100Th Anniversary
LEADING THROUGH THE NEXT 100 YEARS

August 28, 2023 CT Project No. 231140

Saybrook Township
7247 Center Rd S,
Ashtabula, OH 44004

Geotechnical Subsurface Investigation
Carpenter Road Utilities Improvement
Saybrook Township, Ohio

Following is the report of the geotechnical subsurface investigation performed by CT Consultants, Inc. (CT) for the referenced project. This study was conducted for Saybrook Township to support design services for the Proposed Carpenter Road Utilities Improvement Project.

This report contains the results of our study, our engineering interpretation of the results concerning the project characteristics, design and construction recommendations for pavements, and our recommendations for installation and support of the proposed underground utilities.

Soil samples collected during this investigation will be stored at our laboratory for 90 days from the date of this report. The samples will be discarded after this time unless you request that they be saved or delivered to you.

Should you have any questions regarding this report or require additional information, please contact our office.

Sincerely,

CT Consultants, Inc.

STATE OF OHIO
NEGOSLAV
TOSANOVIC
E-78355
REGISTERED
PROFESSIONAL ENGINEER

Negoslav Tosanovic, P.E.
Geotechnical Project Manager

Curtis E. Roupe, P.E.
Vice President

GEOTECHNICAL SUBSURFACE INVESTIGATION
CARPENTER ROAD UTILITIES IMPROVEMENT
SAYBROOK TOWNSHIP, OHIO

FOR

SAYBROOK TOWNSHIP
7247 CENTER RD
ASHTABULA, OH 44004

SUBMITTED

AUGUST 28, 2023
CT PROJECT NO. 231140

8150 STERLING CT
MENTOR, OH 44060
(440) 951-9000

LEADING THROUGH
the next 100 years
www.ctconsultants.com

TABLE OF CONTENTS

Page No.

1.0 INTRODUCTION

This geotechnical subsurface investigation report was performed for the Saybrook Township in support of design services for the Proposed Carpenter Road Utilities Improvement Project. The general project area is shown on the Site Location Map (Plate 1.0). This report summarizes our understanding of the proposed construction, describes the investigative and testing procedures, presents the findings, discusses our evaluations and conclusions, and provides our design and construction recommendations for pavements, as well as provides our recommendations for installation and support of the proposed underground utilities.

The purpose of this investigation was to evaluate the subsurface conditions and laboratory data relative to the design and construction of the utilities and pavements at the referenced site. This investigation included five (5) test borings, field and laboratory soil testing, and a geotechnical engineering evaluation of the test results. This report includes:

- A description of the subsurface soil and groundwater conditions encountered in the borings.
- Design recommendations related to the proposed pavements and underground utilities.
- Recommendations concerning soil- and groundwater-related construction procedures such as site preparation, earthwork, pavement subgrade preparation, and related field testing.

This investigation did not include an environmental assessment of the subsurface materials at this site.

2.0 INVESTIGATIVE PROCEDURES

This subsurface investigation included five (5) test borings drilled by CT on June 23, 2023. Borings B-1 to B-3 were performed to a depth of 10 feet borings B-4 and B-5 which were performed to a depth of 20 feet below the existing grade. The test borings were located in the field by CT personnel in accordance with a proposed boring location plan submitted with the proposal for this study. The approximate locations of the borings are shown on the Test Boring Location Plan (Plate 2.0).

The test borings were performed in general accordance with geotechnical investigative procedures outlined in ASTM Standard D 1452. The test borings performed during this investigation were drilled with a truck-mounted drill rig with utilizing 2¾-inch diameter hollow-stem augers. The approximate ground surface elevations obtained by Google Earth software, termination depths, and elevations for the borings are summarized in Table 1.0 at the end of this section.

During auger advancement, soil samples were collected at 2½-foot for the first ten feet then at 5-foot intervals thereafter. Split-spoon (SS) samples were obtained by the Standard Penetration Test (SPT) Method (ASTM D 1586), which consists of driving a 2-inch outside diameter split-barrel sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sampler was driven in three successive 6-inch increments with the number of blows per increment being recorded. The sum of the number of blows required to advance the sampler the second and third 6-inch increments is termed the Standard Penetration Resistance (N-value) and is presented on the Logs of Test Borings attached to this report. The samples were sealed in jars and shipped to our laboratory for further classification and testing.

The pavement and soil conditions encountered in the test borings are presented in the Logs of Test Borings, along with information related to sample data, SPT, water conditions observed in the borings, and laboratory test data. It should be noted that these logs have been prepared on the basis of soils laboratory classification and testing as well as field logs of the encountered pavements and soils.

All of the recovered samples of the subsoils were visually or manually classified in accordance with the Ohio Department of Transportation (ODOT) soil classification system and were tested in our laboratory for moisture content (ASTM D 2216). Unconfined compressive strength estimates were obtained for the intact cohesive samples using a calibrated hand penetrometer. A particle size analysis (ASTM D 6913 and D 7928) and an Atterberg limits test (ASTM D 4318) were performed on representative samples from Boring B-2 (SS-1), B-5 (SS-1) to determine soil classification and soil index properties. The test results are presented on the Logs of Test Borings, Tabulation of Test Data sheets, and Grain Size Distribution and Atterberg Limits sheets attached to this report.

Soil conditions encountered in the test borings are presented in the Logs of Test Borings, along with information related to sample data, SPT results, water conditions observed in the borings, and laboratory test data. It should be noted that these logs have been prepared on the basis of laboratory classification and testing as well as field logs of the encountered soils.

Experience indicates that the actual subsoil conditions at a site could vary from those generalized on the basis of pavement cores and test borings made at specific locations. Therefore, it is essential that a geotechnical engineer be retained to provide soil engineering services during the site preparation, excavation, and installation phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

As previously mentioned, test boring data is provided in the following table.

Table 1.0 - Test Boring Data

Boring Number	Boring Termination Depth (Ft)	Approximate Ground Elevation (Ft)
B-1	10	625
B-2	10	627
B-3	10	628
B-4	20	617
B-5	20	614

3.0 PROPOSED CONSTRUCTION

The proposed project consists of proposed underground utility improvements in Saybrook Township, Ohio. We understand that the improvements consist of the new Sanitary Sewer Overflow (SSO) force main planned on the 2,840-foot-long section starting at 400 ± feet west of Highland Lane and extending to Stowe Road along Carpenter Road.

We also understand that these underground utilities will be installed using an open-cut excavation technique except for the easternmost 200± feet long section between borings B-4 and B-5, where is anticipated Horizontal Directional Drilling (HDD) method to install the utilities at the crossing under the existing creek.

Pavements at the backfilled, repaired trenches, if utility installation is performed within the road, are anticipated to coincide with the existing pavement, which is flexible (asphalt) pavement at the time of exploration. Final design grades are assumed to approximate existing roadway grades. Traffic loads and volumes were not available at the time of preparing this proposal.

4.0 GENERAL SITE AND SUBSURFACE CONDITIONS

4.1 General Site Conditions

At the time of our investigation, the project area consisted primarily of residential properties with sporadic forested and agricultural areas along the street. Topographically, the road pavement is gently sloping up from the west improvement limit, which is at elevation 625, and going east, reaching elevation 628 at the vicinity of boring B-3, then sloping down along the pavement section between the borings B-3 and B-5 to the elevation 614; this is the area where a road is crossing above the creek. Per the Google Earth image of this area, a culvert at the bottom of the road embankment was noticed to allow the water flow. Approximate terrain elevation at the inlet and outlet of the culvert are 599 and 596, respectively.

Borings B-1 through B-5 penetrated asphalt at the surface with thicknesses ranging from 7 to 13 inches over 8 to 12 inches of aggregate base. Asphalt and aggregate base thicknesses are summarized in the following table. It should be noted that pavement thicknesses were generally measured to the nearest ¼ inch.

Table 2.0 – Pavement Thickness (inch)		
Boring Number	Asphalt	Aggregate Base
B-1	7	8
B-2	7	8
B-3	8	12
B-4	8	12
B-5	13	6

4.2 General Soil and Rock Conditions

Based on the results of our field and laboratory tests, the subsurface profile is primarily composed of fine-grain cohesive soils. Encountered soils consisted of silty clay, sandy silt “and” clay, sandy silty clay, a mix of silt and clay, silt with varying amounts of clay, and, within all these materials, variable amounts of sand and gravel are noted. Trace of iron oxide stain seams were detected in boring B-1, 3, and 5 at depths between 3.5 and 6 feet below the surface. Unconfined compressive strength tests results on the cohesive samples generally ranged from 2.0 to 4.5+ tons per square foot (tsf). One sample, SS-1 at boring B-4, had an unconfined compressive strength test result of 1.0 tsf. Moisture contents ranged from approximately 18 to 25 percent at boring B-1, 2, and 3, while at B-4 and B-5 locations moistures varied between 10 to 15 and 12 to 19 percent, respectively. All materials appear to be naturally deposited except for the near-surface 3.5 feet thick layer at the location of boring B-5, which is classified as a fill. SPT N-values ranged from 6 to 30, and soil consistency was determined in the range between medium stiff to very stiff. The soil color is brown to gray or gray.

Two soil samples obtained from borings B-2 (SS-1) and B-5 (SS-1) were tested for Atterberg Limits with respective results of 38 and 33 for Liquid Limit (LL), 24 and 22 for Plastic Limit (PL) and 14 and 11 for Plasticity Index (PI). The percent passing the #200 sieve are determined to be 73 and 37 percent, respectively. In accordance with

Unified Soil Classification System (USCS), these values along with gradation results, are indicative of Lean Clay (CL) and Clayey Sand (SC), albeit with 37% fines. Following Ohio Department of Transportation (ODOT) Soil Classification System the soils are classified as A-6a material. Bedrock was not encountered in any of the performed borings. Additional descriptions of the stratigraphy encountered in the borings are presented on the Logs of Test Borings.

4.3 Groundwater Conditions

No groundwater was encountered either during or after the completion of the drilling process. It should be noted all the boreholes were drilled and backfilled within the same day, and stabilized water levels are not likely to have occurred over this limited time period. Instrumentation was not installed to observe long-term groundwater levels.

Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that the static, long-term groundwater table is below the explored depths. However, we cannot rule out the possibility for perched groundwater on the site (water held in the pockets or layers of granular soil that are underlain or surrounded by relatively impermeable cohesive soil deposits). In particular, “perched” groundwater may be encountered within the pavement base materials and fill materials. If water bearing soils deposits are penetrated during construction excavations, water will be released; however, it is our experience that perched groundwater can typically be controlled by pumping from shallow sumps or by gravity drainage. Also, groundwater elevations can fluctuate with seasonal and climatic influences. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this exploration.

5.0 DESIGN RECOMMENDATIONS

The following conclusions and recommendations are based on our understanding of the proposed construction and on the data obtained during the field investigation. If the project information or location as outlined is incorrect or should change significantly, a review of these recommendations should be made by CT. These recommendations are subject to the satisfactory completion of the recommended site and subgrade preparation and fill placement operations described in Section 6.0, "Construction Recommendations".

5.1 Pipe Support

We understand that the underground utility improvements for this project will include the installation a new Sanitary Sewer Overflow line. The current stage of design has not determined the type of the pipe and depth of the installation, but it is expected to be within 10 feet below existing grades. We also understand that these underground utilities will be installed using an open-cut excavation technique. There is a crossing below the existing creek located between the borings B-4 and B-5 where pipe installation will likely be performed by Horizontal Directional Drilling (HDD) technique.

Based on our project understanding, the proposed sanitary sewer lines are anticipated to predominantly be supported on the cohesive material encountered in subsurface exploration.

Based on the subsurface exploration findings, laboratory, and field-testing results, it is our professional opinion that the soils within explored depths are capable of sufficiently support planned piping system and structures (e.g., manholes, etc.). planned for the improvements.

Also, we didn't encounter any unfavorable subsoil or groundwater conditions that should negatively interfere with HDD pipe installation proposed to be used for pipe installation at the crossing below the creek.

It will be critical to maintain a sufficient thickness of bedding and haunching to provide adequate support and protection for the underground utilities. Bedding and haunching materials should conform to pipe manufacturer specifications and recommendations.

We recommend that the trench excavation along the proposed underground utilities invert be inspected by a CT geotechnical engineer or qualified representative. This is to confirm that the encountered subsoils are consistent with those encountered in the test borings and that the exposed materials are capable of supporting the proposed underground utilities.

5.2 Open-Cut Installation Methods

The sides of the temporary excavations for underground utilities installation should be adequately sloped to provide stable sides and safe working conditions. If the proposed underground utilities alignment requires working in close proximity to existing underground utilities or other structures, this may not be possible. Where sloped excavations will not be used, the excavation must be properly braced against lateral movements. In any case, applicable OSHA safety standards must be followed. It is the responsibility of the installation contractor to develop appropriate installation methods and equipment prior to commencement of work, and to obtain the services of a geotechnical engineer to design or approve sloped or benched excavations and/or lateral bracing systems as required by OSHA criteria. While not anticipated, any excavations greater than 20 feet deep should be evaluated by a registered professional engineer.

If the excavation is to be performed with sloped banks, adequate stable slopes must be provided. Based on the general OSHA rules and the borings drilled for this investigation, soils encountered in trench excavations should predominately include OSHA Type A and B soils (cohesive soils), however Type C soils were encountered near the surface of Boring B-5. OSHA soil types are described as follows:

- OSHA Type A soils (cohesive soils with unconfined compressive strengths of 3,000 pounds per square foot (psf) or greater),
- OSHA Type B soils (cohesive soils with unconfined compressive strengths greater than 1,000 psf but less than 3,000 psf and dry rock)
- OSHA Type C soils (existing fill materials, granular soils, and cohesive soils with unconfined compressive strengths less than 1,000 psf).

For temporary excavations in Type A, B, and C soils, side slopes must be no steeper than ¾ horizontal to 1 vertical (¾H:1V), 1H:1V, and1½H:1V respectively. For situations where a higher strength soil is underlain by a lower strength soil and the excavation extends into the lower strength soil (including excavation through cohesive soils that are underlain by granular soils or bedrock), the slope of the entire excavation is governed by that required for the lower strength soil. In all cases, flatter slopes may be required if lower strength soils or adverse seepage conditions are encountered during construction.

For permanent excavations and slopes, we recommend that grades be no steeper than 3H:1V without a more extensive geotechnical evaluation of the proposed construction plans and site conditions.

Based on the conditions encountered in the test borings, the probable method of excavation within the medium stiff to very stiff cohesive soils is expected to consist of conventional excavation equipment such as a backhoe or track excavator and metal trench box which is very common practice. However, sloping or benching the sides of the trench excavation is also applicable if found practical and feasible. We highly recommend using a grading bucket for final excavation close to the designed bearing elevation (bottom of the trench) to reduce disturbance of the natural soils.

5.3 Braced Excavations

Braced excavations constructed using soldier piles with wood lagging or sheetpiling may be considered in areas of restricted access or proximity to structures. Also, this method of deep excavation might be required for sending and receiving pit excavation for directional drilling at the before-mentioned crossing below the creek. The method employed will depend on the construction sequencing, required access size and area, and economic considerations.

All braced excavations should be designed to resist lateral earth pressures. Based on the encountered predominantly fine grain cohesive soil profile, a total (wet) unit weight of 130 pounds per cubic foot (pcf) should be utilized for developing lateral soil pressures. A coefficient of active lateral earth pressure (k_a) of 0.58 may be used for analysis of cantilevered sheetpiling or similar systems that allow slight movement or yielding in the soil. However, higher lateral earth pressures may be associated with braced excavations that restrain movement and prevent development of “active” soil conditions. In the case of restrained movement an at rest coefficient (Ko) of 0.65 should be used. The actual design of the shaft or braced excavation will depend on the size and configuration of the opening, as well as the bracing system selected by the contractor.

Additionally, lateral loading due to hydrostatic pressures below the design groundwater depth should be included in design of below-grade walls. Depending on the design methodology, total lateral pressures would be the resultant of the hydrostatic pressures in combination with submerged (or “effective”) unit weights of the soil. An effective unit weight of 68 pcf should be used for lateral earth pressure design below the design groundwater depth.

It should be noted that the above k-parameters may be used for general design of excavation support systems associated with the project. However, certain types of braced excavations may account for method-specific earth pressure distributions, for which the above parameters should be reviewed and utilized in the proper context of the design method/system.

A passive earth pressure coefficient (k_p) of 1.7 may be utilized for the portion of temporary walls (e.g., sheet pile walls) that is below the excavation bottom. In the case of permanent structures, a k_p value of 1.7 should only be utilized below the frost depth of 3½ feet below toe grades. It should be noted that some wall movement or horizontal displacement is typically needed to mobilize the full passive pressure of the soil.

It should also be noted that the earth pressure coefficients in the preceding paragraphs are based on a level backfill condition behind the retaining wall. In areas where appreciable sloping materials are present behind the top of the wall, surcharge loading or equivalent higher earth pressure coefficients should be evaluated, based on the sloping material, backfill slope, and proximity to the wall. In general, 50 percent of the vertical surcharge load should be used for lateral loading in the design of the wall.

5.4 Construction (General)

Construction traffic and excavated material stockpiles should be kept away from the excavation a minimum distance equal to the full depth of the excavation. In all cases, pertinent OSHA requirements must be followed, and adequate protection for workers must be provided.

Where existing buildings or structures, including underground utilities, are located within a distance from the excavation equal to approximately twice its depth, an adequate system of sheet piling and/or lateral bracing may be required to prevent lateral movements that could cause settlement. Any retaining system proposed by the contractor should be reviewed by a registered professional engineer prior to approval for installation and use.

It is also suggested that a condition survey (i.e., preconstruction documentation) of any existing structures and transportation infrastructure located in the vicinity of the proposed underground utilities alignment be completed. For general below-grade underground utilities installation, we recommend the condition survey extend a distance from the proposed installation extents equal to the depth of the excavation, but not less than 50 feet. The condition survey should be extended to 100 feet from the underground utilities' alignment in areas where driving of sheetpiling or H-piling, or compaction of granular material will be performed for braced excavations. The condition survey should identify existing cracks and other forms of distress to the structures before the start of construction operations. This procedure will be helpful to evaluate possible effects the construction operations may have on nearby structures and mitigate potential disputes with property owners.

The construction excavation should not be left open any longer than necessary. As soon as a section of the underground utilities is completed, the area should be backfilled to final grade. After the specified bedding material has been provided below and around the pipe, backfill material placed above the pipes should be compacted sufficiently to achieve stable backfill and avoid undesirable settlements.

Where underground utilities will be installed beneath pavement areas, future structure areas, or future pavement areas, the backfill material should be placed in uniform layers not more than 8 inches thick and compacted to 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor). Backfill placed in pavement areas should consist of dense-graded aggregate, such as ODOT Item 304 material. In order to achieve the desired compaction, the backfill material should be within 3 percent of the optimum moisture content. Alternatively, flowable controlled-density fill could be used to backfill the excavated trenches.

We emphasize the need for placing the fill in lifts and compacting each lift to the specified density, especially where the trench will be directly beneath roadway pavement. The installation contractor should not be allowed to push or end-dump several feet of backfill into the trench as a single layer or lift, because the lower portion of a thick lift will not achieve proper densification from compaction equipment operating at the surface of that lift. If the backfill is not properly placed and compacted, undesirable trench backfill settlement may occur.

It is recommended that all earthwork and site preparation activities be conducted under adequate specifications and properly monitored in the field by a CT geotechnical engineer or qualified representative.

5.5 Construction Dewatering

Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that the static, long-term groundwater table is below the planned excavation depths. However, groundwater elevations can fluctuate with seasonal and climatic influences. In particular, “perched” groundwater may be encountered within, the pavement base materials, fill materials, granular soils as well as at the soil/bedrock interface. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this exploration.

If excavations below the groundwater table are required (e.g., site utilities, foundations, etc.), or if seasonally elevated groundwater conditions are prevalent at the time of construction, diligent dewatering using point wells will be required for groundwater management during construction. In the event excessive seepage is encountered during construction, CT may be notified to evaluate whether other dewatering methods are required. Installation of the proposed site utilities is expected to require excavation above the "normal" groundwater level and groundwater seepage into excavations shouldn't be anticipated. However, seepage perched water cannot be ruled out; if encountered, it will be manageable by shallow sump pumps or gravity drainage.

5.6 Flexible (Asphalt) Pavement

Based on the results of the plasticity and gradation testing for the upper profile cohesive subgrade soil samples, we recommend a subgrade California Bearing Ratio (CBR) value of 6 percent for the Group A-6a or better soils. This CBR value is based on subgrade compacted to at least 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) or verified as stable through proof rolling.

It should be noted that we are not privy to the design traffic loads or intended design life. The subgrade support recommendations indicated herein should be reviewed by the site engineer in conjunction with the design traffic criteria to determine the required pavement sections. In any case, we recommend the light-duty pavement cross-section consist of at least 3 inches of asphalt underlain by 6 inches of aggregate base for even the lightest-duty pavements based on our experience regarding environmental exposure and reasonable serviceability. For the same reason, we recommend the heavy-duty pavement cross-section consist of at least 4 inches of asphalt underlain by 8 inches of aggregate base.

All paving operations should conform to the State of Ohio Department of Transportation (ODOT) specifications. The pavement and subgrade preparation procedures outlined in this report should result in a reasonably workable and satisfactory pavement. It should be recognized, however, that all flexible pavements need repairs or overlays from time to time as a result of progressive yielding under repeated traffic loads for a prolonged period of time, as well as exposure to freeze-thaw conditions.

5.7 Pavement Drainage

Based on the poorly drained nature of the clayey subgrade soils at the site, it is anticipated that surface water infiltration may collect in the aggregate base course. Without adequate drainage, water will remain in the base for extended periods of time, creating localized wet, soft pockets. The presence of these pockets will increase the likelihood that pavement distress (cracking, potholes, etc.) will develop. Drainage features may include grading the subgrade surface to slope downward to the outside edge of pavements and/or providing longitudinal edge drains connected to storm sewers or other outlets. A system of "finger drains" could also be installed near catch basins within the pavement areas to collect surface water, thus reducing the potential for freeze-thaw effects on the pavement.

Note that the above paragraph is a general recommendation for Pavement Drainage mostly applicable for larger pavement areas (e.g., all-width street pavement or pavement on the larger parking lot areas), but it can be used as a general guidance for the narrow, strip-shaped streets' pavement repair on the backfilled sewer trenches.

6.0 QUALIFICATION OF RECOMMENDATIONS

Our evaluation of geotechnical-related pavement subgrade and underground utilities installation and support conditions has been based on the data obtained during our field investigation and our understanding of the furnished site and project information. General subsurface conditions were based on interpretation of the subsurface data at specific boring locations. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. This is especially true for previously developed sites. Therefore, experienced geotechnical engineers should observe earthwork and foundation construction to confirm that the conditions anticipated in design are noted. Otherwise, CT assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations.

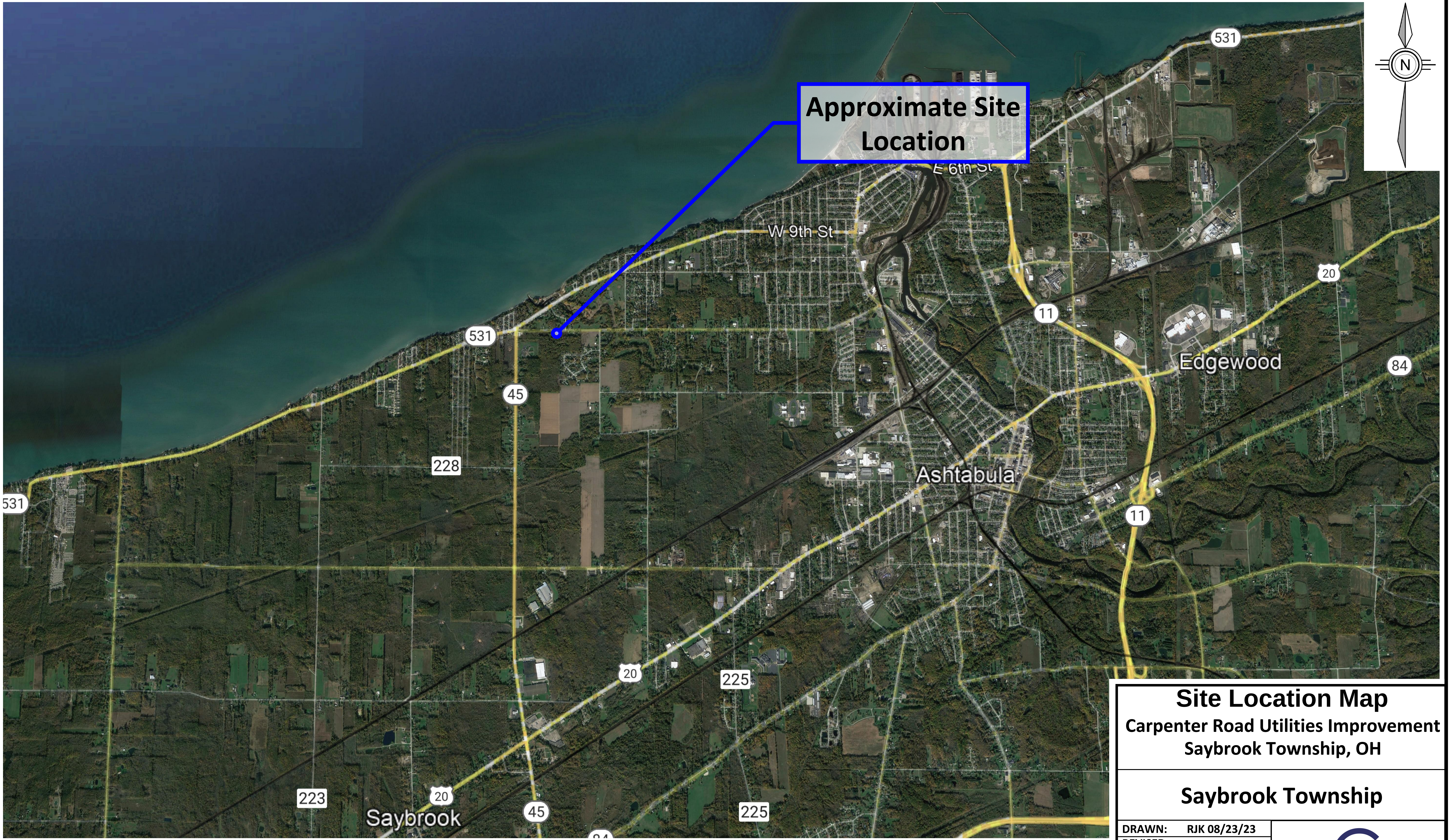
The design recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria or locations change, a qualified geotechnical engineer should be permitted to determine whether the recommendations must be modified. The findings of such a review will be presented in a supplemental report.

The nature and extent of variations between the borings may not become evident until the course of construction. If such variations are encountered, it will be necessary to reevaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed, our findings derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. CT is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Plates

Plate 1.0 Site Location Map
Plate 2.0 Test Boring Location Plan



0' 4000' 8000'

Notes: Aerial Basemap obtained From Google Earth and dated 09/26/2019.

Site Location Map

Carpenter Road Utilities Improvement
Saybrook Township, OH

Saybrook Township

DRAWN: RJK 08/23/23
REVISED: ---
Project No.: 231140
Drawing No.:
Plate 1.0

100 YEARS
LEADING THROUGH the next 100 years
www.ctconsultants.com

Legend:

⊕ **B-1** Approximate Test Boring Location

0' 150' 300'

N

Notes: Aerial Basemap obtained From Google Earth and dated 09/26/2019

Test Boring Location Plan

Carpenter Road Utilities Improvement
Saybrook Township, OH

Saybrook Township

REVISED: ---
Project No.: 231140
Drawing No.: Plate 2.0

100 YEARS
LEADING THROUGH the next 100 years
www.ctconsultants.com

APPENDIX A

Logs of Test Borings

TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-1

PAGE 1 OF 1

CLIENT CT Consultants, Inc.
PROJECT NAME Carpenter Road SSO
PROJECT NUMBER 231140
PROJECT LOCATION Ashtabula, OH
DRILLING CONTRACTOR CT Consultants Inc. JP DC
RIG NO. 844
GROUND ELEVATION 625 ft
DRILLING METHOD 2-3/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 6/23/23
COMPLETED 6/23/23
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY IEH
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL 20 40 60 80 ▲ SPT N VALUE ▲ 20 40 60 80
625	0		ASPHALT - 7 Inches 0.6'						
			AGGREGATE BASE - 8 Inches 1.3'						
			Moist Stiff Brown/Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel 3.5'	SS 1	100	4-5-4 (9)	>4.5		24
620	5		Moist Medium Stiff Brown/Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel 6.0'	SS 2	100	2-4-3 (7)	3.50		22
			Moist Stiff Brown/Gray SANDY SILT (A-4a),"and"Clay, Trace Gravel, Trace Iron Oxide Stain Seam 8.0'	SS 3	100	4-5-6 (11)	3.75		21
615	10		Moist Very Stiff Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel 10.0'	SS 4	100	12-14-16 (30)	>4.5		18
			Bottom of hole at 10.0 feet.						

TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-2

PAGE 1 OF 1

CLIENT CT Consultants, Inc.

PROJECT NAME Carpenter Road SSO

PROJECT NUMBER 231140

PROJECT LOCATION Ashtabula, OH

DRILLING CONTRACTOR CT Consultants Inc. JP DC

RIG NO. 844

GROUND ELEVATION 627 ft

DRILLING METHOD 2-3/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 6/23/23

COMPLETED 6/23/23

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY IEH

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL 20 40 60 80 ▲ SPT N VALUE ▲ 20 40 60 80
	0		ASPHALT - 7 Inches 0.6'						
			AGGREGATE BASE - 8 Inches 1.3'						
625			Moist Medium Stiff Gray SILT and CLAY, Some Sand, Trace Gravel A-6a (9) 3.5'	SS 1	100	2-3-4 (7)	2.00		23
	5		Moist Stiff Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel 6.0'	SS 2	100	4-4-7 (11)	3.00		20
620			Moist Very Stiff Brown/Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel	SS 3	100	10-13-16 (29)	4.00		25
	10		@8': Medium Stiff, Gray/Brown 10.0'	SS 4	100	3-3-3 (6)	2.75		19

Bottom of hole at 10.0 feet.

TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-3

PAGE 1 OF 1

CLIENT CT Consultants, Inc.

PROJECT NAME Carpenter Road SSO

PROJECT NUMBER 231140

PROJECT LOCATION Ashtabula, OH

DRILLING CONTRACTOR CT Consultants Inc. JP DC

RIG NO. 844

GROUND ELEVATION 628 ft

DRILLING METHOD 2-3/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 6/23/23 **COMPLETED** 6/23/23

AT TIME OF DRILLING None

LOGGED BY KKC **CHECKED BY** IEH

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL 20 40 60 80 ▲ SPT N VALUE ▲ 20 40 60 80
	0		ASPHALT - 8 Inches 0.7'						
			AGGREGATE BASE - 12 Inches 1.7'	SS 1	100	3-3-3 (6)	2.75		24
625			Moist Medium Stiff Brown/Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel						
	5		@3.5': Trace Iron Oxide Stain Seam 6.0'	SS 2	94	2-3-5 (8)	>4.5		23
620			Moist Very Stiff Gray/Brown SANDY SILT (A-4a),"and"Clay, Trace Iron Oxide Stain Seam 9.5'	SS 3	94	12-14-16 (30)	4.50		22
				SS 4	100	8-11-11 (22)	3.00		24
	10		Moist Very Stiff Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel 10.0'						

Bottom of hole at 10.0 feet.

TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-4

PAGE 1 OF 1

CLIENT CT Consultants, Inc.

PROJECT NAME Carpenter Road SSO

PROJECT NUMBER 231140

PROJECT LOCATION Ashtabula, OH

DRILLING CONTRACTOR CT Consultants Inc. JP DC

RIG NO. 844

GROUND ELEVATION 617 ft

DRILLING METHOD 2-3/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 6/23/23

COMPLETED 6/23/23

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY IEH

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)	PL MC LL 20 40 60 80 ▲ SPT N VALUE ▲ 20 40 60 80
	0		ASPHALT - 8 Inches 0.7'						
			AGGREGATE BASE - 12 Inches 1.7'						
615			Moist Medium Stiff Gray SILTY CLAY (A-6b), Some Sand, Trace Gravel	SS 1	100	6-3-3 (6)	1.00		10
			@3': Little Gravel						
				SS 2	100	2-3-3 (6)	2.50		14
	5		6.0'						
610			Moist Very Stiff Gray SILTY CLAY (A-6b), Little Sand, Trace Gravel	SS 3	100	8-12-13 (25)	>4.5		13
			@8': Stiff						
				SS 4	100	4-7-8 (15)	>4.5		15
	10								
605									
			@13.5': Very Stiff	SS 5	100	4-8-11 (19)	>4.5		13
	15								
600									
				SS 6	100	4-10-10 (20)	>4.5		15
	20		20.0'						
			Bottom of hole at 20.0 feet.						

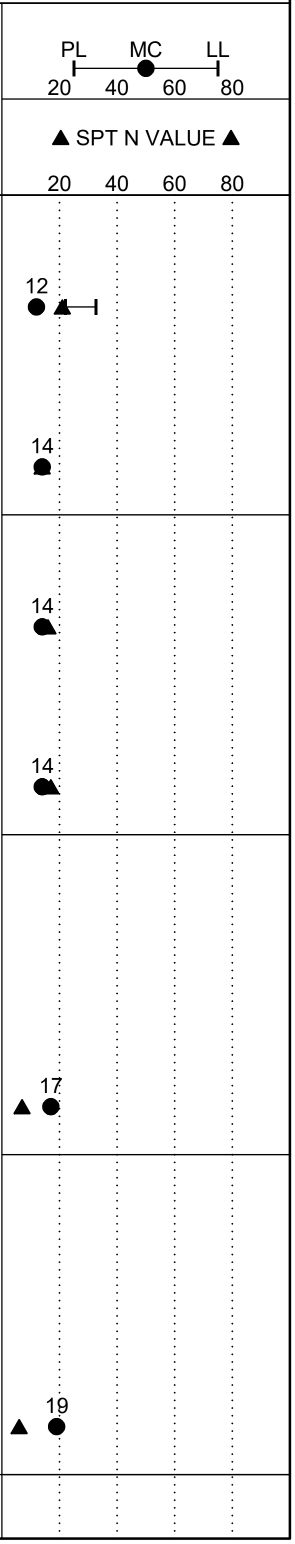
consultants
TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-5

PAGE 1 OF 1

CLIENT CT Consultants, Inc.
PROJECT NAME Carpenter Road SSO
PROJECT NUMBER 231140
PROJECT LOCATION Ashtabula, OH
DRILLING CONTRACTOR CT Consultants Inc. JP DC
RIG NO. 844
GROUND ELEVATION 614 ft
DRILLING METHOD 2-3/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 6/23/23
COMPLETED 6/23/23
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY IEH
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings and Bentonite Chips

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)
	0	ASPHALT - 13 Inches 1.1'					
		AGGREGATE BASE - 6 Inches 1.6'					
		FILL - Moist Very Stiff Gray SILT and CLAY, "and" Gravel, Some Sand, Trace Asphalt Fragments 3.5'	SS 1	100	11-12-9 (21)	4.00	
610		Moist Stiff Brown/Gray SILTY CLAY (A-6b), Some Sand, Trace Gravel, Trace Iron Oxide Stain Seam	SS 2	100	8-8-6 (14)	>4.5	
	5						
		@6': Very Stiff	SS 3	100	5-7-9 (16)	4.00	
605		@8.5': Gray	SS 4	100	4-9-8 (17)	4.00	
	10	11.0'					
		Moist Medium Stiff Gray/Brown SANDY SILT (A-4a), Some Clay, Trace Gravel					
600			SS 5	100	3-3-4 (7)	2.00	
	15						
595			SS 6	100	3-3-3 (6)	2.00	
	20	20.0'					
		Bottom of hole at 20.0 feet.					



APPENDIX B

Legend Key

LEGEND KEY

Unified Soil Classification System Soil Symbols

GW - WELL GRADED GRAVEL Includes Gravel-Sand mixtures, little or no fines.	GP - POORLY GRADED GRAVEL Includes Gravel-Sand mixtures, little or no fines.	GM - SILTY GRAVEL Includes Gravel-Sand-Silt mixtures.	GC - CLAYEY GRAVEL Includes Gravel-Sand-Clay mixtures.
SW - WELL GRADED SAND Includes Gravelly Sands, little or no fines.	SP - POORLY GRADED SAND Includes Gravelly Sands, little or no fines.	SM - SILTY SAND Includes Sand-Silt mixtures.	SC - CLAYEY SAND Includes Sand-Clay mixtures.
ML - SILT Includes Silt with Sand and Sandy Silt.	CL - LEAN CLAY Includes Sandy Lean Clay and Lean Clay with Sand and Gravel.	MH - ELASTIC SILT Includes Sandy Elastic Silt and Elastic Silt with Sand.	CH - FAT CLAY Includes Sandy Fat Clay and Fat Clay with Sand.
CL-ML - SILTY CLAY Includes Clayey Silt of low plasticity.	OL - ORGANIC SILT and ORGANIC CLAY of low plasticity.	OH - ORGANIC SILT and ORGANIC CLAY of medium to high plasticity.	Pt - PEAT Includes humus, swamp and other soils with high organic content.
FILL MATERIAL - Includes controlled and non-controlled soil and non-soil materials.	TOPSOIL	■ ASPHALT - Bituminous Asphalt	CONCRETE - Includes broken concrete rubble.

Sample Symbols

☒ SS - Split Spoon	■ ST - Shelby Tube	RC - Rock Core	GS - Geoprobe Sleeve
	AU - Auger Cuttings	GB - Grab	

Notes:

1. Exploratory borings were drilled on June 23, 2023. The borings were advanced utilizing 2-3/4 inch inside diameter hollow -stem augers.
2. These logs are subject to the limitations, conclusions, and recommendations in the report and should not be interpreted separate from the report.
3. The borings were located in the field by CT Consultants in accordance with a proposed Boring location plan provided by Saybrook Township.
4. Ground Surface Elevations were depicted from Google Earth and reported to the nearest foot.

APPENDIX C

Tabulation of Laboratory Test Data

TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

SUMMARY OF LABORATORY RESULTS

CLIENT CT Consultants, Inc.

PROJECT NAME Carpenter Road SSO

PROJECT NUMBER 231140

PROJECT LOCATION Ashtabula, OH

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	1.0							23.5			
B-1	3.5							21.9			
B-1	6.0							20.6			
B-1	8.5							18.2			
B-2	1.0	38	24	14	12.5	73	CL	23.4			
B-2	3.5							19.8			
B-2	6.0							25.5			
B-2	8.5							18.7			
B-3	1.0							24.1			
B-3	3.5							23.0			
B-3	6.0							21.7			
B-3	8.5							24.3			
B-4	1.0							9.9			
B-4	3.5							13.5			
B-4	6.0							12.6			
B-4	8.5							15.1			
B-4	13.5							12.7			
B-4	18.5							14.7			
B-5	1.0	33	22	11	19	37	SC	12.0			
B-5	3.5							14.1			
B-5	6.0							14.4			
B-5	8.5							13.9			
B-5	13.5							16.8			
B-5	18.5							18.8			

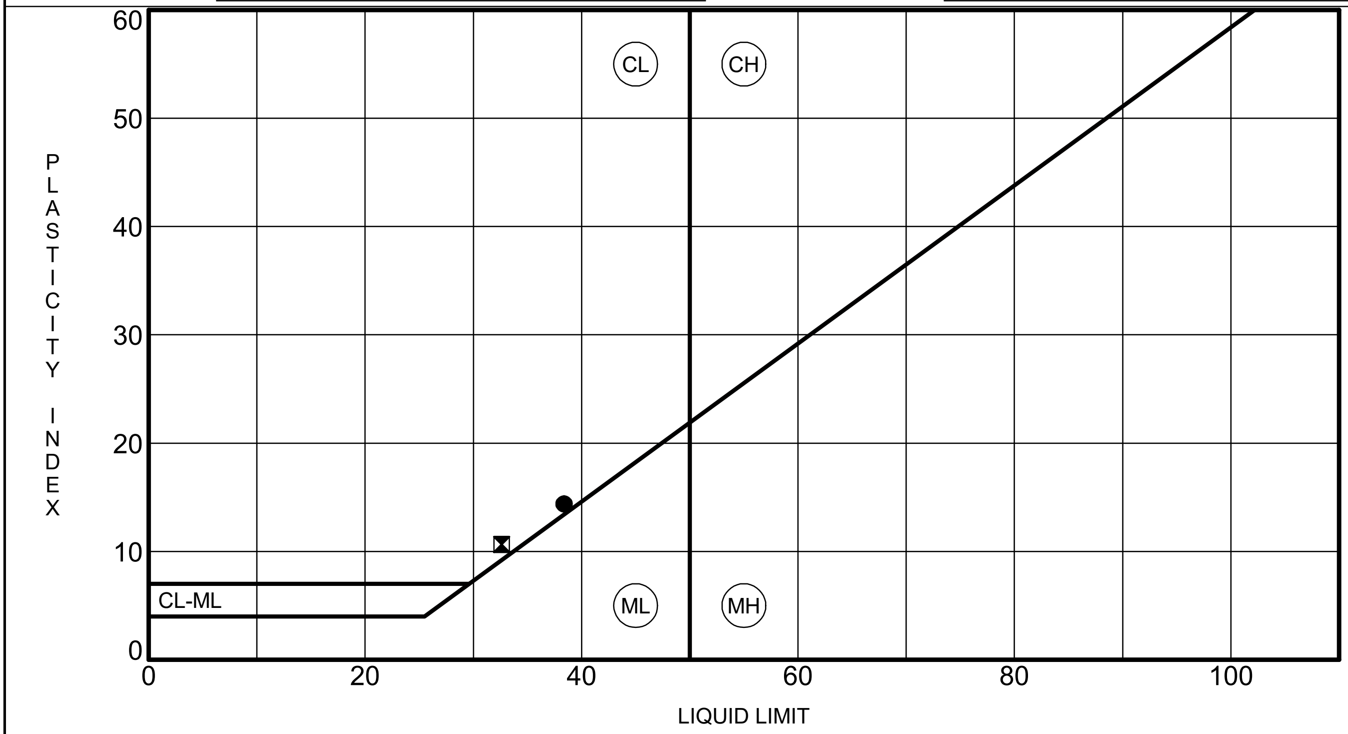
APPENDIX D

Laboratory Test Results

TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

ATTERBERG LIMITS' RESULTS

CLIENT CT Consultants, Inc.
PROJECT NAME Carpenter Road SSO
PROJECT NUMBER 231140
PROJECT LOCATION Ashtabula, OH

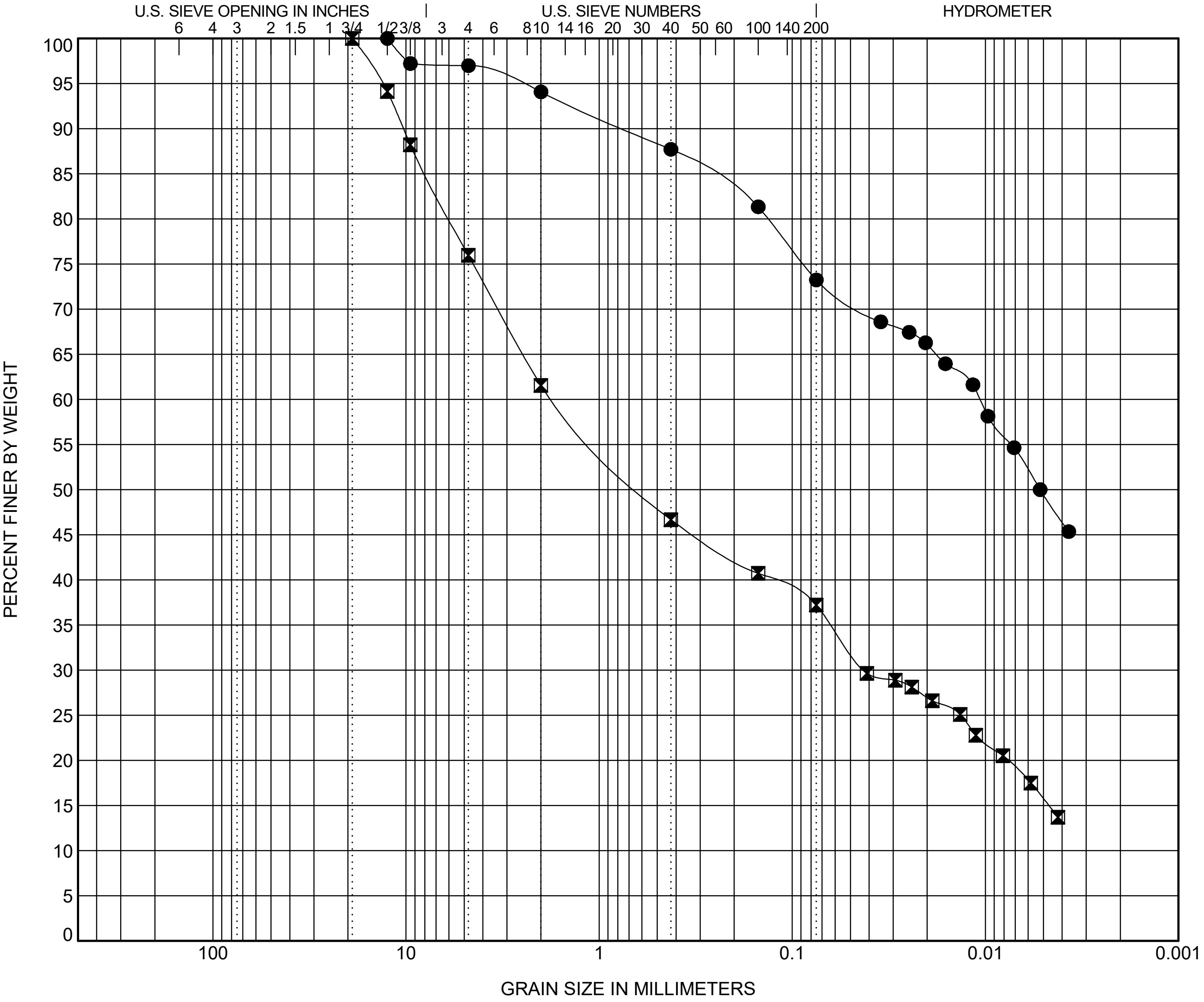


	Specimen Identification	LL	PL	PI	Fines	Classification
●	**B-2 1.0**	**38**	**24**	**14**	**73**	**SILT and CLAY, Some Sand, Trace Gravel A-6a (9)**
⧗	**B-5 1.0**	**33**	**22**	**11**	**37**	**SILT and CLAY, "and" Gravel, Some Sand A-6a (1)**

TTL Associates, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

GRAIN SIZE DISTRIBUTION

CLIENT CT Consultants, Inc.
PROJECT NAME Carpenter Road SSO
PROJECT NUMBER 231140
PROJECT LOCATION Ashtabula, OH



COBBLES	GRAVEL		SAND		SILT	CLAY
	coarse	fine	coarse	fine		

	Specimen Identification		OHDOT Classification	LL	PL	PI	Cc	Cu
●	**B-2**	**1.0**	**SILT and CLAY, Some Sand, Trace Gravel A-6a (9)**	**38**	**24**	**14**		
☒	**B-5**	**1.0**	**SILT and CLAY, "and" Gravel, Some Sand A-6a (1)**	**33**	**22**	**11**		

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2**	**1.0**	**12.5**	**0.005**			**5.9**	**20.8**	**23.8**	**49.5**
☒	**B-5**	**1.0**	**19**	**0.601**	**0.042**		**38.5**	**24.3**	**21.5**	**15.7**

SILT-CLAY BOUNDARY = 0.005 MILLIMETERS