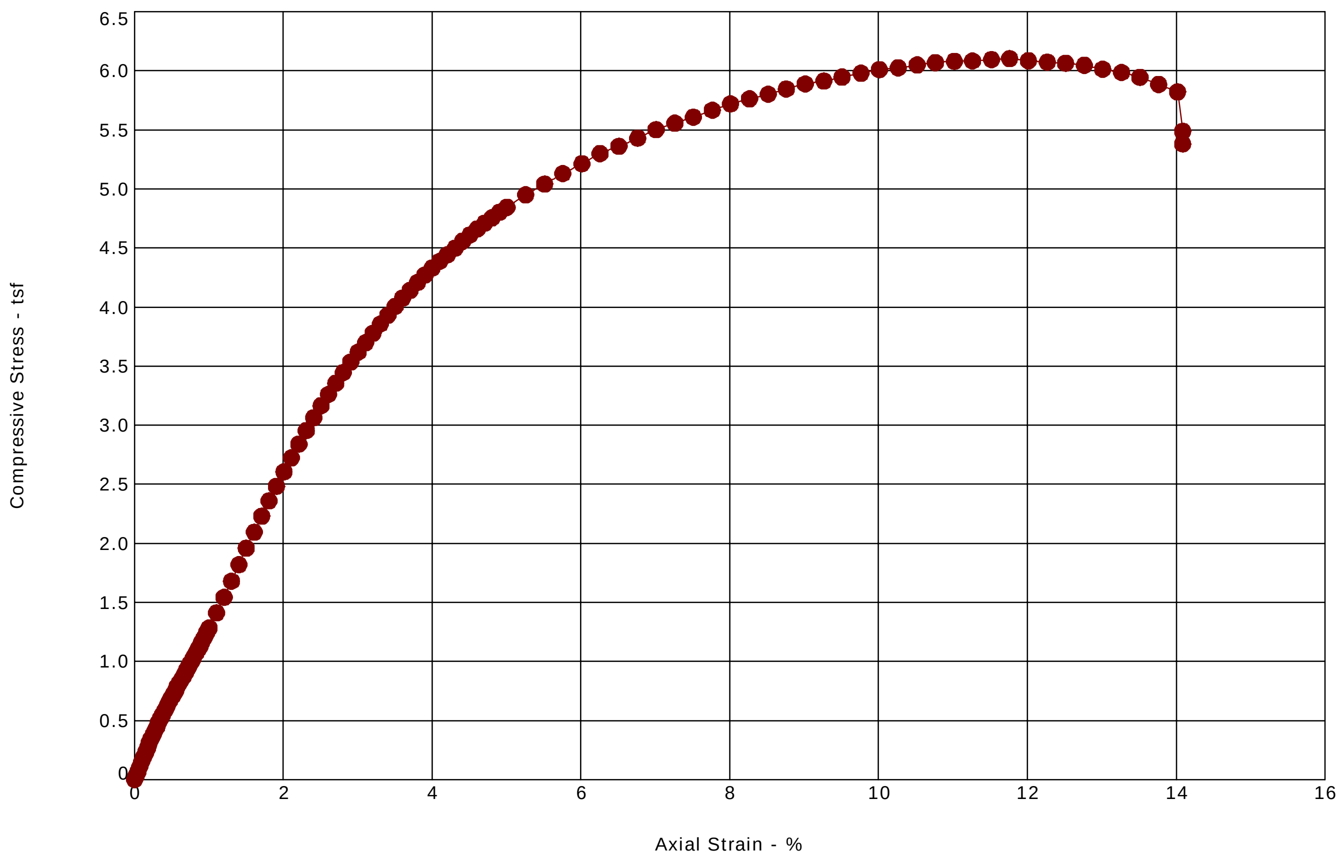
Specimen Test Data

Moisture Content (%):	16.3
Dry Density (pcf):	118
Diameter (in.):	2.85
Height (in.):	5.69
Height / Diameter Ratio:	1.99
Calculated Saturation (%):	98.92
Calculated Void Ratio:	0.45
Assumed Specific Gravity:	2.75
Failure Strain (%):	3.63
Unconfined Compressive Strength (tsf):	10.92
Undrained Shear Strength (tsf):	5.46
Strain Rate (in/min):	0.0567
Remarks:	

Terracon
12460 Plaza Dr
Parma, OH

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B-8	21 - 23	Shelby Tube					

Specimen Failure Mode	Specimen Test Data	
	Moisture Content (%):	15.7
	Dry Density (pcf):	123
	Diameter (in.):	2.83
	Height (in.):	5.67
	Height / Diameter Ratio:	2.01
	Calculated Saturation (%):	108.25
	Calculated Void Ratio:	0.40
	Assumed Specific Gravity:	2.75
	Failure Strain (%):	11.76
	Unconfined Compressive Strength (tsf):	6.10
	Undrained Shear Strength (tsf):	3.05
	Strain Rate (in/min):	0.0565
	Remarks: Calculated saturation of over 100% is likely the result of measurement limitations and the use of an assumed specific gravity.	

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

12460 Plaza Dr
Parma, OH

General Notes

Sampling	Water Level	Field Tests
Shelby Tube; Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N — Standard Penetration Test Resistance (Blows/Ft.) (HP) — Hand Penetrometer (T) — Torvane (DCP) — Dynamic Cone Penetrometer UC — Unconfined Compressive Strength (PID) — Photo-Ionization Detector (OVA) — Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

![Terracon GeoReport]

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]	GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]	SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A”	CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line	CH	Fat clay [K, L, M]
			PI plots below “A” line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ≥ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.