Village of Oak Harbor
Oak Harbor, Ohio

Geotechnical Subsurface Investigation
Church Street Improvement Project
Oak Harbor, Ohio

May 2019

TTL associates inc
Environmental, Geotechnical
Engineering & Testing

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May 21, 2019

TTL Project No. 1797901

Mr. Randall Genzman
Administrator
Village of Oak Harbor
150 West Main Street
Oak Harbor, Ohio 43449

Geotechnical Subsurface Investigation
Church Street Improvement Project
Oak Harbor, Ohio

Dear Mr. Genzman:

Following is the report of the geotechnical subsurface investigation performed by TTL Associates, Inc. (TTL) for the referenced project. This investigation was performed in general accordance with TTL Proposal No. 1797901, dated March 5, 2019, and authorized by you on March 6, 2019.

"Draft" boring logs and tabulated encountered pavement core conditions were provided to Mr. Mike Karafa of Jones & Henry Engineers, Ltd. (J&H) via email on May 10, 2019. This report contains the results of our study, our engineering interpretation of the results with respect to the project characteristics, design and construction recommendations for roadway reconstruction, as well as our recommendations for installation and support of the proposed underground utilities.

Pavement core and 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,

TTL Associates, Inc.

Imad El Hajjar
Geotechnical Project Manager

CHRISTOPHER P
IOTT
E-69734

Christopher P. Iott, P.E.
Chief Geotechnical Engineer

c.c.: Mr. Mike Karafa – Jones & Henry Engineers, Ltd.

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GEOTECHNICAL SUBSURFACE INVESTIGATION
CHURCH STREET IMPROVEMENT PROJECT
OAK HARBOR, OHIO

FOR

VILLAGE OF OAK HARBOR
150 WEST MAIN STREET
OAK HARBOR, OHIO 43449

SUBMITTED

MAY 21, 2019
TTL PROJECT NO. 1797901

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1.0 INTRODUCTION

This geotechnical subsurface investigation report has been prepared for proposed roadway reconstruction and underground utilities project in Oak Harbor, Ohio. We understand that the project will include roadway and underground utility improvements, generally along Church Street, from Norfolk Southern Railroad south to Portage River. Additionally, improvements are planned along Main Street, from Church Street east to Locust Street. The general project area is shown on the Site Location Map (Plate 1.0).

This report describes the investigative and testing procedures, presents our findings and the results of the laboratory testing, provides our design and construction recommendations for roadway reconstruction, as well as provides our recommendations for installation and support of the proposed underground utilities.

This investigation was performed in general accordance with TTL Proposal No. 1797901, dated March 5, 2018, and authorized by Mr. Randall L. Genzman, Village of Oak Harbor Administrator, on March 6, 2018.

The purpose of this investigation was to evaluate the roadway pavement, as well as subsurface conditions and laboratory data, relative to the roadway reconstruction, as well as installation and support of the proposed underground utilities, at the referenced site. To accomplish this, 23 pavement cores, 14 test borings, field and laboratory soil testing, and a geotechnical engineering evaluation of the test results were performed.

This report includes:

- A description of the surface, subsurface soil, and groundwater conditions encountered in the pavement cores and borings.
- Design recommendations related to the proposed roadway 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 the site.

2.0 INVESTIGATIVE PROCEDURES

This investigation included 23 pavement cores and 14 test borings, which were performed by TTL during the period from March 15 through April 15, 2019. The pavement cores and test borings were designated as Borings B-1 through B-23. Note that B-3 was intended to be a boring and B-14 was intended to be a pavement core only. However, due to access constraints with the drill rig, we drilled a boring at B-14. A pavement core was obtained at B-3 using a portable coring machine.

Boring B-1 and B-23 were performed within a parking lot associated with an adjacent bank, and located between the northern bank of Portage River and Water Street. Boring B-2 was performed along Water Street. Borings B-3 and B-6 through B-22 were performed along Church Street. Borings B-4, B-5 and B-5PC were performed along Main Street. The locations of the pavement cores and test borings were established in the field by J&H. Ground surface elevations at the core and boring locations were provided by J&H on the plan provided with the request for proposal. The approximate locations of the test borings are shown on the Test Boring Location Plans (Plates 2.1 and 2.2).

The pavement cores were initially performed on March 15 and 18, 2019. Coring was performed at each core/boring location using a portable core machine equipped with a nominal 4-inch diameter core bit. These cores were extended only through asphalt pavement, and did not penetrate underlying brick or crushed stone. The recovered pavement material was transported to our laboratory for further evaluation and photographic logging. Photographic logs of pavement cores are attached to this report for seven representative samples.

During subsequent drilling operations with drill rigs, each core and boring location included advancement using augers through the asphalt pavement, as well as underlying brick and crushed stone to the underlying soil subgrade so that the thickness of brick and crushed stone could be evaluated at each location. Due to varying pavement conditions encountered in adjacent core and augered locations for B-5, a separate log has been prepared for the core only (designated B-5PC).

Subsequent to completing the pavement coring operations at 14 locations (B-1, B-2, B-4 through B-14, and B-23), test borings were performed in accordance with geotechnical investigative procedures outlined in ASTM Standards D 1452 and D 5434. The test borings performed during this investigation were drilled with truck-mounted rotary drilling rigs utilizing 2¼-inch inside diameter hollow-stem augers. The borings were generally extended to the requested termination depth of 25 feet below surrounding grades. Borings B-1 and B-5 encountered auger refusal at depths of 21½ feet below existing grade and 20½ feet, respectively. Five other borings encountered split-spoon refusal (SSR, 50 or more blows for 6 inches or less penetration during a Standard Penetration Test as described below) over the final planned sample interval.

During auger advancement, soil samples were collected at 2½-foot intervals to a depth of 5 feet below existing grade, and at 5-foot intervals thereafter to boring termination. 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 and the number of blows per increment was 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. The samples were sealed in jars and transported to our laboratory for further classification and testing.

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.

All samples of the subsoils were visually or manually classified using the Unified Soil Classification System (ASTM D 2487 and D 2488). Approximately two-thirds of the samples were tested for moisture content (ASTM D 2216). Dry density determinations were performed on selected intact cohesive samples. Unconfined compressive strength estimates were obtained for the intact cohesive samples using a calibrated hand penetrometer. Atterberg limits tests (ASTM D 4318) and particle size analyses (ASTM D 422) were performed on selected samples to determine soil classification and index properties. The results of these tests are presented on the Logs of Test Borings, Tabulation of Test Data sheets, and Grain Size Distribution sheets attached to this report.

Experience indicates that the actual surface and 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 and excavation 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.

3.0 PROPOSED CONSTRUCTION

We understand that the project will include roadway and underground utility improvements, generally along Church Street, in Oak Harbor, Ohio. The project extends along Church Street from Norfolk Southern Railroad south to Portage River. Additionally, improvements are planned along Main Street, from Church Street east to Locust Street. The project includes:

- An 8 inch-diameter water line along Church Street between South Railroad Street and Park Street.
- A 24-to-84 inch-diameter storm sewer line installed along Church Street starting at South Railroad Street and discharging into the Portage River.
- A 12-to-21 inch-diameter sanitary sewer line installed along Church Street between South Railroad Street and Water Street.
- A 36-to-48 inch-diameter storm sewer line installed along Main Street between Church Street and Locust Street.

We also understand that these underground utilities will be installed using an open-cut excavation technique.

4.0 GENERAL SITE AND SUBSURFACE CONDITIONS

4.1 General Site Conditions

At the time of this investigation, the project area consisted predominantly of residential areas, but also included areas of light commercial development.

Borings B-1 and B-23 were performed within a parking lot associated with an adjacent bank, and were located between the northern bank of Portage River and Water Street. Boring B-2 was performed along Water Street. Borings B-3 and B-6 through B-22 were performed along Church Street. Borings B-4, B-5 and B-5PC were performed along Main Street. The encountered surface materials in the borings are summarized in the following table.

Table 4.1. Encountered Pavement Conditions

Boring/ Core Number	Pavement Thickness (Inches)			Asphalt Core Notes (Distances referenced below top of pavement)
	Asphalt	Brick	Crushed Stone	
B-1	3.75	-	25	Horizontal fracture at 1-7/8”
B-2	6	-	13	Only 3-3/4” intact core recovered. No distinct layering.
B-3	6	4	*	Apparent layering at 2”. Apparent ¼” tack coat at 4”.
B-4	2.5	4	8	No distinct layering.
B-5	3	6	7	Measurement by drillers along borehole.
B-5PC	11	-	*	Only 9-1/4” intact core recovered. Coarser stone in mix than in other cores obtained from this project. No distinct layering.
B-6	5	6	6	Only 4-1/2” intact core recovered. Apparent layering at 1-1/4” to 1-3/8”, and horizontal fracture at 3-1/4”.
B-7	5	4	11	Apparent layering at 1” to 1-1/2” and 3-1/2” to 3-3/4”.
B-8	4.5	4	8	Apparent layering at 1-1/4” to 1-1/2”, and horizontal fracture at 3”.
B-9	6.5	4	11	Apparent layering at 1-1/2” to 1-3/4”, 3” to 3-1/4”, and 4-1/4”.
B-10	6.25	4	11	Apparent layering at 1-1/4” to 1-3/4”, horizontal fracture at 3”, and apparent layering at 4-1/4” to 4-1/2”.
B-11	3.25	5	8	Apparent layering at 1-3/4” to 2”.
B-12	5.5	4	10	Horizontal fracture at 1-1/2”, and apparent layering at 3” to 3-1/8”.
B-13	5	4	8	Only 1-7/8” intact core recovered. No distinct layering.
B-14	5.75	4	10	Apparent layering at 1-1/2” and 2-1/4”. Apparent ¼” thick tack coat at approximately 3-1/4” to 3-1/2”.
B-15	4.25	6	8	Apparent layering at 1-1/2” to 1-3/4”, and 2-1/2” to 2-3/4”.
B-16	3.5	6	8	Apparent layering at 1-1/2”.
B-17	4.5	4	10	Apparent layering at 1-3/4” and 2-1/2” to 2-3/4”.
B-18	5.25	5.5	5.5	Apparent layering at 1” to 1-1/4”, 2-1/4” to 2-1/2”, and 3-1/2”.
B-19	4.25	4.5	7.5	Apparent layering at 1-1/4” to 1-5/8”, 2-1/4”, and 3”.

B-20	4	5	6	Apparent layering at 1”. Apparent ¼” tack coat at approximately 2-1/8”.
B-21	4	5	6.5	Apparent layering at 1-1/2”, and horizontal fracture at 2-1/2”.
B-22	4	-	12	Apparent layering at 1-1/2”
B-23	5.5	-	11.5	Horizontal fractures at 2-3/4” and 3-1/2”.

*Crushed stone thickness not determined during pavement coring operations using portable coring machine.

Photographic pavement core logs are attached to this report for seven selected representative samples.

Underlying the surface materials in Borings B-1, B-7, B-9, B-12 and B-23, cohesive and granular **existing fill materials** were encountered to depths generally ranging from 3 to 4½ feet below existing grades. In Borings B-1 and B-9, the fill materials extended to depths on the order of 12 feet and 14 feet, respectively. The cohesive fill materials generally consisted of lean clay with varying amounts of crushed stone. The granular fill materials consisted of poorly graded sand encountered in Boring B-1, from approximately 4 to 8 feet, clayey sand in Boring B-1, from 9½ to 12 feet, and silty crushed stone in Boring B-12 from approximately 1½ to 4½ feet. Occasional samples included trace amounts of organics, shells, and debris such as glass, brick, concrete, or asphalt fragments. SPT N-values generally ranged from 2 to 7 blows per foot (bpf), indicating **very soft** to medium stiff cohesive fills and **very loose** to **loose** granular fills. SPT N-values of 15 bpf and 23 bpf, indicating stiff to very stiff consistency, were determined for the cohesive fill encountered from 3 to 14 feet in Boring B-9. Moisture contents within the fill materials generally ranged from approximately 25 to 38 percent.

4.2 General Soil and Rock Conditions

Based on the conditions encountered in the test borings, the subsoils encountered underlying the surface and fill materials can be generally described as four strata of cohesive soils exhibiting varying strength and moisture characteristics. The upper two strata consisted of lacustrine deposits; underlying stratums consisted of glacial till deposits overlying weathered bedrock.

Stratum I consisted of predominantly medium stiff to stiff cohesive lacustrine deposits encountered underlying the surface and/or fill materials in all borings, except Borings B-1, B-2, B-7, B-9, B-14 and B-23. Stratum I generally extended to depths ranging from 3 to 3½ feet below existing grade. Stratum I extended to depths ranging from 8 to 8½ feet in Borings B-5, B-11, B-12, and B-13. These cohesive soils consisted of lean clay (CL) with varying amounts of sand and gravel. SPT N-values generally ranged from 5 to 10 blows per foot (bpf). An SPT N-value of 4 bpf, indicating **soft** consistency, was determined for a zone of clay encountered from 4½ to 8½ feet in Boring B-12. Unconfined compressive strengths typically ranged from 2,500 to 6,500 pounds per square foot (psf). Moisture contents ranged from 20 to 25 percent.

Stratum II consisted of predominantly stiff to very stiff cohesive lacustrine deposits encountered underlying the surface materials in Boring B-14, the fill materials in Borings B-2, B-7, and B-23, and underlying Stratum I in Borings B-4 and B-10. Stratum II extended to depths ranging from 7 to 8½ feet. These cohesive soils consisted of lean clay (CL) with varying amounts of sand and trace amounts of gravel. SPT N-values ranged from 10 to 16 bpf. Unconfined compressive strengths ranged from 4,500 to 6,000 psf. Moisture contents ranged from 22 to 26 percent.

Stratum III consisted of predominantly medium stiff to very stiff cohesive glacial till deposits encountered underlying the fill materials in Borings B-1 and B-9, Stratum I in Borings B-5, B-6, B-8, B-11, B-12, and B-13, and Stratum II in the remaining borings. Stratum III extended to depths generally ranging from 18½ to 24 feet. Boring B-13 was terminated within this stratum at a depth of 25 feet. These cohesive soils consisted of lean clay (CL) with varying amounts of sand and trace gravel. SPT N-values generally ranged from 5 to 25 bpf. Unconfined compressive strengths within Stratum III typically ranged from 2,000 psf to greater than 9,000 psf (maximum reading obtainable using a hand penetrometer). An SPT N-value of 4 bpf, indicating **soft** consistency, was determined for a zone of clay encountered from approximately 12 to 18½ feet in Boring B-12. Moisture contents ranged from 13 to 21 percent.

Stratum IV consisted of predominantly hard cohesive glacial till deposits (typically referred to as "hardpan" in this region) encountered underlying Stratum III in each of the borings, except Boring B-13. Stratum IV extended to depths ranging from approximately 21 to 24½ feet in borings that encountered apparent weathered rock, and to boring termination at a depth of 25 feet in the remaining borings. These cohesive soils consisted of lean clay (CL) with sand and trace gravel, silty clay (CL/ML) with sand and varying amounts of rock fragments, as well as sandy silt (ML) with rock fragments. SPT N-values ranged from 36 to 96 bpf. Unconfined compressive strengths ranged from 9,000 psf to greater than 9,000 psf. Moisture contents ranged from 8 to 15 percent.

Weathered Rock was encountered in Boring B-1 just prior to encountering auger refusal at a depth of 21½ feet. Auger refusal on apparent bedrock was also encountered at a depth of 20½ feet in Boring B-5. Based on split-spoon refusal during the final planned sample interval and the presence of rock fragments in Stratum IV, we have also indicated apparent weathered rock at the termination depth of Borings B-6, B-8, B-9, B-10 and B-14 at depths ranging from 23.6 to 24.6 feet below existing grades.

The depths and elevations of encountered Stratum IV "hardpan" and apparent weathered rock are summarized in the following table.

Table 4.2. Depth/Elevation of "Hardpan" and Weathered Rock

Boring Number	Ground Surface Elevation (feet)	Depth to Stratum IV "Hardpan" (feet)	Elevation of Stratum IV "Hardpan" (feet)	Depth to Weathered Rock (feet)	Elevation of Weathered Rock (feet)
B-1	585.8	18.5	567.3	20.9	564.9
B-2	587.5	22.0	565.5	N.E.	–
B-4	585.3	22.5	562.8	N.E.	–
B-5	578.4	18.5	559.9	20.5	557.9
B-6	585.8	22.0	563.8	24.6	561.2
B-7	583.5	23.0	560.5	N.E.	–
B-8	583.5	22.0	561.5	24.1	559.4
B-9	585.9	21.0	564.9	23.6	562.3
B-10	586.1	22.0	564.1	24.5	561.6
B-11	586.4	24.2	562.2	N.E.	–
B-12	586.0	22.5	563.5	N.E.	–
B-13	587.2	N.E.	–	N.E.	–
B-14	586.8	23.0	563.8	24.0	562.8
B-23	587.3	22.4	564.9	N.E.	–

N.E.: Not Encountered

Additional descriptions of the stratigraphy encountered in the borings and laboratory testing results are presented on the Logs of Test Borings.

4.3 Groundwater Conditions

Groundwater was initially encountered during drilling in three of the fourteen borings. Groundwater was observed upon completion of drilling in two borings. The groundwater conditions observed in the borings are summarized in the following table.

Table 4.3. Encountered Groundwater Conditions

Boring Number	Depth of Groundwater Initially Encountered During Drilling (feet)	Depth of Groundwater Observed Upon Completion of Drilling (feet)
B-11	24.0	24.6
B-13	24.0	23.0
B-14	1.0*	N.E.

N.E. = Not Encountered.

*Apparent perched water within pavement stone base.

Groundwater was not encountered during drilling or observed upon completion of drilling in any of the remaining test borings. It should be noted that the test borings were backfilled upon completion, so ample time may not have occurred to achieve stabilized water levels within the open boreholes in the predominantly clayey profile.

Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that “normal” groundwater levels can generally be expected to occur at depths on the order of 12 to 17 feet below existing grades (Elevs. 575± to 565±). However, “perched” water may be encountered within existing fill materials and pavement base materials that are underlain by relatively impermeable cohesive soils.

It should be noted that groundwater elevations will tend to fluctuate with seasonal and climatic influences. In particular, groundwater levels in the southern portion of the project site may be affected by water levels in Portage River. Thus, groundwater conditions may be different at other times of the year from those encountered at the time of this investigation.

5.0 DESIGN AND CONSTRUCTION RECOMMENDATIONS

The following recommendations are based on the data obtained during our field investigation as well as our understanding of the proposed construction and project design information furnished to date. If the project information as outlined herein is incorrect or should change significantly, a review of these recommendations should be made by TTL.

5.1 Pipe Support

We understand that the underground utility improvements for this project will include the installation of a water line, a sanitary sewer line and a storm sewer line. The water line will consist of an 8 inch-diameter ductile iron and/or PVC pipe with inverts that are six to eight feet below existing grades. The storm sewer lines will consist of a 24 to 84 inch-diameter concrete and/or PVC pipes with inverts that are six to seventeen (17) feet below existing grades. The sanitary sewer lines will consist of a 12-to-21 inch-diameter PVC pipe with inverts that are thirteen (13) to twenty (20) feet below existing grades. We also understand that these underground utilities will be installed using an open-cut excavation technique. Some excavated trenches will include both sewer lines installed at different invert elevations (the sanitary sewer is proposed to be installed below the storm sewer line).

Based on the borings performed for this investigation and our project understanding, the subsoils at the water line invert depths are anticipated to consist predominantly of Stratum I medium stiff to stiff cohesive lacustrine deposits and Stratum II stiff to very stiff cohesive lacustrine deposits. Based on Borings B-8 and B-14, Stratum III stiff to very stiff cohesive glacial till deposits may also be encountered at pipe invert elevations. All of these subsoils are considered generally suitable for support of the proposed water line. Based on Boring B-12, the Stratum I cohesive soils may exhibit **soft** consistency at pipe invert elevations. Based on Boring B-9, stiff to very stiff cohesive **fill** may be encountered at the proposed invert elevation. The fill materials and soft cohesive soils may require over-excavation as discussed below.

Based on our project understanding, storm sewer line is anticipated to predominantly be supported on new engineered fill placed overlying the sanitary sewer line to be installed deeper in the same trench. Properly placed and compacted new engineered fill is considered suitable for support of the storm sewer line. Based on borings B-1, B-2 and B-23, the subsoils at the pipe invert depth in this area of the project along Water Street and within the adjacent parking area are anticipated to consist of predominantly Stratum III stiff to very stiff cohesive glacial till deposits. Based on Borings B-4 and B-5, the subsoils within the portion of pipe alignment along Main

Street are anticipated to consist of predominantly Stratum I medium stiff to stiff cohesive lacustrine deposits or Stratum II stiff to very stiff cohesive lacustrine deposits. All of these soils are considered generally suitable for support of the proposed storm sewer pipe.

Based on the borings performed for this investigation and our project understanding, the subsoils at the sanitary sewer line invert depths are anticipated to consist predominantly of Stratum III medium stiff to very stiff cohesive glacial till deposits. Based on Boring B-9, the invert depth may be approaching the underlying Stratum IV hard cohesive glacial till deposits.

With the exception of the soft cohesive soils, the subsurface materials anticipated at pipe invert elevations are considered generally suitable for pipe support, provided that sufficient bedding and haunching is maintained below and above the proposed water lines. The condition of the existing fill materials encountered in Boring B-9 are also considered generally suitable, although the owner accepts some additional risk associated with fills of unknown origin and potential conditions that are not as good as those encountered in the test boring. If poor existing fill conditions, such as encountered in Boring B-1, are present at the pipe invert elevation, they should be over-excavated and replaced with new engineered fill. Where soft/loose soils or other unsuitable soils are encountered at the invert elevations, they should be undercut to firm subgrade conditions. As a minimum, unsuitable soils should be undercut to a depth of one pipe diameter below invert, or 12 inches, whichever is greater. The undercut zones should be replaced with engineered fill, properly placed and compacted as outlined in Section 5.7 of this report prior to placement of the bedding and haunching material.

In any case, 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. In the absence of specific criteria for bedding and haunching materials, we recommend the use of dense graded aggregate meeting Ohio Department of Transportation (ODOT) Item 304 specifications, or alternately, ODOT 703 coarse aggregate meeting No. 57 or No. 6 gradations.

We recommend that the trench excavation along the proposed underground utilities invert be inspected by a TTL 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 borings drilled for this investigation, soils encountered in trench excavations may include one or more of the following:

- 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
- OSHA Type C soils (fill materials).

For temporary excavations in Type A, B, and C soils, side slopes must be constructed no steeper than ¾ horizontal to 1 vertical (¾H:1V), 1H:1V, and 1½H:1V, respectively. For situations where a higher strength soil overlies a lower strength soil and the excavation extends into the lower strength soil, 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.

When a portable trench box or sliding trench shield system is utilized, vertical side slopes may be used up to 18 inches below the top of the shield. The sides should then be sloped back from that point to the ground surface.

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 and roadways. The method employed will depend on the construction sequencing, required access size and area, and economic considerations. Difficult driving or refusal would be anticipated with piles extending to the Stratum IV “hardpan” or the underlying weathered rock. This may limit embedment of piling.

All braced excavations should be designed to resist lateral earth pressures. Based on the encountered predominantly 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 (ka) of 0.35 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. 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 as 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 70 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 3.0 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 3.0 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.

It should be noted that debris may be present in the existing fill materials. Although not encountered during our exploration, cobbles and boulders may be present in the glacial till subsoils. Therefore, provisions should be made by the contractor to drive replacement piling if refusal is encountered shallower than anticipated.

5.4 Seismic Considerations

We have reviewed seismic design parameters in accordance with the Ohio Building Code (OBC) criteria. It should be noted that the OBC seismic site characterization is based on the upper 100 feet of the geologic profile and the borings performed for this investigation extended only to a maximum depth of 25 feet below existing grade. Borings B-1 and B-5 encountered auger refusal on apparent bedrock at depths of 21½ feet below existing grade and 20½ feet, respectively. Additionally, apparent bedrock has been noted for five additional borings based on split-spoon refusal near the planned termination depth, after extending into "hardpan" material with rock fragments. Therefore, our analysis considers the encountered overburden soil profile and the underlying bedrock.

Based on OBC Section 1613.3.2, which references ASCE 7-10, utilizing the SPT N-value method, the weighted average N-value for the profile was calculated to be greater than 15 but less than 50 blows per foot (bpf). Based on this average N-value, the site can be characterized as Site Class D (stiff soils) in accordance with ASCE 7-10 Table 20.3-1.

Using the USGS U.S. Seismic Design Maps web application referencing ASCE 7-10 Standard, spectral response accelerations were determined as follows:

- S_S (mapped spectral acceleration for short periods) = 0.124g, and
- S_1 (mapped spectral acceleration for 1-sec period) = 0.054g,

  where acceleration is expressed as a ratio of gravitational acceleration (g).

Using these spectral response accelerations, the site coefficients and response accelerations were determined based on ASCE Section 11.4 7 for Site Class D, as follows:

Table 5.4. Site Coefficients/Spectral Response Acceleration Parameters	
F_a (site coefficient as defined in Table 11.4-1)	1.6
F_v (site coefficient as defined in Table 11.4-2)	2.4
S_{MS} (maximum considered earthquake spectral response acceleration for short periods): $S_{MS} = F_aS_s$	0.198
S_{M1} (maximum considered earthquake spectral response acceleration for 1-second period): $S_{M1} = F_vS_1$	0.13
SDS (5 percent damped design spectral response acceleration at short periods): SDS = 2/3 SMS	0.132
S_{D1} (5 percent damped design spectral response acceleration at 1-second period): S_{D1} = 2/3 S_{M1}	0.086

These parameters may be used by the structural engineer to develop the design response spectrum in accordance with ASCE 7 Section 11.4.5, along with the fundamental period (T, in seconds) of vibration of the structure(s).

5.5 Pavement Recommendations

Evaluations are provided below for subgrade soils if full-depth removal and replacement is considered for the project.

5.5.1 Existing Subgrade

The subgrades that would result upon the satisfactory completion of the site preparation as described in Section 5.6 of this report are considered moderately suitable for support of the proposed replacement pavements. Based on field and laboratory data developed during this investigation, the subgrade soils consist of predominantly cohesive existing fill materials and native cohesive soils, although zones of granular existing fill materials may also be encountered.

Based on laboratory testing as well as visual descriptions of the upper soil profile, the cohesive soils may be classified as Group A-7-6, A-6a, or A-6b in accordance with the Ohio Department of Transportation (ODOT) system of soil classification. Based on visual descriptions of the upper soil profile, the isolated encountered granular fill materials may be classified as Group A-3a in accordance with the ODOT system of soil classification. These soils are considered good as subgrade materials. The cohesive soils are considered fair to poor as subgrade materials because they have relatively low permeabilities and a high percentage of silt and clay particles, which makes them susceptible to moisture, frost penetration, and frost heave. Therefore, the cohesive soils will dictate pavement design.

At the time of this investigation, moisture contents in the upper 3 feet of the subgrade soils were generally found to range from approximately 20 to 31 percent. These moisture contents are estimated to range from somewhat above to significantly above the expected optimum moisture content for these soils. Therefore, remedial action should be anticipated to adjust the moisture contents of the existing materials and achieve proper compaction of the subgrade, particularly during wet seasonal periods.

5.5.2 Modified Subgrade

If moisture contents are lower than optimum, water should be uniformly mixed into the subgrade. If moisture contents are higher than optimum, modification may consist of scarification and aeration (discing and exposure to sun and wind). However, this method may not be feasible if construction occurs during wet seasonal conditions or if the construction schedule must be expedited. Very moist to wet soils will "pump" under the operation of heavy equipment, resulting in deep rutting and perhaps rendering the operation of grading and paving equipment difficult or impossible.

Therefore, other methods of subgrade modification may be required in areas of high moisture content. Modification may be achieved by undercutting and replacement with granular subbase (possibly in combination with a geotextile separation layer or geogrid reinforcement), mixing stone into the subgrade, or treating the subgrade with lime or cement. The method of subgrade modification should be determined at the time of construction (See Section 5.6, "Construction (General)").

5.5.3 Pavement Drainage

Based on the poorly-drained nature of the encountered cohesive subgrade soils, 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 infiltration, thus reducing the potential for adverse freeze-thaw effects on the pavement.

5.5.4 Flexible (Asphalt) Pavement Design

For evaluation of existing pavement cross-sections with respect to design traffic loads and volumes, or design of new replacement pavement should full-depth removal of existing pavement materials be performed, we recommend a subgrade CBR value of 4 percent for the for the Group A-7-6 or better soils. This value is based on the results of the gradation analysis and Atterberg limits testing, as well as visual classification of the recovered subgrade soil samples.

For full-depth removal and replacement of the existing pavement materials, the subgrade should be 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.

If asphalt and underlaying brick will be completely removed and existing crushed stone base will remain, we recommend that the crushed stone base be re-compacted to alleviate loose zones of aggregate base prior to repaving with the new intermediate course. This compaction can be accomplished with a smooth-drum vibratory roller.

If milling and resurfacing of pavements requires isolated areas of asphalt be completely removed (such as spot repairs at potholes), a hydraulically-operated “hoe-pac” should be utilized for re-compaction of the underlying aggregate base.

If an asphalt overlay is utilized, it should be noted that reflective cracks tend to occur over time in areas of existing cracks.

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 roadway pavement cross-section consist of at least 4 inches of asphalt underlain by 8 inches of aggregate base based on our experience regarding environmental exposure and reasonable serviceability.

It is recommended that proof rolling/compaction, placement of aggregate base, and placement of asphalt be performed within as short a time period as possible. Exposure of the aggregate base to rain, snow, or freezing conditions may lead to deterioration of the subgrade and/or base due to excessive moisture conditions and to difficulties in achieving the required compaction. Additionally, pavement design and all paving operations should conform to Ohio Department of Transportation (ODOT) specifications.

5.5.5 Rigid (Concrete) Pavement Design

For properly prepared subgrade soils, a modulus of subgrade reaction (k) of 120 pounds per cubic inch (pci) may be used for rigid pavement design. This section should consist of a minimum of 6 inches of reinforced, air-entrained concrete with a minimum compressive strength of 3,500 pounds per square inch (psi) underlain by a minimum of 6 inches of a dense-graded granular base. The pavement section should be supported on a subgrade compacted to not less than 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) or verified as stable through proof rolling. All paving operations should conform to the Ohio Department of Transportation (ODOT) specifications.

5.6 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 to 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, suitable excavated material may be used to backfill the trench, if located in non-structural and non-pavement areas. Such non-structural and non-pavement areas are anticipated to be limited for this project. Fill required for backfill operations in non-structural and non-pavement areas may consist of any on-site soils that are free of organic matter, excessive moisture, and debris.

In general, 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.**

Where underground utilities are installed in unpaved and non-structural areas, suitable excavated material from the underground utilities trench may be utilized as backfill. Based on the borings, the excavated material would consist of predominantly cohesive fill materials and native cohesive soils. At the time of this investigation, moisture contents determined for these cohesive materials generally ranged from near to significantly above optimum moistures expected for these soils. Depending on seasonal conditions, it may not be practical to effectively scarify and aerate excavated soils that are wet of optimum, and imported granular backfill may be required.

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 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 TTL geotechnical engineer or qualified representative.

If roadway rehabilitation consists of full depth removal and replacement, site preparation activities should include the removal of pavements and other deleterious non-soil materials from all proposed roadway areas. As stated above, upon completion of the clearing and undercutting activities, all areas that are to receive fill, or that have been excavated to proposed final subgrade elevation, should be inspected and proof rolled by a geotechnical engineer.

Backfill for utility trenches in existing or proposed roadways is anticipated to consist of new granular engineered fill, which should be generally suitable for support of new pavements. Based on the borings performed for this investigation, subgrade soils beyond the granular backfill associated with the utility trench backfill are anticipated to consist of predominantly cohesive existing fill materials or native cohesive soils. However, zones of granular existing fill materials may also be present at subgrade elevations. The cohesive subgrade soils should be proof rolled using a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. For granular subgrades containing little silt or clay fraction, proof rolling/compaction of these soils should be performed utilizing a vibratory smooth drum roller. The truck or roller should make a minimum of two passes in each of two perpendicular directions covering the proposed development area, with additional passes as necessary to achieve required compaction and/or subgrade stabilization.

The purpose of proof rolling the cohesive soil subgrades and clayey sand subgrades is to locate any weak, soft, loose, or excessively wet materials that may be present at the time of construction. The purpose of vibratory compaction for the “clean” (less silty/clayey) granular soils is to densify zones of loose materials that are encountered in the upper portion of the soil profile, thereby providing more uniform subgrade support. We recommend a roller with a minimum dead weight on the drums of 8 tons, vibrating at 30 Hz or greater, and traveling at speeds not exceeding approximately 4 feet per second (about 3 miles per hour). These operational criteria should provide sufficient dynamic compaction energy to alleviate loose soil conditions within the zone of influence for subgrade support.

Any unsuitable materials observed during the inspection and proof-rolling operations should be undercut and replaced with compacted fill or stabilized in place utilizing conventional remedial measures such as discing, aeration, and recompaction. Once the site has been proof rolled, inspected, and stabilized, the proof-rolled or inspected subgrades should not be exposed to wet conditions. It should be recognized that during periods of wet weather, the clayey soils that will be exposed at design subgrades will tend to pond water for short periods of time, with the potential to deteriorate the prepared subgrade.

The results of the inspection and proof-rolling operations will be partially dependent on construction operations, the moisture content of the soil, and the weather conditions prevalent at the time. If pumping or rutting is encountered and difficulty is experienced in the operation of construction equipment, TTL should be notified in order to determine which method of subgrade modification may be best suited for the conditions encountered. Should such conditions be experienced, we may recommend that a small test area be used to determine the necessary depth of undercutting and stone replacement or other remedial action necessary to achieve a stable subgrade condition. Due to the size of the project, we presume that chemical stabilization would not be economical compared to the over-excavation and replacement option for modification of unsuitable subgrade soils. Nonetheless, TTL could provide soil-chemical mix design services if this option is being considered for the project.

5.7 Construction Dewatering

Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that “normal” groundwater levels can generally be expected at depths on the order of 12 to 17 feet below existing grades (Elevs. 575± to 565±). However, “perched” water may be encountered within the pavement base materials and existing fill materials that are underlain by relatively impermeable cohesive soils.

Adequate control of groundwater seepage, “perched” water, or surface water run-off into shallow excavations extending not more than a few feet below the water table in cohesive soils should be achievable by minor dewatering systems, such as pumping from prepared sumps. For deeper excavations, temporary sheeting may be required to extend into the underlying cohesive soils for a groundwater cutoff. If excessive seepage is experienced, other means of groundwater control may be required. TTL should be notified if such conditions are encountered in order to evaluate if other dewatering methods are needed.

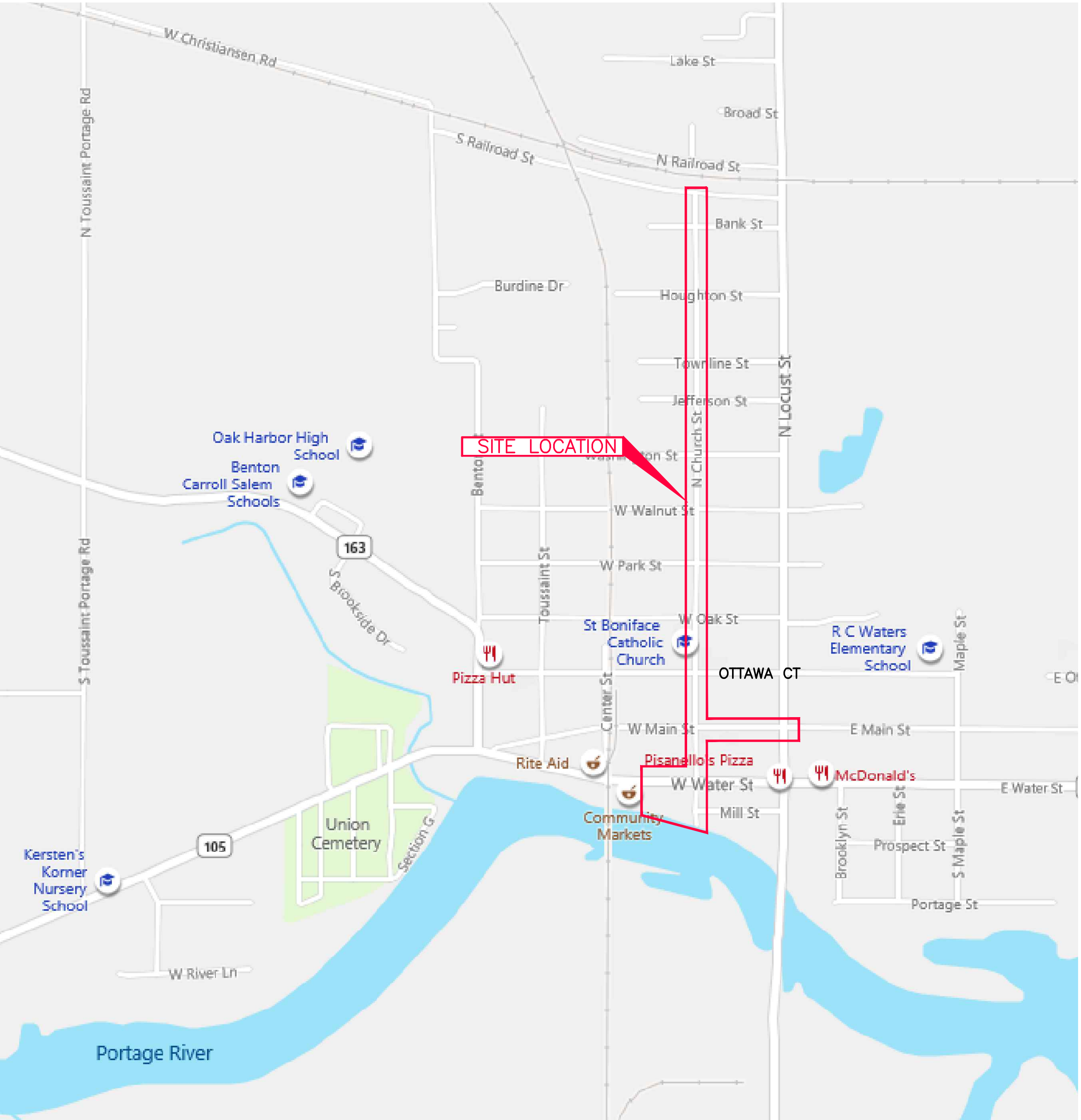
6.0 QUALIFICATION OF RECOMMENDATIONS

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. The general subsurface conditions were based on interpretation of subsurface data obtained 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. Therefore, experienced geotechnical engineers should observe earthwork and foundation construction to confirm that the conditions anticipated in design are noted. Otherwise, TTL 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. TTL is not responsible for the conclusions, opinions, or recommendations of others based on this data.



LEGEND

—— APPROXIMATE SITE LOCATION

N

APPROXIMATE SCALE – FEET

0 1,200 2,400

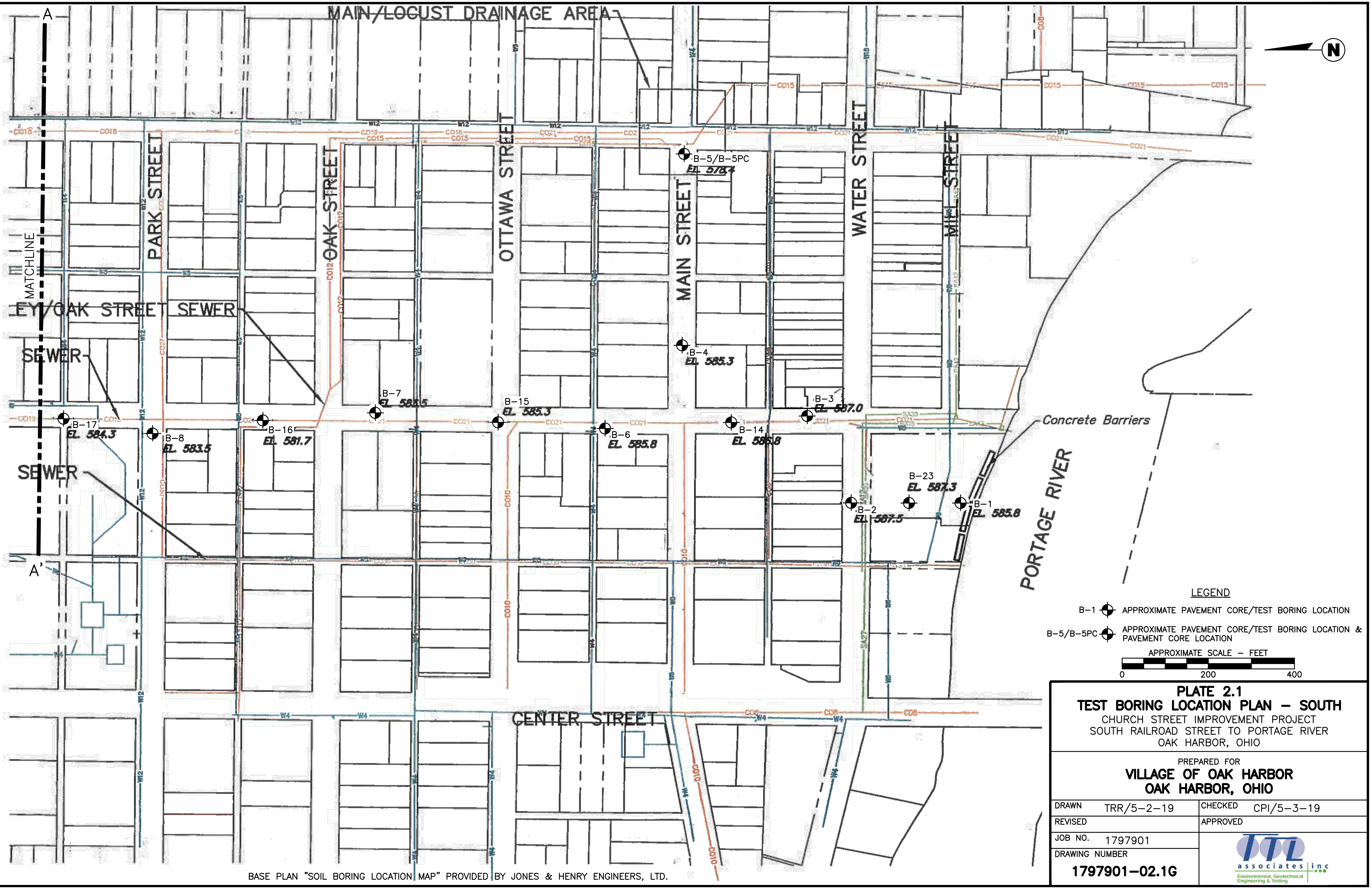
PLATE 1.0
SITE LOCATION MAP

CHURCH STREET IMPROVEMENT PROJECT
SOUTH RAILROAD STREET TO PORTAGE RIVER
OAK HARBOR, OHIO

PREPARED FOR
VILLAGE OF OAK HARBOR
OAK HARBOR, OHIO

DRAWN	TRR/5-2-19	CHECKED	CPI/5-3-19
REVISED		APPROVED	
JOB NO.	1797901		
DRAWING NUMBER	**1797901-01G**		

TTL associates inc
Environmental, Geotechnical Engineering & Testing



BASE PLAN "SOIL BORING LOCATION MAP" PROVIDED BY JONES & HENRY ENGINEERS, LTD.

PLATE 2.1
TEST BORING LOCATION PLAN – SOUTH
CHURCH STREET IMPROVEMENT PROJECT
SOUTH RAILROAD STREET TO PORTAGE RIVER
OAK HARBOR, OHIO

PREPARED FOR
VILLAGE OF OAK HARBOR
OAK HARBOR, OHIO

DRAWN	TRR/5-2-19	CHECKED	CPI/5-3-19
REVISED		APPROVED	
JOB NO.	1797901		
DRAWING NUMBER	**1797901-02.1G**		

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Environmental, Geotechnical Engineering & Testing

BASE PLAN "SOIL BORING LOCATION MAP" PROVIDED BY JONES & HENRY ENGINEERS, LTD.

PLATE 2.2
TEST BORING LOCATION PLAN – NORTH

CHURCH STREET IMPROVEMENT PROJECT
SOUTH RAILROAD STREET TO PORTAGE RIVER
OAK HARBOR, OHIO

PREPARED FOR
VILLAGE OF OAK HARBOR
OAK HARBOR, OHIO

DRAWN	TRR/5-2-19	CHECKED	CPI/5-3-19
REVISED		APPROVED	
JOB NO.	1797901		
DRAWING NUMBER	**1797901-02.2G**		

TTL associates inc
Environmental, Geotechnical Engineering & Testing

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Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

BORING NUMBER B-1

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates TB IC

RIG NO. 844

GROUND ELEVATION 585.8 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 3/19/19

COMPLETED 3/19/19

AT TIME OF DRILLING None

LOGGED BY KKC

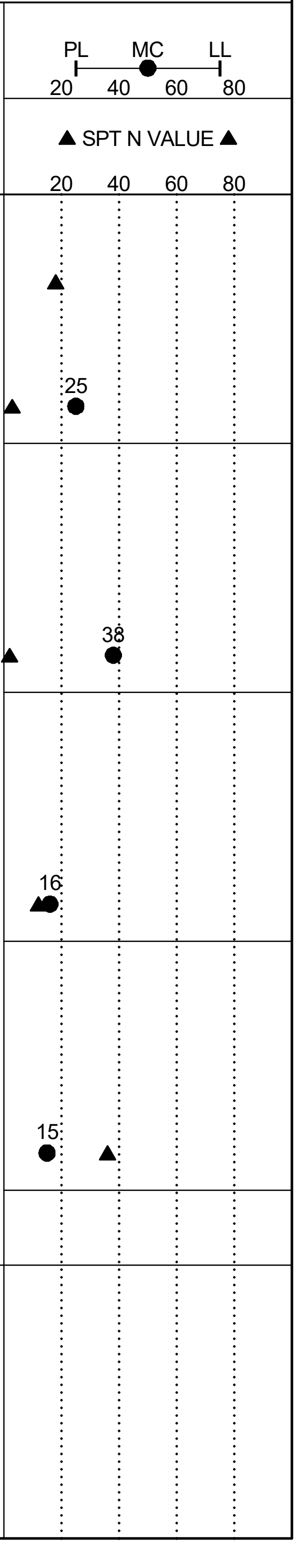
CHECKED BY CPI

AT END OF DRILLING None

NOTES Auger refusal encountered at a depth of 21.5 feet.

0hrs AFTER DRILLING Backfilled w/Cuttings & 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
585	0		ASPHALT - 3.75 Inches 0.3'						
			CRUSHED STONE - 25 Inches 2.4'	SS 1	53	18-10-8 (18)	NI		
			FILL - Moist Very Stiff Black/Gray GRAVELLY (Crushed Stone) LEAN CLAY w/Concrete Fragments and Trace Brick 4.2'						
580	5		FILL - Moist Very Loose Red/Brown POORLY GRADED SAND w/Trace Brick Fragments, Slag, and Clay 8.0'	SS 2	56	3-2-1 (3)	NP		25
			FILL - Moist Very Soft Red/Dark Brown SANDY LEAN CLAY w/Trace Slag, Glass, Silt, Organics, and Shells 9.4'	SS 3	72	1-1-1 (2)	0.50		38
575	10		FILL - Moist Very Loose Red/Dark Brown CLAYEY SAND 12.0'						
570	15		Moist Stiff to Very Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL) 18.5'	SS 4	69	3-5-7 (12)	4.50	118	16
565	20		Moist Hard Brown LEAN CLAY w/Sand and Trace Gravel (CL) 20.9'	SS 5	74	8-16-20 (36)	4.50	114	15
			WEATHERED ROCK 21.5'						
			Bottom of hole at 21.5 feet.						



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BORING NUMBER B-2

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates TB IC

RIG NO. 844

GROUND ELEVATION 587.5 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/15/19

COMPLETED 4/15/19

AT TIME OF DRILLING None

LOGGED BY KKC

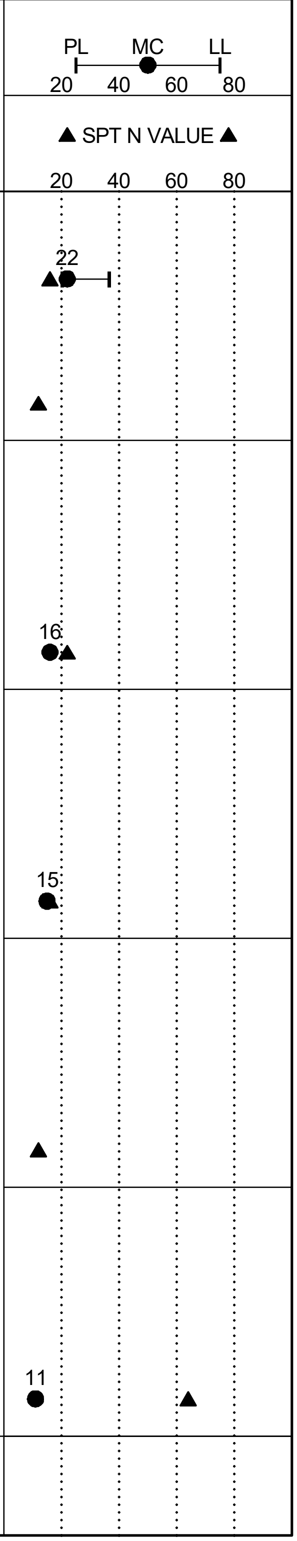
CHECKED BY CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Backfilled w/Cuttings & 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 - 6 Inches 0.5'					
		CRUSHED STONE - 13 Inches 1.6'	SS 1	72	8-8-8 (16)	2.25	
585		Moist Very Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL)					
	5	@3.5': Stiff to Very Stiff	SS 2	100	3-5-7 (12)	2.75	
580		8.0'					
	10	Moist Very Stiff to Hard Brown LEAN CLAY w/Sand and Gravel (CL)	SS 3	100	5-10-12 (22)	4.50	116
575							
	15	@14.7': Gray w/Trace Gravel	SS 4	100	5-7-9 (16)	3.00	124
570		18.5'					
	20	Moist Gray Stiff to Very Stiff LEAN CLAY w/Sand and Gravel (CL)	SS 5	100	2-4-8 (12)	2.50	
565		22.0'					
		Moist Very Hard Gray SILTY CLAY w/Sand (CL/ML)					
	25	@24.5': w/Trace Rock Fragments 25.0'	SS 6	94	17-27-37 (64)	>4.5	
		Bottom of hole at 25.0 feet.					



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BORING NUMBER B-3

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates MB JP

RIG NO. Portable Core Machine

GROUND ELEVATION 587.0 ft

DRILLING METHOD Pavement Coring

GROUND WATER LEVELS:

DATE STARTED 3/18/19 **COMPLETED** 3/18/19

AT TIME OF DRILLING None

LOGGED BY KKC **CHECKED BY** CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Patched

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 - 6 Inches 0.5'						
			BRICK - 4 Inches (No crushed stone thickness determination during pavement coring operations using portable coring machine.) 0.8'						
			Bottom of hole at 0.8 feet.						

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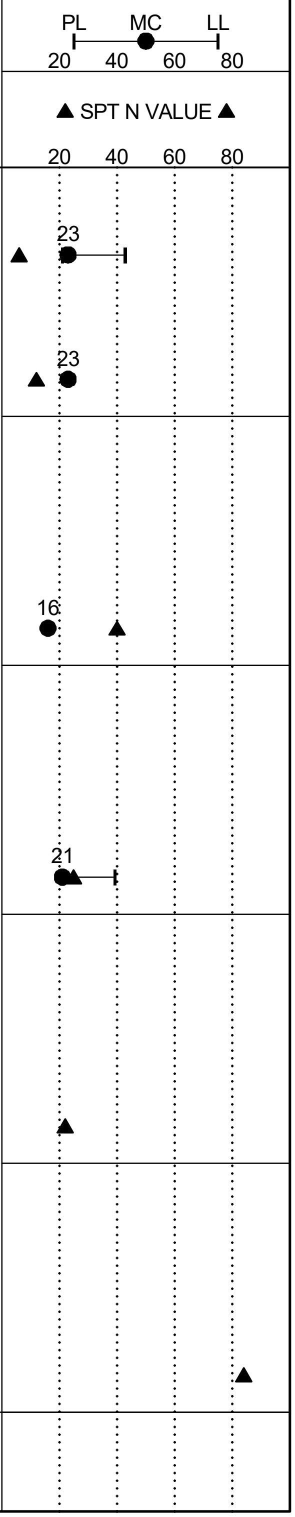
BORING NUMBER B-4

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 585.3 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/15/19
COMPLETED 4/15/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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)
585	0	ASPHALT - 2.5 Inches 0.3'					
		BRICK - 4 Inches 0.6'	SS 1	67	2-2-4 (6)	1.25	109
		CRUSHED STONE - 8 Inches 1.3'					
		Moist Medium Stiff to Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL) 3.0'	SS 2	100	2-4-8 (12)	3.25	109
580	5	Moist Stiff to Very Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL) 8.5'					
575	10	Moist Hard Brown LEAN CLAY w/Sand and Gravel (CL) 13.5'	SS 3	100	8-16-24 (40)	4.50	
570	15	Moist Very Stiff to Hard Brown LEAN CLAY w/Sand and Trace Gravel (CL)	SS 4	100	5-10-15 (25)	4.50	109
		@17': Gray w/Trace Sand					
565	20	@18.5': (Noted as Auger Sample)	SS 5	0	8-11-11 (22)	NI	
		22.5'					
	25	Moist Very Hard Gray SILTY CLAY w/Sand and Rock Fragments (CL/ML) 25.0'	SS 6	100	14-34-50 (84)	>4.5	
		Bottom of hole at 25.0 feet.					



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BORING NUMBER B-5

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates CW MB

RIG NO. 111

GROUND ELEVATION 578.4 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/9/19 **COMPLETED** 4/9/19

AT TIME OF DRILLING None

LOGGED BY KKC **CHECKED BY** CPI

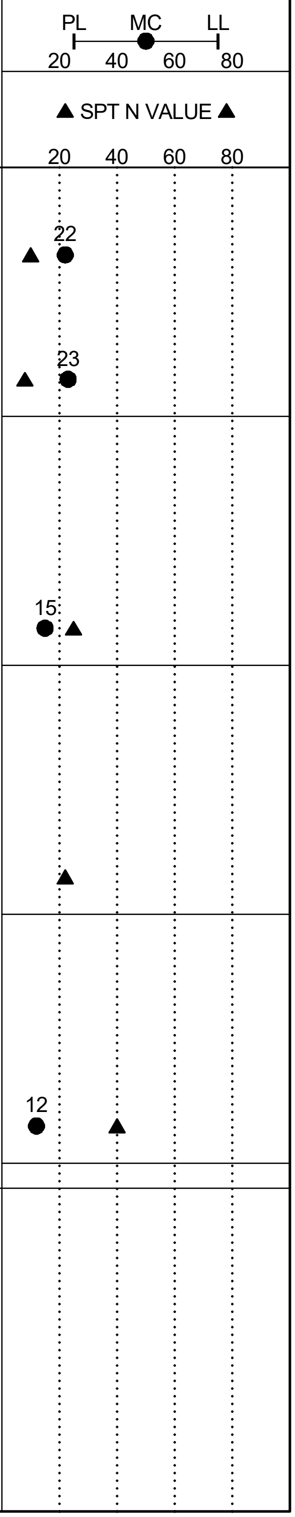
AT END OF DRILLING None

NOTES Auger refusal encountered at a depth of 20.5 feet.

0hrs AFTER DRILLING Backfilled w/Cuttings & 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 - 3 Inches 0.3'					
		BRICK - 6 Inches 0.8'	SS 1	89	5-4-6 (10)	3.25	
		CRUSHED STONE - 7 Inches 1.3'					
575		Moist Stiff to Very Stiff Brown/Gray LEAN CLAY w/Sand and Trace Gravel (CL) 3.0'	SS 2	100	2-3-5 (8)	2.00	100
570	5	Moist Medium Stiff to Stiff Brown/Gray LEAN CLAY w/Sand and Trace Gravel (CL) 8.5'					
	10	Moist Very Stiff to Hard Brown/Gray LEAN CLAY w/Sand and Trace Gravel (CL)	SS 3	100	6-10-15 (25)	>4.5	
565		@13': Gray					
560	15	18.5'	SS 4	100	14-10-12 (22)	>4.5	
	20	Moist Hard Gray LEAN CLAY w/Sand and Trace Rock Fragments (CL) 20.5'	SS 5	100	12-14-26 (40)	>4.5	121

Bottom of hole at 20.5 feet.



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BORING NUMBER B-5PC

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates MB JP

RIG NO. Portable Core Machine

GROUND ELEVATION 578.4 ft

DRILLING METHOD Pavement Coring

GROUND WATER LEVELS:

DATE STARTED 3/18/19

COMPLETED 3/18/19

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY CPI

AT END OF DRILLING None

NOTES Performed adjacent to B-5 Core/Boring Location

0hrs AFTER DRILLING Patched

ELEVATION (ft)	DEPTH (ft) 0	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
		■	ASPHALT - 11 Inches (No brick encountered at core location. Crushed stone thickness determination was not performed during pavement coring operations using portable coring machine.) 0.9' Bottom of hole at 0.9 feet.						

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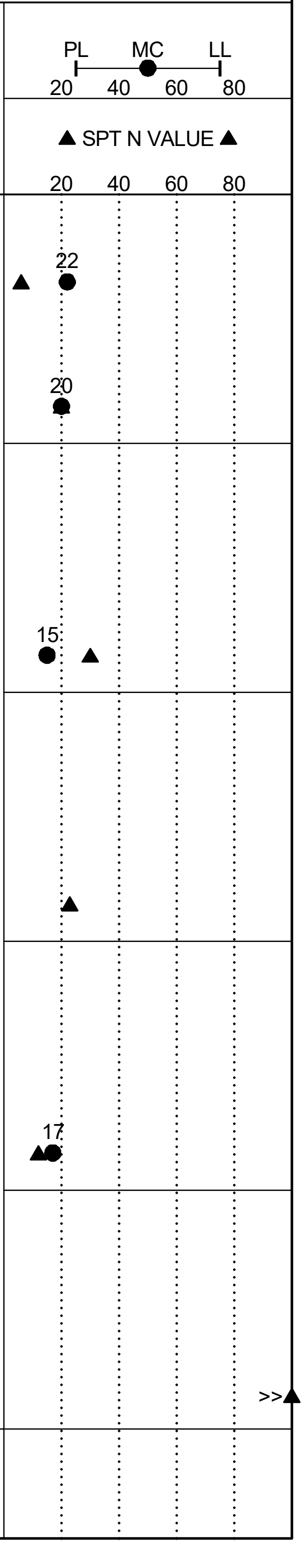
BORING NUMBER B-6

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 585.8 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/15/19
COMPLETED 4/15/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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)
585	0	ASPHALT - 5 Inches 0.4'					
		BRICK - 6 Inches 0.9'	SS 1	78	2-2-4 (6)	2.50	
		CRUSHED STONE - 6 Inches 1.4'					
	5	Moist Medium Stiff to Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL) 3.0'	SS 2	100	6-8-12 (20)	4.50	
580		Moist Very Stiff to Hard Brown LEAN CLAY w/Sand and Trace Gravel (CL) @7': w/Gravel					
575	10		SS 3	100	6-12-18 (30)	4.50	117
570	15	@13.8': Very Stiff Gray	SS 4	100	5-10-13 (23)	2.00	
		18.5'					
565	20	Moist Stiff to Very Stiff Gray LEAN CLAY w/Sand and Gravel (CL) 22.0'	SS 5	100	3-5-7 (12)	2.00	115
		Moist Very Hard Gray SILTY CLAY w/Sand and Rock Fragments (CL/ML) 24.6'	SS 6	100	13-26-50/3"	>4.5	
		WEATHERED ROCK [INFERRED FROM DRILLING] 24.8'					

Bottom of hole at 24.8 feet.



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BORING NUMBER B-7

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 583.5 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/15/19
COMPLETED 4/15/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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 - 5 Inches 0.4'						
			BRICK - 4 Inches 0.8'	SS 1	78	4-3-4 (7)	1.50		31
			CRUSHED STONE - 11 Inches 1.8'						
580			FILL - Moist Medium Stiff to Stiff Gray LEAN CLAY w/Sand, Crushed Stone, Trace Brick Fragments, and Organics 3.0'	SS 2	100	3-5-7 (12)	2.50	98	26
	5		Moist Stiff to Very Stiff Brown LEAN CLAY w/Trace Sand (CL)						
			@7': w/Sand and Trace Gravel						
575	10			SS 3	100	3-4-5 (9)	2.00		
			@12': Very Stiff w/Gravel						
570	15			SS 4	100	5-8-11 (19)	3.50	107	19
			17.0'						
			Moist Stiff to Very Stiff Gray LEAN CLAY w/Sand and Gravel (CL)						
565	20			SS 5	100	3-4-8 (12)	2.50		
			23.0'						
560			Moist Very Hard Gray SILTY CLAY w/Sand and Rock Fragments (CL/ML)						
	25		25.0'	SS 6	100	17-48-48 (96)	>4.5		8
			Bottom of hole at 25.0 feet.						

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BORING NUMBER B-8

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 583.5 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/15/19
COMPLETED 4/15/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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)	PL MC LL 20 40 60 80 ▲ SPT N VALUE ▲ 20 40 60 80
	0	ASPHALT - 4.5 Inches 0.4'						
		BRICK - 4 Inches 0.8'	SS 1	89	2-4-6 (10)	4.00		20
		CRUSHED STONE - 8 Inches 1.4'						
580	5	Moist Stiff to Very Stiff Brown LEAN CLAY w/Trace Sand (CL) @3.5': w/Sand and Gravel	SS 2	100	3-5-9 (14)	4.50	110	19
575	10		SS 3	100	6-6-8 (14)	4.00		21
570	15	@12': Gray	SS 4	100	4-6-9 (15)	3.25		
565		18.5'						
	20	Moist Stiff Gray LEAN CLAY w/Sand and Gravel (CL) 22.0'	SS 5	100	3-4-7 (11)	2.00	119	13
560		Moist Very Hard Gray SANDY SILT w/Rock Fragments (ML) 24.1'	SS 6	100	45-50/3"	NI		>>
		WEATHERED ROCK [INFERRED FROM DRILLING] 24.3'						

Bottom of hole at 24.3 feet.

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BORING NUMBER B-9

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 585.9 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/15/19 **COMPLETED** 4/15/19
AT TIME OF DRILLING None
LOGGED BY KKC **CHECKED BY** CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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)	PL MC LL 20 40 60 80 / ▲ SPT N VALUE ▲ 20 40 60 80
	0	ASPHALT - 6.5 Inches 0.5'						
585		BRICK - 4 Inches 0.8'	SS 1	11	4-3-3 (6)	NI		16
		CRUSHED STONE - 11 Inches 1.8'						
	5	FILL - Moist Medium Stiff Black/Brown LEAN CLAY w/Sand, Trace Crushed Stone, Brick Fragments, and Asphalt Fragments 3.0'	SS 2	100	3-6-9 (15)	3.75	109	20
580		FILL - Moist Stiff to Very Stiff Brown LEAN CLAY w/Trace Sand, Root, and Root Hairs @7': Very Stiff w/Sand Trace Shells						
575	10	14.0'	SS 3	100	7-9-14 (23)	4.50	110	19
570	15	Moist Stiff Gray LEAN CLAY w/Sand and Gravel (CL)	SS 4	100	4-6-9 (15)	1.50		18
565	20	@18.5': Stiff to Very Stiff 21.0'	SS 5	100	4-4-6 (10)	2.25		
		Moist Very Hard Gray SILTY CLAY w/Sand and Trace Rock Fragments (CL/ML) 23.6'						
		WEATHERED ROCK [INFERRED FROM DRILLING] 23.8'	SS 6	33	50/3"	NI		>>▲

Bottom of hole at 23.8 feet.

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BORING NUMBER B-10

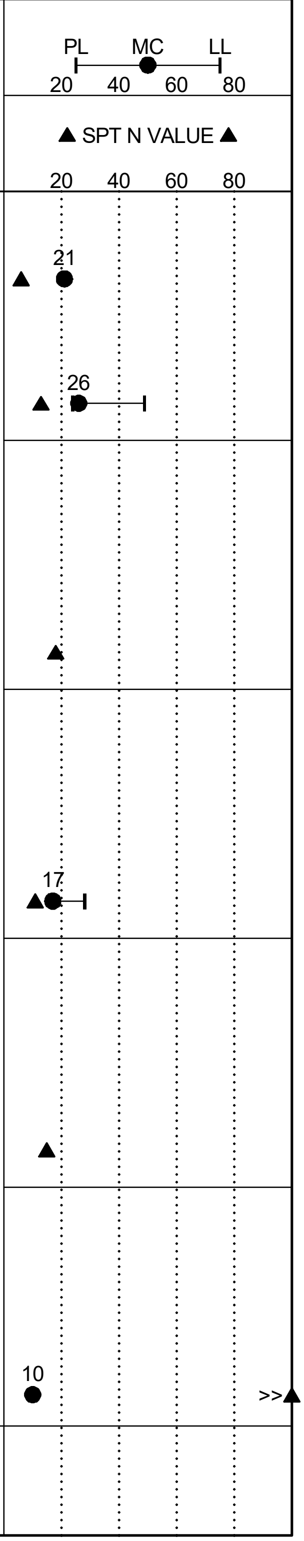
PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 586.1 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/15/19
COMPLETED 4/15/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & Bentonite Chips

ELEVATION (ft)	DEPTH (ft)
	0
585	
	5
580	
	10
575	
	15
570	
	20
565	

MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF. COMP. STR. (tsf)	DRY UNIT WT. (pcf)
ASPHALT - 6.25 Inches 0.5'					
BRICK - 4 Inches 0.8'	SS 1	78	3-3-3 (6)	2.00	
CRUSHED STONE - 11 Inches 1.8'					
Moist Medium Stiff to Stiff Gray/Brown LEAN CLAY w/Sand and Gravel (CL) 3.0'	SS 2	100	5-6-7 (13)	3.00	97
Moist Stiff to Very Stiff Brown LEAN CLAY w/Trace Sand (CL) @7': Very Stiff w/Sand and Gravel	SS 3	100	6-9-9 (18)	3.50	
12.0'					
Moist Stiff to Very Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL)	SS 4	100	3-4-7 (11)	2.25	117
	SS 5	100	4-6-9 (15)	2.75	
22.0'					
Moist Very Hard Gray SILTY CLAY w/Sand and Rock Fragments (CL/ML) 24.5'	SS 6	100	21-24-50/4"	>4.5	
WEATHERED ROCK [INFERRED FROM DRILLING] 24.8'					

Bottom of hole at 24.8 feet.



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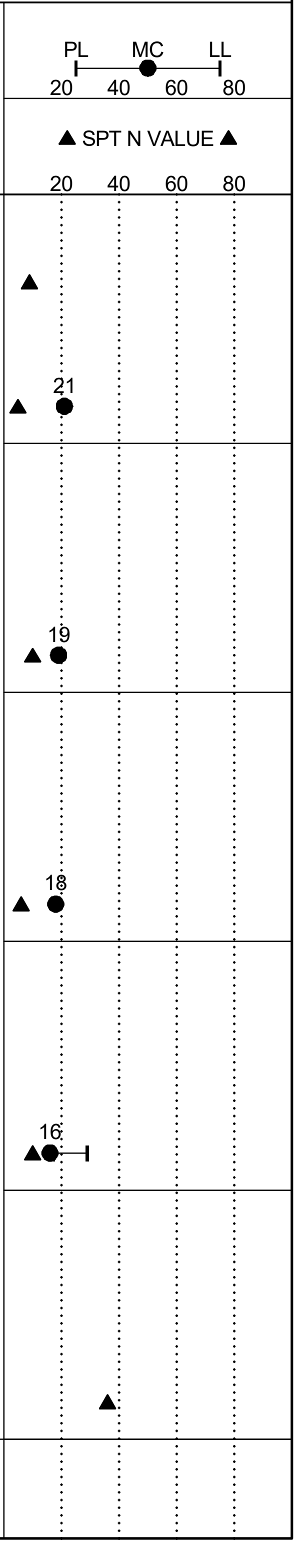
BORING NUMBER B-11

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 586.4 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 3/19/19
COMPLETED 3/19/19
▽ **AT TIME OF DRILLING** 24.0 ft / Elev 562.4 ft
LOGGED BY KKC
CHECKED BY CPI
▼ **AT END OF DRILLING** 24.6 ft / Elev 561.8 ft
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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)	MC
	0		ASPHALT - 3.25 Inches 0.3'						
			BRICK - 5 Inches 0.8'	SS 1	40	2-4-5 (9)	2.50		
585			CRUSHED STONE - 8 Inches 1.4'						
			Moist Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL) 3.5'	SS 2	53	2-2-3 (5)	2.75	106	21
580	5		FILL - Moist Medium Stiff to Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL) 8.5'						
575	10		Moist Stiff to Very Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL)	SS 3	100	3-5-5 (10)	2.50		19
			14.6'	SS 4	100	2-3-3 (6)	1.50	115	18
570	15		Moist Medium Stiff to Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL) 18.5'						
565	20		Moist Stiff to Very Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL)	SS 5	75	3-4-6 (10)	2.75		16
			▽ 24.2'	SS 6	100	15-18-18 (36)	4.50		
	25		▼ Moist Hard Gray SILTY CLAY w/Sand and Trace Gravel (CL/ML) 25.0'						
			Bottom of hole at 25.0 feet.						



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BORING NUMBER B-12

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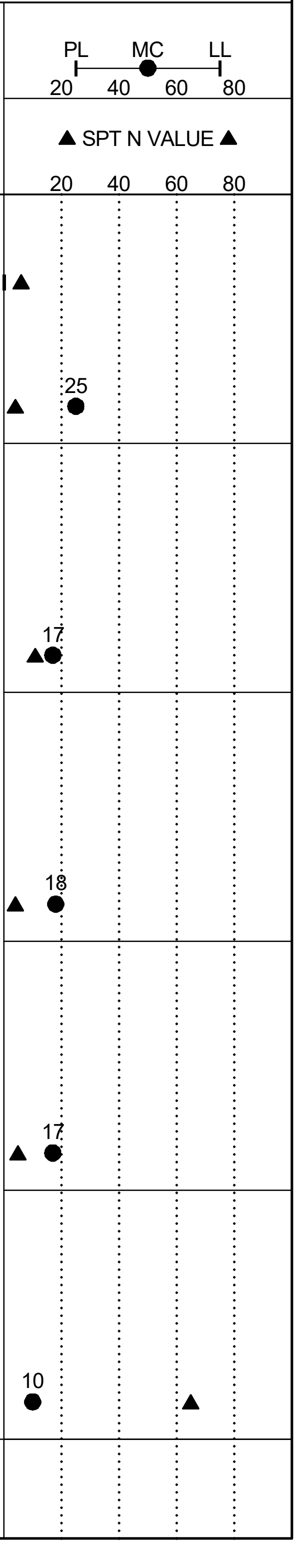
CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 586.0 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 3/19/19
COMPLETED 3/19/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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 - 5.5 Inches 0.5'					
585		BRICK - 4 Inches 0.8'	SS 1	25	6-3-3 (6)	NP	
		CRUSHED STONE - 10 Inches 1.7'					
		FILL - Moist Loose Brown SILTY CRUSHED STONE w/Sand 4.5'	SS 2	35	2-2-2 (4)	2.25	
580	5	Moist Soft Brown LEAN CLAY w/Sand and Trace Gravel (CL) 8.5'					
575	10	Moist Stiff Dark Brown LEAN CLAY w/Sand and Trace Gravel (CL) 12.3'	SS 3	86	3-5-6 (11)	1.75	117
570	15	Moist Soft to Medium Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL) 18.5'	SS 4	100	2-2-2 (4)	1.00	
565	20	Moist Medium Stiff to Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL) 22.5'	SS 5	93	1-2-3 (5)	2.00	114
	25	Moist Very Hard Gray SILTY CLAY w/Sand and Trace Gravel (CL/ML) 25.0'	SS 6	93	20-30-35 (65)	4.50	
		Bottom of hole at 25.0 feet.					



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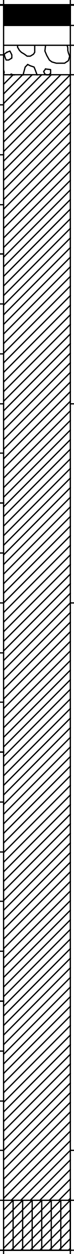
BORING NUMBER B-13

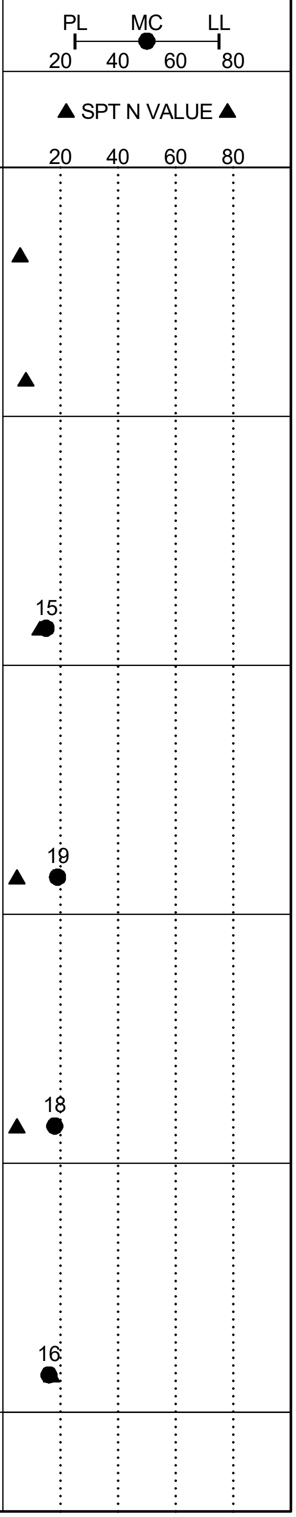
PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 587.2 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 3/19/19
COMPLETED 3/19/19
▽ **AT TIME OF DRILLING** 24.0 ft / Elev 563.2 ft
LOGGED BY KKC
CHECKED BY CPI
▼ **AT END OF DRILLING** 23.0 ft / Elev 564.2 ft
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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)	PL MC LL
	0	ASPHALT - 5 Inches 0.4'						
585		BRICK - 4 Inches 0.8'	SS 1	28	2-2-4 (6)	3.25		
		CRUSHED STONE - 8 Inches 1.4'						
	5	Moist Medium Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL) @3.5': Gray/Brown	SS 2	61	3-3-5 (8)	2.50		
580		8.0'						
	10	Moist Stiff Brown LEAN CLAY w/Sand and Trace Gravel (CL)	SS 3	85	4-6-7 (13)	4.25		15
575		12.0'						
	15	Moist Medium Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL)	SS 4	100	2-2-3 (5)	1.00	117	19
570								
	20		SS 5	100	2-2-3 (5)	1.00	115	18
565		23.0'						
		▼ ▽ Moist Very Stiff Gray LEAN CLAY w/Sand and Trace Gravel (CL) 24.0'						
	25	Moist Very Stiff Gray SILTY CLAY w/Sand and Trace Gravel (CL/ML) 25.0'	SS 6	83	12-7-10 (17)	4.50		16

Bottom of hole at 25.0 feet.



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BORING NUMBER B-14

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CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 586.8 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/15/19
COMPLETED 4/15/19
▽ **AT TIME OF DRILLING** 1.0 ft / Elev 585.8 ft
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES Boring planned at B-3 drilled at B-14 due to access.
0hrs AFTER DRILLING Backfilled w/Cuttings & 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 - 5.75 Inches 0.5'						
		▽	BRICK - 4 Inches 0.8'						
585			CRUSHED STONE - 10 Inches 1.6'	SS 1	78	5-40-10 (50)	2.75		▲
			Moist Very Stiff Brown LEAN CLAY w/Sand (CL) 3.0'						
	5		Moist Very Stiff to Hard Brown LEAN CLAY w/Sand and Trace Gravel (CL)	SS 2	100	5-8-13 (21)	4.50	105	21 ● ▲
580			8.0'						
	10		Moist Hard Brown LEAN CLAY w/Sand and Gravel (CL)	SS 3	100	10-12-20 (32)	NI	118	18 ● ▲
575			12.0'						
	15		Moist Very Stiff Gray LEAN CLAY w/Sand and Gravel (CL)	SS 4	100	5-7-10 (17)	2.75		▲
570	20		@18.5': Stiff to Very Stiff	SS 5	100	3-4-8 (12)	2.25		16 ▲●
565			23.0'						
			Moist Very Hard Gray SILTY CLAY w/Sand and Rock Fragments (CL/ML) 24.0'	SS 6	71	25-50/1"	4.50		10 ● >>▲
			WEATHERED ROCK [INFERRED FROM DRILLING] 24.1'						

Bottom of hole at 24.1 feet.

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BORING NUMBER B-15

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates CW MB
RIG NO. 111
GROUND ELEVATION 585.3 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/9/19
COMPLETED 4/9/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Patched

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
585	0		ASPHALT - 4.25 Inches 0.4'						
			BRICK - 6 Inches 0.9'						
			CRUSHED STONE - 8 Inches 1.5'						
			Bottom of hole at 1.5 feet.						

TTL Associates, Inc.
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Toledo, Ohio 43624
Telephone: 419-324-2222
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BORING NUMBER B-16

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates CW MB

RIG NO. 111

GROUND ELEVATION 581.7 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/9/19

COMPLETED 4/9/19

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Patched

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 - 3.5 Inches 0.3'						
			BRICK - 6 Inches 0.8'						
			CRUSHED STONE - 8 Inches 1.5'						
			Bottom of hole at 1.5 feet.						

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BORING NUMBER B-17

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates CW MB

RIG NO. 111

GROUND ELEVATION 584.3 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/9/19

COMPLETED 4/9/19

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Patched

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 20 MC 40 60 LL 80 / ▲ SPT N VALUE ▲ 20 40 60 80
	0		ASPHALT - 4.5 Inches 0.4'						
			BRICK - 4 Inches 0.7'						
			CRUSHED STONE - 10 Inches 1.5'						
			Bottom of hole at 1.5 feet.						

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BORING NUMBER B-18

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates CW MB

RIG NO. 111

GROUND ELEVATION 587.0 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/9/19

COMPLETED 4/9/19

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Patched

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 - 5.25 Inches 0.4'						
			BRICK - 5.5 Inches 0.9'						
			CRUSHED STONE - 5.5 Inches 1.4'						
			Bottom of hole at 1.4 feet.						

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BORING NUMBER B-19

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates CW MB

RIG NO. 111

GROUND ELEVATION 585.7 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/9/19

COMPLETED 4/9/19

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Patched

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								
585			ASPHALT - 4.25 Inches 0.4'						
			BRICK - 4.5 Inches 0.8'						
			CRUSHED STONE - 7.5 Inches 1.4'						
			Bottom of hole at 1.4 feet.						

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BORING NUMBER B-20

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates CW MB

RIG NO. 111

GROUND ELEVATION 587.1 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/9/19 **COMPLETED** 4/9/19

AT TIME OF DRILLING None

LOGGED BY KKC **CHECKED BY** CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Patched

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 - 4 Inches 0.3'						
			BRICK - 5 Inches 0.8'						
			CRUSHED STONE - 6 Inches 1.3'						
			Bottom of hole at 1.3 feet.						

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BORING NUMBER B-21

PAGE 1 OF 1

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH

DRILLING CONTRACTOR TTL Associates CW MB

RIG NO. 111

GROUND ELEVATION 586.8 ft

DRILLING METHOD 2-1/4 in. HSA

GROUND WATER LEVELS:

DATE STARTED 4/9/19

COMPLETED 4/9/19

AT TIME OF DRILLING None

LOGGED BY KKC

CHECKED BY CPI

AT END OF DRILLING None

NOTES

0hrs AFTER DRILLING Patched

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 - 4 Inches 0.3'						
			BRICK - 5 Inches 0.8'						
			CRUSHED STONE - 6.5 Inches 1.3'						
			Bottom of hole at 1.3 feet.						

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BORING NUMBER B-22

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates CW MB
RIG NO. 111
GROUND ELEVATION 588.3 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 4/9/19
COMPLETED 4/9/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Patched

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 - 4 Inches 0.3'						
			CRUSHED STONE - 12 Inches 1.3'						
			Bottom of hole at 1.3 feet.						

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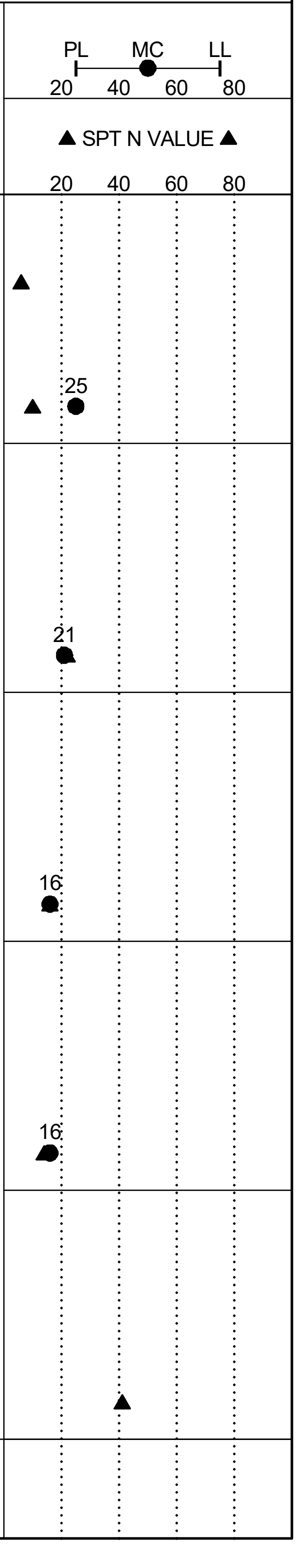
BORING NUMBER B-23

PAGE 1 OF 1

CLIENT Village of Oak Harbor
PROJECT NAME Church Street Improvement Project
PROJECT NUMBER 1797901
PROJECT LOCATION Oak Harbor, OH
DRILLING CONTRACTOR TTL Associates TB IC
RIG NO. 844
GROUND ELEVATION 587.3 ft
DRILLING METHOD 2-1/4 in. HSA
GROUND WATER LEVELS:
DATE STARTED 3/19/19
COMPLETED 3/19/19
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY CPI
AT END OF DRILLING None
NOTES
0hrs AFTER DRILLING Backfilled w/Cuttings & 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 - 5.5 Inches 0.5'					
		CRUSHED STONE - 11.5 Inches 1.4'					
585		FILL - Moist Medium Stiff Red/Brown LEAN CLAY w/Sand, Trace Gravel, Brick Fragments, and Glass 3.5'	SS 1	44	3-3-3 (6)	1.50	
	5	Moist Stiff to Very Stiff Brown LEAN CLAY w/Sand (CL)	SS 2	61	3-4-6 (10)	2.75	
580	10	@8.4': Very Stiff Gray/Brown w/Trace Gravel	SS 3	90	7-9-13 (22)	4.50	111
575	15	@13.5': Brown	SS 4	83	6-8-8 (16)	4.50	
570	20	@18.4': Stiff to Very Stiff 22.4'	SS 5	78	5-6-8 (14)	4.50	111
565	25	Moist Hard Gray SILTY CLAY w/Sand and Trace Gravel (CL/ML) 25.0'	SS 6	85	13-18-23 (41)	4.50	
		Bottom of hole at 25.0 feet.					



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.

▤ Shale

▨ Weathered Shale

▨ Sandstone

▨ Weathered Sandstone

Sample Symbols

☒ SS - Split Spoon

■ ST - Shelby Tube

▥ RC - Rock Core

▨ GS - Geoprobe Sleeve

▨ AU - Auger Cuttings

✋ GB - Grab

Notes:

1. Pavement cores were performed on March 15 and 18, 2019 using a portable core machine equipped with a nominal 4-inch diameter core bit.

2. Exploratory borings were drilled during the period from March 18 through April 15, 2019, using 2¼-inch inside diameter hollow-stem augers.

3. These logs are subject to the limitations, conclusions, and recommendations in the report and should not be interpreted separate from the report.

4. Core and boring locations were established in the field by Jones & Henry Engineers, Ltd. (J&H). Ground surface elevations at the boring locations were provided by J&H on a plan provided with the request for proposal.

5. Unconfined Compressive Strength (tsf):
   NI = Not Intact
   NP = Non-Plastic

PROJECT: Church Street Improvement Project, Oak Harbor, Ohio

TTL Associates, Inc.

PROJECT NO: 1797901

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	SS-1	1.0-2.5		18														
	SS-2	3.5-5.0		3	25.3													
	SS-3	8.5-10.0		2	37.6		*1,000											
	SS-4	13.5-15.0		12	15.6	117.9	*9,000											
	SS-5	18.5-20.0		36	14.8	113.7	*9,000											
B-2	SS-1	1.0-2.5		16	21.8		*4,500		2	6	5	11	22	54	36	20	16	CL
	SS-2	3.5-5.0		12			*5,500											
	SS-3	8.5-10.0		22	16.4	115.6	*9,000											
	SS-4	13.5-15.0		16	14.9	123.7	*6,000											
	SS-5	18.5-20.0		12			*5,000											
	SS-6	23.5-25.0		64	10.9		*9,000+											

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Church Street Improvement Project, Oak Harbor, Ohio

TTL Associates, Inc.

PROJECT NO: 1797901

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-4	SS-1	1.0-2.5		6	22.6	109.1	*2,500		13	1	6	6	21	53	43	21	22	CL
	SS-2	3.5-5.0		12	22.7	109.4	*6,500											
	SS-3	8.5-10.0		40	16.5		*9,000											
	SS-4	13.5-15.0		25	21.0	109.2	*9,000		4	4	8	13	25	46	39	21	18	CL
	SS-5	18.5-20.0		22														
	SS-6	23.5-25.0		84			*9,000+											
B-5	SS-1	1.0-2.5		10	21.9		*6,500											
	SS-2	3.5-5.0		8	22.8	100.3	*4,000											
	SS-3	8.5-10.0		25	15.2		*9,000+											
	SS-4	13.5-15.0		22			*9,000+											
	SS-5	18.5-20.0		40	11.5	121.2	*9,000+											

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Church Street Improvement Project, Oak Harbor, Ohio | **TTL Associates, Inc.** | PROJECT NO: 1797901

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-6	SS-1	1.0-2.5		6	22.5		*5,000											
	SS-2	3.5-5.0		20	19.5		*9,000											
	SS-3	8.5-10.0		30	15.4	116.9	*9,000											
	SS-4	13.5-15.0		23			*4,000											
	SS-5	18.5-20.0		12	16.6	115.4	*4,000											
	SS-6	23.5-24.8		SSR			*9,000+											
B-7	SS-1	1.0-2.5		7	31.3		*3,000											
	SS-2	3.5-5.0		12	25.5	97.8	*5,000											
	SS-3	8.5-10.0		9			*4,000											
	SS-4	13.5-15.0		19	19.2	106.5	*7,000											
	SS-5	18.5-20.0		12			*5,000											
	SS-6	23.5-25.0		96	7.7		*9,000+											

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Church Street Improvement Project, Oak Harbor, Ohio | **TTL Associates, Inc.** | PROJECT NO: 1797901

TABULATION OF TEST DATA

									Particle Size Distribution (%)						Atterberg Limits (%)			
Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification
B-8	SS-1	1.0-2.5		10	20.2		*8,000											
	SS-2	3.5-5.0		14	18.5	110.2	*9,000											
	SS-3	8.5-10.0		14	20.7		*8,000											
	SS-4	13.5-15.0		15			*6,500											
	SS-5	18.5-20.0		11	13.1	118.7	*4,000											
	SS-6	23.5-24.3		SSR														
B-9	SS-1	1.0-2.5		6	16.4													
	SS-2	3.5-5.0		15	20.0	109.3	*7,500											
	SS-3	8.5-10.0		23	18.7	110.3	*9,000											
	SS-4	13.5-15.0		15	17.7		*3,000											
	SS-5	18.5-20.0		10			*4,500											
	SS-6	23.5-23.8		SSR														

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Church Street Improvement Project, Oak Harbor, Ohio | **TTL Associates, Inc.** | PROJECT NO: 1797901

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-10	SS-1	1.0-2.5		6	21.2		*4,000											
	SS-2	3.5-5.0		13	26.5	97.0	*6,000		0	0	2	8	22	68	49	24	25	CL
	SS-3	8.5-10.0		18			*7,000											
	SS-4	13.5-15.0		11	17.0	116.7	*4,500		2	6	6	12	25	49	28	17	11	CL
	SS-5	18.5-20.0		15			*5,500											
	SS-6	23.5-24.8		SSR	9.7		*9,000+											
B-11	SS-1	1.0-2.5		9			*5,000											
	SS-2	3.5-5.0		5	20.6	105.7	*5,500											
	SS-3	8.5-10.0		10	18.8		*5,000											
	SS-4	13.5-15.0		6	17.6	115.1	*3,000											
	SS-5	18.5-20.0		10	16.3		*5,500		2	8	7	12	26	45	29	17	12	CL
	SS-6	23.5-25.0		36			*9,000											

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Church Street Improvement Project, Oak Harbor, Ohio	**TTL Associates, Inc.**	PROJECT NO: 1797901

TABULATION OF TEST DATA

Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Particle Size Distribution (%)						Atterberg Limits (%)			Unified Soil Classification
									Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	
B-12	SS-1	1.0-2.5		6					45	14	15	10	13	3	NON-PLASTIC			GM
	SS-2	3.5-5.0		4	25.0		*4,500											
	SS-3	8.5-10.0		11	17.5	117.0	*3,500											
	SS-4	13.5-15.0		4	18.0		*2,000											
	SS-5	18.5-20.0		5	16.9	114.3	*4,000											
	SS-6	23.5-25.0		65	9.6		*9,000											
B-13	SS-1	1.0-2.5		6			*6,500											
	SS-2	3.5-5.0		8			*5,000											
	SS-3	8.5-10.0		13	15.2		*8,500											
	SS-4	13.5-15.0		5	18.5	116.8	*2,000											
	SS-5	18.5-20.0		5	18.2	114.7	*2,000											
	SS-6	23.5-25.0		17	16.5		*9,000											

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

PROJECT: Church Street Improvement Project, Oak Harbor, Ohio

TTL Associates, Inc.

PROJECT NO: 1797901

TABULATION OF TEST DATA

									Particle Size Distribution (%)						Atterberg Limits (%)			
Boring Number	Sample Number	Sample Interval Depth (Feet)		Standard Penetration (Blows per Foot)	Natural Moisture Content (% of Dry Weight)	In-Place Dry Density (Pounds per Cubic Foot)	Unconfined Compressive Strength (Pounds per Square Foot)		Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification
B-14	SS-1	1.0-2.5		50			*5,500											
	SS-2	3.5-5.0		21	21.3	104.7	*9,000											
	SS-3	8.5-10.0		32	18.5	117.7												
	SS-4	13.5-15.0		17			*5,500											
	SS-5	18.5-20.0		12	16.1		*4,500											
	SS-6	23.5-24.1		SSR	9.7		*9,000											
B-23	SS-1	1.0-2.5		6			*3,000											
	SS-2	3.5-5.0		10	24.6		*5,500											
	SS-3	8.5-10.0		22	20.5	110.6	*9,000											
	SS-4	13.5-15.0		16	15.6		*9,000											
	SS-5	18.5-20.0		14	16.3	111.3	*9,000											
	SS-6	23.5-25.0		41			*9,000											

SSR = Split-Spoon Refusal

*Unconfined compressive strength derived from a calibrated hand penetrometer

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

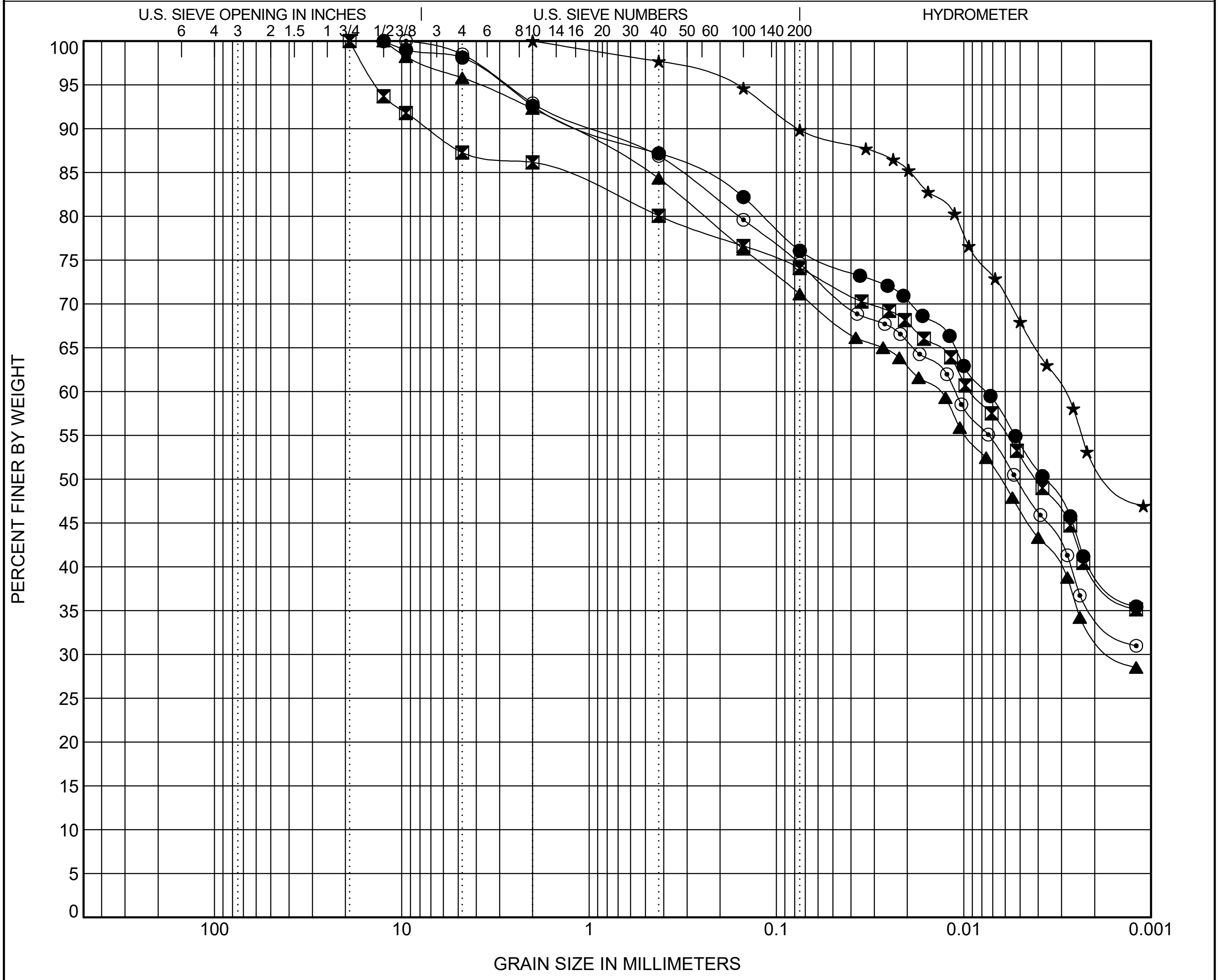
GRAIN SIZE DISTRIBUTION

CLIENT Village of Oak Harbor

PROJECT NAME Church Street Improvement Project

PROJECT NUMBER 1797901

PROJECT LOCATION Oak Harbor, OH



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	**B-2**	**1.0**	**LEAN CLAY with SAND (CL)**	**36**	**20**	**16**		
☒	**B-4**	**1.0**	**LEAN CLAY with SAND (CL)**	**43**	**21**	**22**		
▲	**B-4**	**13.5**	**LEAN CLAY with SAND (CL)**	**39**	**21**	**18**		
★	**B-10**	**3.5**	**LEAN CLAY (CL)**	**49**	**24**	**25**		
⊙	**B-10**	**13.5**	**LEAN CLAY with SAND (CL)**	**28**	**17**	**11**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2**	**1.0**	**12.5**	**0.008**			**1.9**	**22.0**	**22.0**	**54.1**
☒	**B-4**	**1.0**	**19**	**0.009**			**12.7**	**13.2**	**21.4**	**52.7**
▲	**B-4**	**13.5**	**12.5**	**0.014**	**0.001**		**4.2**	**24.7**	**24.6**	**46.5**
★	**B-10**	**3.5**	**2**	**0.003**			**0.0**	**10.2**	**21.9**	**67.9**
⊙	**B-10**	**13.5**	**9.5**	**0.011**			**1.5**	**23.9**	**25.2**	**49.4**

GRAIN SIZE 1797901.GPJ GINT US LAB.GDT 4/30/19

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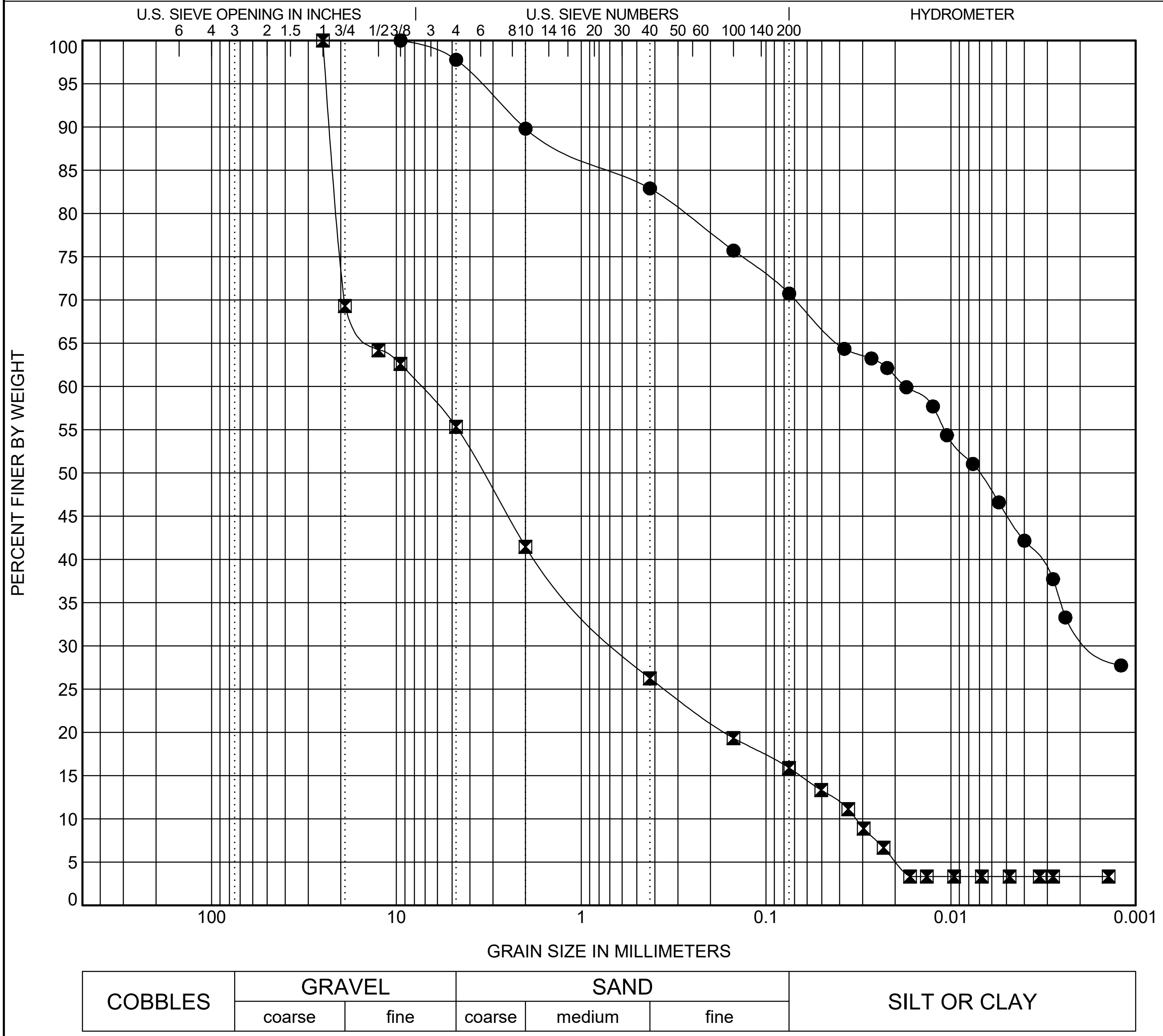

Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
● B-11	18.5	**LEAN CLAY with SAND (CL)**	29	17	12		
☒ B-12	1.0	**SILTY GRAVEL with SAND (GM)**	NP	NP	NP	1.6	227.2

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-11	18.5	9.5	0.018	0.002		2.2	27.0	25.5	45.3
☒ B-12	1.0	25	7.408	0.623	0.033	44.7	39.5	12.6	3.3

CORE LOG for B-3

Project: Church Street Improvement Project
Project Location: Oak Harbor, Ohio
TTL Project No. 1797901
Core Date: March 18, 2019

ASPHALT THICKNESS (in)	=	6
BRICK THICKNESS (in)	=	4
CORE BARREL DIAMETER (in)	=	4

VISUAL DESCRIPTION:

Apparent layering at 2 inches. Apparent ¼-inch tack coat at 4 inches. Brick not shown in photograph.

CORE LOG for B-4

Project: Church Street Improvement Project
Project Location: Oak Harbor, Ohio
TTL Project No. 1797901
Core Date: March 18, 2019

ASPHALT THICKNESS (in)	=	2.5
BRICK THICKNESS (in)	=	4
CORE BARREL DIAMETER (in)	=	4

VISUAL DESCRIPTION:

No distinct layering. Brick not shown in photograph.

CORE LOG for B-5PC

Project: Church Street Improvement Project

Project Location: Oak Harbor, Ohio

TTL Project No. 1797901

Core Date: March 18, 2019

ASPHALT THICKNESS (in)	=	11*
BRICK THICKNESS (in)	=	None
CORE BARREL DIAMETER (in)	=	4

*Measured along sidewall of core hole.

VISUAL DESCRIPTION:

Only 9-1/4 inches intact core recovered. Coarser stone in mix than in other cores obtained from this project. No distinct layering. No brick underlying asphalt. More typical asphalt thickness underlain by brick was encountered in adjacent B-5 boring. Therefore, this core may have been obtained in an area of repair or excavation for installation of underground utilities where asphalt was utilized rather than including brick typical to the original pavement cross-section.

CORE LOG for B-12

Project: Church Street Improvement Project
Project Location: Oak Harbor, Ohio
TTL Project No. 1797901
Core Date: March 18, 2019

ASPHALT THICKNESS (in)	=	5.5
BRICK THICKNESS (in)	=	4
CORE BARREL DIAMETER (in)	=	4

VISUAL DESCRIPTION:

Horizontal fracture at 1-1/2 inches, and apparent layering at 3 to 3-1/8 inches. Brick not shown in photograph.

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CORE LOG for B-14

Project: Church Street Improvement Project
Project Location: Oak Harbor, Ohio
TTL Project No. 1797901
Core Date: March 18, 2019

ASPHALT THICKNESS (in)	=	5.75
BRICK THICKNESS (in)	=	4
CORE BARREL DIAMETER (in)	=	4

VISUAL DESCRIPTION:

Apparent layering at 1-1/2 inches and 2-1/4 inches. Apparent ¼-inch tack coat at approximately 3-1/4 to 3-1/2 inches. Brick not shown in photograph.

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CORE LOG for B-18

Project: Church Street Improvement Project
Project Location: Oak Harbor, Ohio
TTL Project No. 1797901
Core Date: March 15, 2019

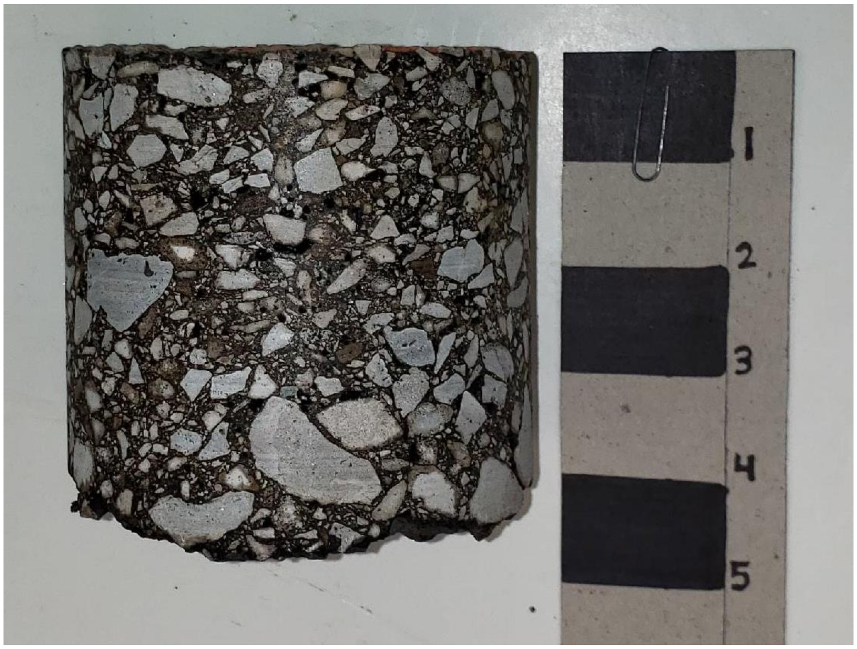
ASPHALT THICKNESS (in)	=	5.25
BRICK THICKNESS (in)	=	5.5
CORE BARREL DIAMETER (in)	=	4

VISUAL DESCRIPTION:

Apparent layering at 1 to 1-1/4 inches, 2-1/4 to 2-1/2 inches, and 3-1/2 inches. Brick not shown in photograph.

CORE LOG for B-22

Project: Church Street Improvement Project
Project Location: Oak Harbor, Ohio
TTL Project No. 1797901
Core Date: March 15, 2019



ASPHALT THICKNESS (in)	=	4
BRICK THICKNESS (in)	=	None
CORE BARREL DIAMETER (in)	=	4

VISUAL DESCRIPTION:

Apparent layering at 1-1/2 inches.