Geotechnical Subsurface Investigation Report for Parsons Avenue Sanitary Improvements

Prepared for:
Joann Esenwein
Village of Lowellville
140 East Liberty Street
Lowellville, Ohio 44436

Prepared by:
Verdantas LLC
8150 Sterling Court
Mentor, OH 44060
440.951.9000

Verdantas Project No: 232475

February 2025

Village of Lowellville
140 East Liberty Street
Lowellville, Ohio 44436

Geotechnical Subsurface Investigation
Parsons Avenue Sanitary Improvements
Village of Lowellville, Ohio

Dear Ms. Esenwein,

Following is the report of the geotechnical subsurface investigation performed by Verdantas LLC (VDT) for the referenced project. This study was performed for the Village of Lowellville in support of design services for the Proposed Parsons Avenue Sanitary Improvements Project.

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.

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,

Verdantas LLC

Negoslav Tosanovic, P.E.
Geotechnical Project Manager

Curtis Roupe, P.E.
Assistant Vice President
Department Lead, Geotechnical Engineering

This page was intentionally left blank.

Table of Contents

1. INTRODUCTION

Verdantas proposes to conduct a geotechnical subsurface investigation to evaluate the properties of the underlying soils with respect to the design of underground utilities and pavements for the Sanitary Sewer Improvement Project in Lowellville, Ohio. This investigation is focused on an 850±-foot section of Parsons Avenue, from its intersection with W. Walnut Street to W. Liberty Street. A drill rig and crew will be utilized to advance test borings for the purpose of collecting soil samples, as well as performing in-situ tests. Laboratory testing will be conducted on the collected soil samples to provide the physical properties and characteristics of the underlying materials. Engineering design recommendations for pavements and utility support will be developed based on information obtained from the drilling and laboratory testing.

This geotechnical subsurface investigation report has been prepared for proposed improvements of the underground utilities and roadway reconstruction project in Lowellville, Ohio. We understand that the planned improvements are focused on the 850±-foot section of Parsons Avenue, from its intersection with West Walnut Street to West Liberty Street where sewer improvements are planned with inverts depths ranging from 8 to 12 feet. The general project area is shown on the Site Location Map (Plate 1.0).

This study was performed for the Village of Lowellville in support of design services for the Proposed Parsons Avenue Sanitary Improvements Project. This report summarizes our understanding of the proposed construction, describes the investigative and testing procedures, presents the findings, discusses our evaluations and conclusions, and provides our design and construction recommendations for roadway reconstruction, as well as provides our recommendations for installation and support of the proposed underground utilities.

The purpose of this investigation was to evaluate the subsurface conditions and laboratory data relative to the design and construction of pavements at the referenced site. This investigation included three (3) test borings, field and laboratory soil and rock testing, and a geotechnical engineering evaluation of the test results. This report includes:

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

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

2. INVESTIGATIVE PROCEDURES

This subsurface investigation included three (3) test borings drilled by Ridgeway Drilling, Inc. under VDT directions on December 19, 2024. The test borings were located in the field by VDT in accordance with a proposed boring location plan submitted with the proposal of this study. The approximate locations of the borings are shown on the Test Boring Location Plan (Plate 2.0).

The test borings were performed in general accordance with geotechnical investigative procedures outlined in ASTM Standard D 1452. The test borings performed during this investigation were drilled with a truck-mounted drill rig utilizing 2 3/4-inch diameter hollow-stem augers. Ground Surface Elevations were surveyed in the field and are reported to the nearest foot. The approximate ground surface elevations, termination depths, and elevations for the borings are summarized in Table 2.0 at the end of this section.

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

The samples were sealed in jars and transported to our laboratory for further classification and testing. The pavement and soil conditions encountered in the test borings are presented in the Logs of Test Borings, along with information related to sample data, SPT 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 soil laboratory classification and testing as well as field logs of the encountered pavements and soils.

All of the recovered samples of the subsoils were visually or manually classified in accordance with the Ohio Department of Transportation (ODOT) soil classification system and were tested in our laboratory for moisture content (ASTM D 2216). Unconfined compressive strength estimates were obtained for the intact cohesive samples using a calibrated hand penetrometer. A particle size analysis (ASTM D 6913 and D 7928) and an Atterberg limits test (ASTM D 4318) were performed on representative samples from Boring B-1 (SS-1), B-2 (SS-2), and B-3 (SS-4) to determine soil classification and soil index properties. The test results are presented on the Logs of Test Borings, Tabulation of Test Data sheets, and Grain Size Distribution sheet attached to this report.

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

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

Table 1: Borehole Surface and Termination Elevations

Borehole No.	Surface Elevation (ft)	Termination Depth (ft)	Termination Elevation (ft)	Surface Cover Type	Surface Cover Thickness (in)
B-1	882	8.5	873.5	Asphalt/Concrete	3/6
B-2	845	8.5	836.5	Asphalt/ granular base (Slag)l	4/10
B-3	837	10.5	826.5	Asphalt/Granular Base (Crushed Stone)	3/18

3. PROPOSED CONSTRUCTION

This investigation is focused on an 850-foot section of Parsons Avenue, from its intersection with W. Walnut Street to W. Liberty Street, where sewer improvements are planned with invert depths ranging from 8 to 12 feet.

The project consists of proposed underground sanitary sewer utility improvements and roadway reconstruction in Lowellville, Ohio. We understand that the improvements are focused on an 850±-foot section of Parsons Avenue, from its intersection with W. Walnut Street to W. Liberty Street, where is planned replacement of the existing, 70+ years old sanitary sewer system currently in place, which entails approximately 530± lineal feet of 8-inch diameter sewer with three sanitary manholes and approximately 300± lineal feet of 6-inch diameter sanitary sewer laterals up to ROW line; inverts are 8 to 12 feet below existing grades. Parts of the project are storm sewer improvements, road resurfacing, curbing, and sidewalk improvements.

We also understand that these underground utilities will be installed using an open-cut excavation technique. Pavements are anticipated to consist of flexible (asphalt) sections. Final design grades are assumed to approximate existing roadway grades. Traffic loads and volumes were not available at the time of preparing this proposal. There will be replacements of the three existing sanitary manholes. Taking in account that the site is located in an urban area, in order the protect the existing structure during the trench excavation, and to replace the existing manholes, some types of shoring may be required such as Sheet piling or an H-piling system (Soldier Piles with wood lagging).

A typical cross-section of the sheet piling system is presented in **Error! Reference source not found.**.

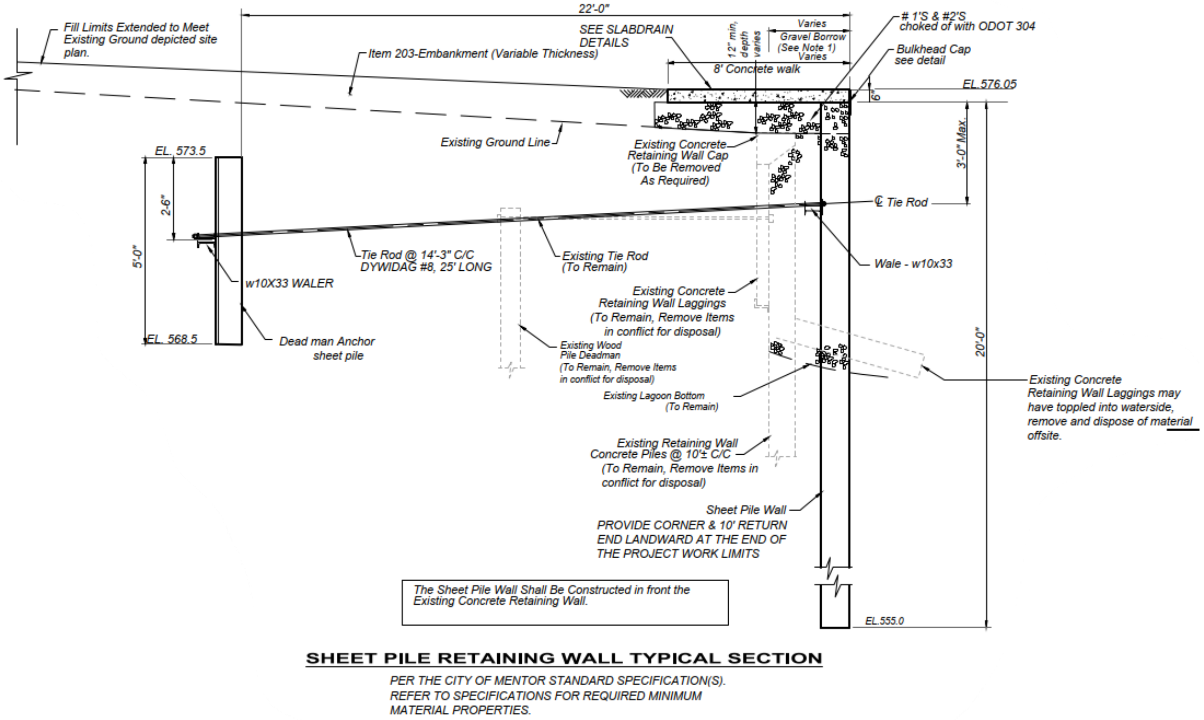


Figure 1: Typical cross-section of sheet piling system used for Mentor Lagoon, Ohio (Project No. 232145, Standard Detail 1, Sheet 6)

We anticipate that final site elevation will approximate existing site elevations.

4. GENERAL SITE AND SUBSURFACE CONDITIONS

4.1 Regional Geology

Published geologic maps from the Ohio Department of Natural Resources (ODNR) indicate that the project site is located within the glaciated portion of Ohio. This region is characterized by its rolling hills and valleys formed by glacial activity during the last Ice Age. The area is part of the Appalachian Plateau, which features a mix of flat-topped hills and steep valleys.

The Quaternary deposits in this area consist primarily of glacial till, which is an unsorted mixture of clay, silt, sand, gravel, and boulders deposited directly by glacial ice. These deposits are typically found at varying depths and can influence the soil's drainage properties and stability.

Bedrock at the site consists primarily of sedimentary rocks, including shale, sandstone, and limestone. These rocks were formed during the Paleozoic era and provide a stable foundation for construction. The depth to bedrock can vary, but it is typically found at a relatively shallow depth in this region. Weathered sandstone bedrock was encountered in all of the borings at approximately 4.5 to 8.7 feet below existing grades (Elev. 877.5 to Elev. 828.3).

Auger refusal on apparent sound bedrock occurred in the borings at depths approximately 8 to 10.5 feet below existing grades (Elev. 874 to 826.5)

4.2 General Site Conditions

Based on the results of our field and laboratory tests, the subsoils encountered underlying the pavement and aggregate base materials consisted of predominantly medium stiff to very stiff fine grain cohesive soils. However, a zone of cohesive soils exhibiting very soft consistency was encountered in Boring B-3 (SS-2).

The Cohesive soils consisted of predominantly silt and clay (CL) mixed with varying amounts of sand and gravel, and sandy silt (SM) mixed with sandstone fragments and clay. SPT N-values generally ranged from 5 to 19 blows per foot (bpf). The exceptions are the isolated stratum (or pocket) of cohesive soil in Boring B-3 (SS-2) with an SPT N-value of 2 indicating a very soft consistency and very hard sandy silt encountered in Boring B-2 (SS-3) where was recorded SSR (Split Spoon Refusal). Unconfined compressive strengths generally ranged from 2,000 to 6,000 pounds per square foot (psf). Moisture contents ranged from 16 to 22 percent. Liquid limits of 32, 34 percent and plasticity indices of 12, and 12 percent were determined for samples obtained from Boring B-1 (SS-1), and B-2 (SS-2), respectively. These values along with gradation results, are indicative of Silt and Clay (CL) or Sandy Silt (SM) in accordance with USCS, and Silt and Clay (A-6a) and Sandy Silt (A-4a) in accordance with ODOT Soil Classification System. Soil sample tested from Boring B-3 (SS-4) was collected from within the bedrock stratum resulting in non-plastic (NP) being designated as Silty Gravel with Sand (GM) per USCS and as A-2-4 material per ODOT soil Classification System.

Bedrock consisting of sandstone was encountered in all the borings at approximately 4.5 to 8.7 feet (Elev. 828.3 to 877.5). Weathered rock that was able to be penetrated with the augers was encountered in all the boring tests. This weathered portion of the bedrock was severely weathered such that it was auger-able and was found to range in thickness from 1.4 feet in Boring B-2 to 3.5 feet in Boring B-1 before reaching solid bedrock. Within the weathered rock, the SPT generally resulted in SSR. Moisture contents ranged from 3 to 12 percent for the recovered samples. The depths of encountered rock are summarized in the following table.

Table 2: Summary of Rock Information

Borehole No.	Boring Termination Depth (ft)	Surface Elevation (ft)	Depth to Weathered Bedrock (ft)	Weathered Bedrock Elevation (ft)	Depth to Intact Bedrock (ft)	Intact Bedrock Elevation (ft)
B-1	8.5	882	4.5	877.5	8	874
B-2	8.5	845	7.1	837.9	8.5	836.5
B-3	10.5	837	8.7	828.3	10.5	826.5

No rock coring was performed for this project. However, the Split Spoon Refusal record [when soil or rock samples experience 50 or more blows per foot (bpf) for less than 6-inch penetration], with recorded 50 blows per 1 to 4 inches of penetration indicates medium-hard to hard rock hardness. The top portion of the weathered rock which was drillable with the drilling augers is usually possible to excavate with a regular backhoe bucket. At a deeper depth, where bedrock is hard, such as below 8 to 10 feet of depth, additional effort and methods may be required as described in the last paragraph in section 5.2. Additional descriptions of the stratigraphy encountered in the borings are presented on the Logs of Test Borings.

4.3 Groundwater Conditions

Groundwater was not encountered either during or after the drilling process. It should be noted all the boreholes were drilled and backfilled within the same day and stabilized water levels are not likely to have occurred over this limited time period. Instrumentation was not installed to observe long-term groundwater levels.

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

5. DEISGN RECOMMENDATIONS

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

5.1 Pipe Support

We understand that the underground utility improvements for this project will include the replacement of the existing sanitary sewer system on an 850± feet long portion of Parsons Avenue with an 8-inch diameter sewer with three sanitary manholes and approximately 300± lineal feet of 6-inch diameter sanitary sewer laterals up to ROW line; inverts are 8 to 12 feet below existing grades. Some improvements to the storm sewer system within the subject area are considered as a part of the project.

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 inverts elevations.

Based on our project understanding, the proposed storm sewer and sanitary sewer lines are anticipated to predominantly be supported on either the sandstone bedrock or native cohesive soils. In the trenches where the two sewer lines will be present, the storm sewer line will be supported on flowable controlled-density fill placed overlying the sanitary sewer line to be installed deeper in the same trench. Both options are considered generally suitable for support of the proposed storm and sanitary sewer pipes.

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 VDT 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:

- Stable Rock (rock that can be excavated with vertical sides and remain intact while exposed),
- OSHA Type A soils (cohesive soils with unconfined compressive strengths of 3,000 pounds per square foot (psf) or greater),
- OSHA Type B soils (cohesive soils with unconfined compressive strengths greater than 1,000 psf but less than 3,000 psf and dry rock), and
- OSHA Type C soils (granular soils and fill materials).

Vertical side slopes are acceptable for temporary excavations in stable rock. Based on the auger-ability of the majority drilled bedrock, we recommend that temporary excavations in bedrock be considered borderline material and treated as Type B materials unless test excavations are performed to substantiate use of the Stable Rock designation.

For temporary excavations in Type A, B and C soils, side slopes must be no steeper than ¾ horizontal to 1 vertical (¾H:1V), 1H:1V, and 1½H:1V, respectively. For situations where a higher strength soil is underlain by a lower strength soil and the excavation extends into the lower strength soil (including excavation through cohesive soils that are underlain by granular soils or bedrock), the slope of the entire excavation is governed by that required for the lower strength soil. In all cases, flatter slopes may be required if lower strength soils or adverse seepage conditions are encountered during construction.

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

Based on the conditions encountered in the test borings, the probable method of excavation within the “weathered sandstone” zone which was penetrable with augers is expected to consist of conventional excavation equipment such as a backhoe or track excavator, with some assistance from pneumatic chippers, jackhammers, or hydraulic wedging equipment. However, excavation into the more intact bedrock beyond the depth of auger refusal is expected to be unproductive and uneconomical with conventional excavation equipment. Excavations that must extend into this zone will likely require use of hard rock removal methods. Based on the limited rock information regarding the strength and rippability but relying on the auger and split spoon refusal information, it is anticipated that equipment including pneumatic chippers, jackhammers, or hydraulic wedging equipment will be sufficient to rip and dig the rock. However, there may be some areas beyond the depth of auger refusal that require drilling and use of expansive chemicals to fracture and loosen the rock.

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. 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 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 (kp) 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 kp 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.

5.4 Construction (General)

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

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

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

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

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

5.5 Construction Dewatering

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

If excavations below the groundwater table are required (e.g., site utilities, foundations, etc.), or if seasonally elevated groundwater conditions are prevalent at the time of construction, diligent dewatering using point wells will be required for groundwater management during construction. In the event excessive seepage is encountered during construction, VDT may be notified to evaluate whether other dewatering methods are required. Installation of the proposed site utilities is expected to require excavation below the “normal” groundwater level and groundwater seepage into excavations should be anticipated.

5.6 Flexible (Asphalt) Pavement

Based on the results of the plasticity and gradation testing for the upper profile cohesive subgrade soil samples, we recommend a subgrade CBR value of 6 percent for group A-6a or better soils. This CBR value is based on subgrade compacted to at least 100 percent of the maximum dry density as determined by ASTM D 698 (Standard Proctor) or verified as stable through proof rolling. It should be noted that we are not privy to the design traffic loads or intended design life. The subgrade support recommendations indicated herein should be reviewed by the site engineer in conjunction with the design traffic criteria to determine the required pavement sections. In any case, we recommend the light-duty pavement cross-section consist of at least 3 inches of asphalt underlain by 6 inches of aggregate base for even the lightest-duty pavements based on our experience regarding environmental exposure and reasonable serviceability. For the same reason, we recommend the heavy-duty pavement cross-section consist of at least 4 inches of asphalt underlain by 8 inches of aggregate base. All paving operations should conform to the State of Ohio Department of Transportation (ODOT) specifications. The pavement and subgrade preparation procedures outlined in this report should result in a reasonably workable and satisfactory pavement. It should be recognized, however, that all flexible pavements need repairs or overlays from time to time as a result of progressive yielding under repeated traffic loads for a prolonged period of time, as well as exposure to freeze-thaw conditions.

5.7 Pavement Drainage

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

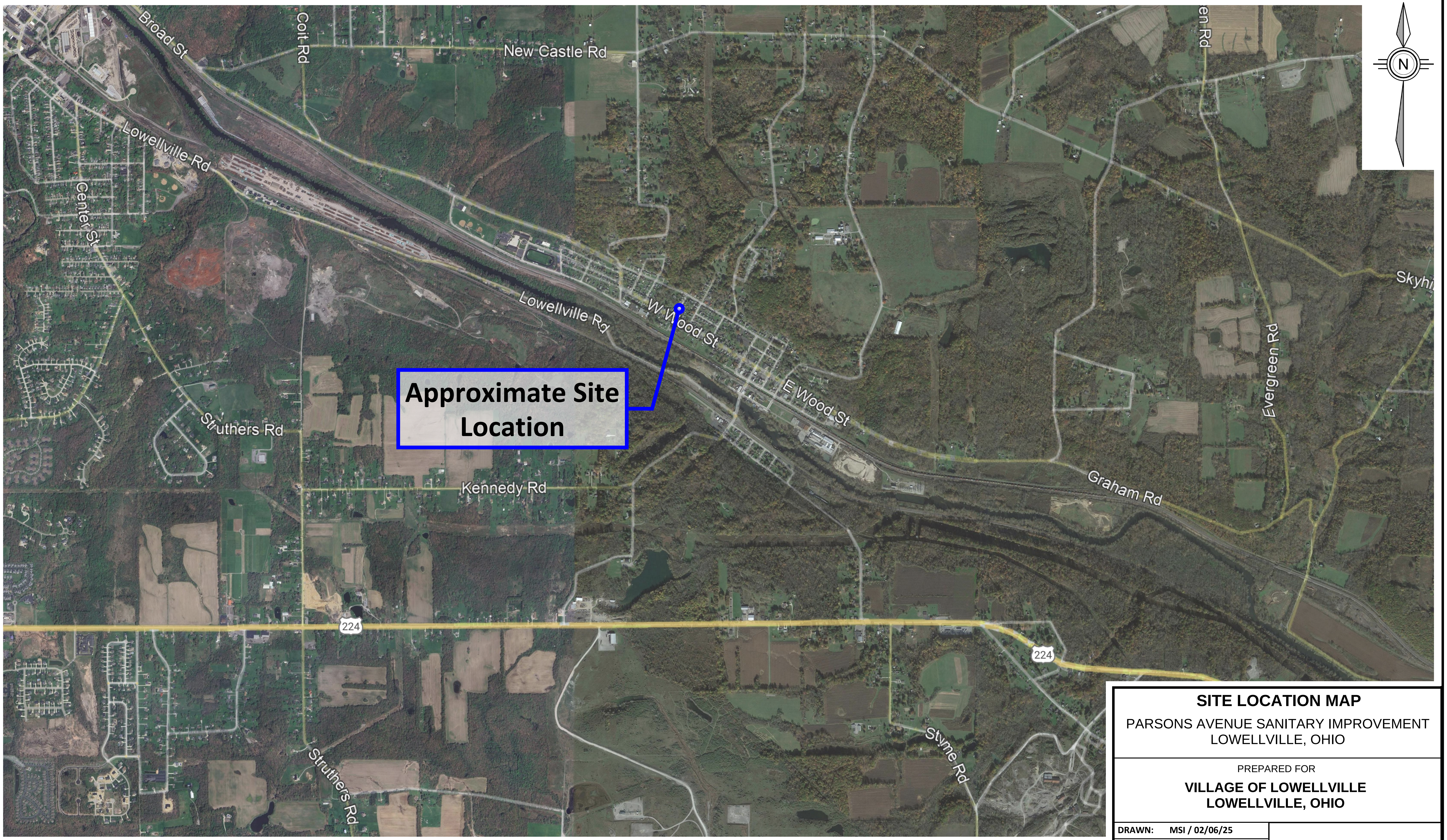
6. QUALIFICATION OF RECOMMENDATIONS

Our evaluation of geotechnical-related pavement subgrade and underground utilities installation and support conditions has been based on the data obtained during our field investigation and our understanding of the furnished site and project information. general subsurface conditions were based on interpretation of the subsurface data at specific boring locations. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. This is especially true for previously developed sites. Therefore, experienced geotechnical engineers should observe earthwork and foundation construction to confirm that the conditions anticipated in design are noted. Otherwise, VDT 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. VDT is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Plates



BASE PLAN "SITE AERIAL PLAN" DATED 11/06/2021 OBTAINED FROM GOOGLE EARTH.

SITE LOCATION MAP

PARSONS AVENUE SANITARY IMPROVEMENT
LOWELLVILLE, OHIO

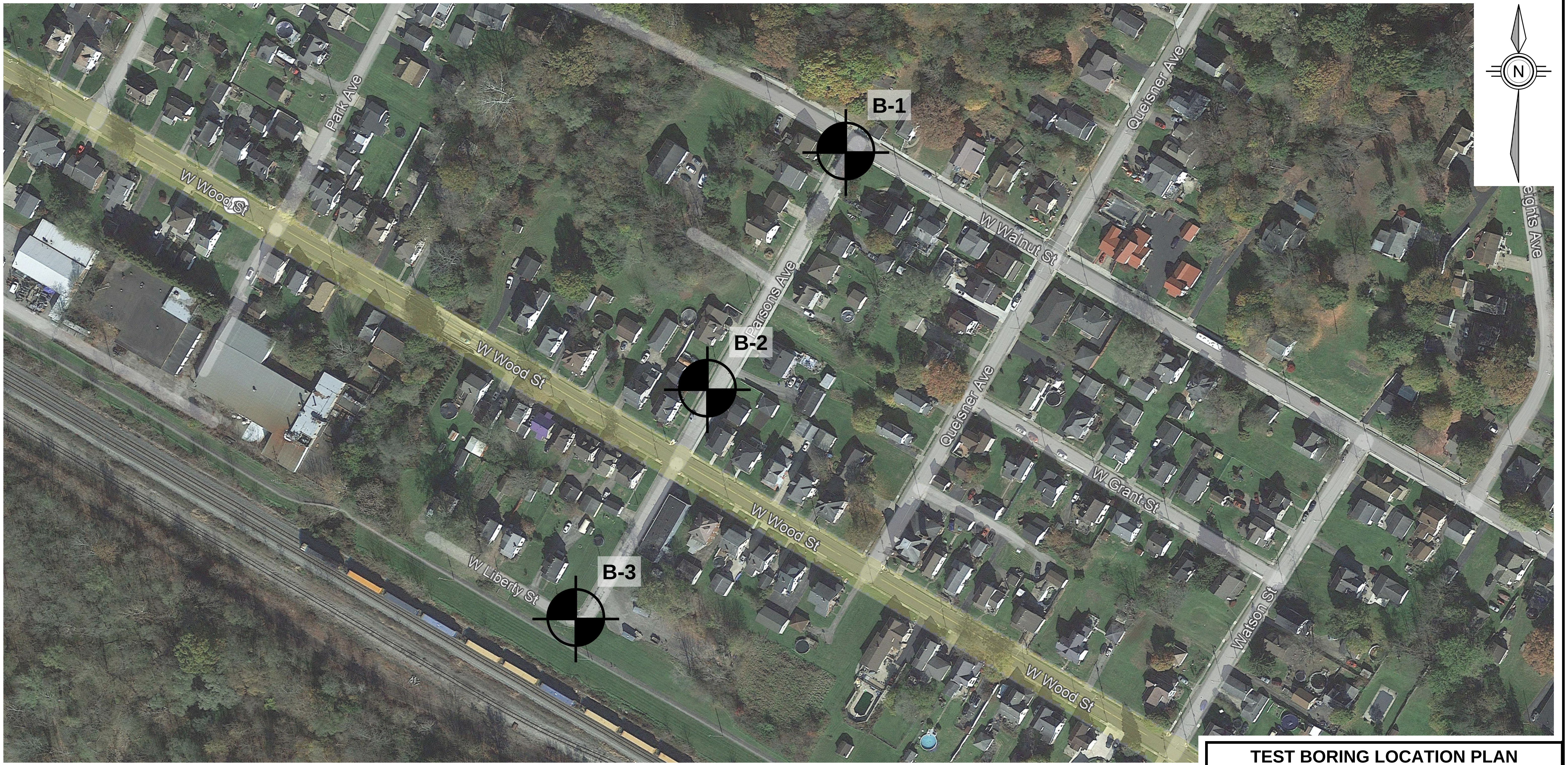
PREPARED FOR

VILLAGE OF LOWELLVILLE
LOWELLVILLE, OHIO

DRAWN: MSI / 02/06/25
REVISED: ---
PROJECT No: 232475

verdantas

PLATE 1.0



LEGEND:

⊕ **B-1** APPROXIMATE TEST BORING LOCATION

SCALE IN FEET

0' 200' 400'

BASE PLAN "SITE AERIAL PLAN" DATED 11/06/2021 OBTAINED FROM GOOGLE EARTH.

TEST BORING LOCATION PLAN

PARSONS AVENUE SANITARY IMPROVEMENT
LOWELLVILLE, OHIO

PREPARED FOR

VILLAGE OF LOWELLVILLE
LOWELLVILLE, OHIO

DRAWN: MSI / 02/06/25
REVISED: ---
PROJECT No: 232475

verdantas

PLATE 2.0

Appendices

A/ Logs of Test Borings
B/ Legend Key
C/ Tabulation of Test Data
D/ Laboratory Test Results

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

BORING NUMBER B-1

CLIENT Village of Lowellville

PROJECT NAME Parsons Avenue Sanitary Improvement

PROJECT NUMBER 232475

PROJECT LOCATION Lowellville, OH

DRILLING CONTRACTOR Ridgeway Drilling, Inc. PS

RIG NO. White Truck

GROUND ELEVATION 882 ft

DRILLING METHOD HSA

GROUND WATER LEVELS:

DATE STARTED 12/19/24 **COMPLETED** 12/19/24

AT TIME OF DRILLING None

LOGGED BY KKC **CHECKED BY**

AT END OF DRILLING None

NOTES Split spoon refusal encountered at 8.3 feet.

0hrs AFTER DRILLING Backfilled w/Cuttings

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
	0.0		ASPHALT - 3 Inches 0.3'						
			CONCRETE - 6 Inches 0.8'						
880.0			Moist Medium Stiff Brown SILT and CLAY , Some Sand, Trace Gravel A-6a (8)	SS 1	67	4-3-2 (5)	2.25		22
	2.5		3.5'						
877.5			Moist Brown WEATHERED SANDSTONE	SS 2	100	5-11-50/2"	NP		12 >>
	5.0			SS 3	83	50	NP		8
875.0	7.5								
			8.5'	SS 4	50	50/4"	NP		10 >>
			Bottom of hole at 8.5 feet.						

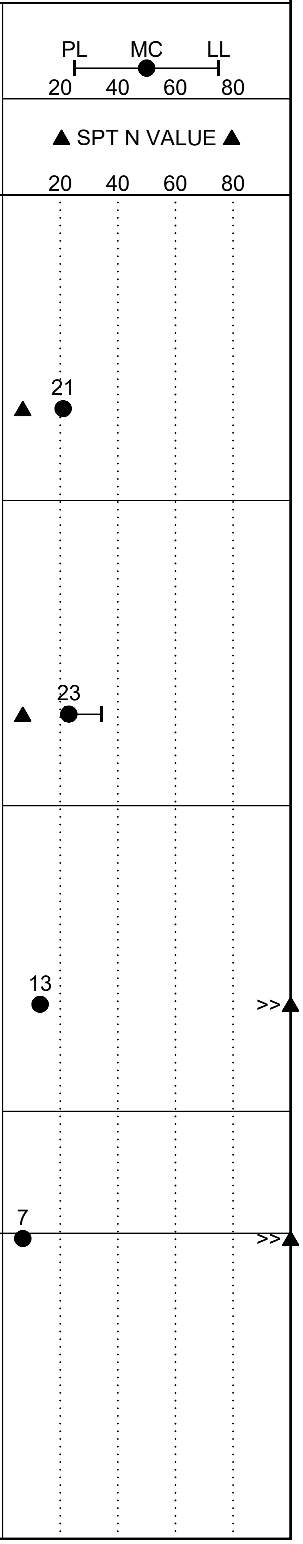
CT Consultants, Inc.
1915 N 12th Street
Toledo Ohio 43604
Telephone: (419)324-2222

BORING NUMBER B-2

PAGE 1 OF 1

CLIENT Village of Lowellville
PROJECT NAME Parsons Avenue Sanitary Improvement
PROJECT NUMBER 232475
PROJECT LOCATION Lowellville, OH
DRILLING CONTRACTOR Ridgeway Drilling, Inc. PS
RIG NO. White Truck
GROUND ELEVATION 845 ft
DRILLING METHOD HSA
GROUND WATER LEVELS:
DATE STARTED 12/19/24
COMPLETED 12/19/24
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY
AT END OF DRILLING None
NOTES Split spoon refusal encountered at 8.6 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings

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)
845.0	0.0		ASPHALT - 4 Inches 0.3'					
			SLAG - 10 Inches 1.2'					
			Moist Medium Stiff Brown SILT and CLAY (A-6a), Some Sand, Trace Gravel	SS 1	94	7-4-3 (7)	2.00	
842.5	2.5							
			@3.5': Little Sand, A-6a (9)	SS 2	83	2-3-4 (7)	3.00	
840.0	5.0		6.0'					
			Moist Very Hard Brown SANDY SILT (A-4a), Little Sandstone Fragmnents, Little Clay 7.0'	SS 3	93	5-7-50/3"	2.00	
			Moist Brown WEATHERED SANDSTONE					
837.5	7.5		8.5'					
			Bottom of hole at 8.5 feet.	SS 4	100	50/1"	NP	



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

BORING NUMBER B-3

PAGE 1 OF 1

CLIENT Village of Lowellville
PROJECT NAME Parsons Avenue Sanitary Improvement
PROJECT NUMBER 232475
PROJECT LOCATION Lowellville, OH
DRILLING CONTRACTOR Ridgeway Drilling, Inc. PS
RIG NO. White Truck
GROUND ELEVATION 837 ft
DRILLING METHOD HSA
GROUND WATER LEVELS:
DATE STARTED 12/19/24
COMPLETED 12/19/24
AT TIME OF DRILLING None
LOGGED BY KKC
CHECKED BY
AT END OF DRILLING None
NOTES Auger refusal encountered at 10.5 feet.
0hrs AFTER DRILLING Backfilled w/Cuttings

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)
	0.0		ASPHALT - 3 Inches 0.3'						
			CRUSHED STONE - 18 Inches 1.8'	SS 1	44	14-7-4 (11)	2.00		16
835.0	2.5		Moist Stiff Brown SILT and CLAY (A-6a), Some Sand, Trace Gravel 3.5'						
832.5	5.0		Moist Very Soft Gray/Brown SILT and CLAY (A-6a), Some Sand, Trace Sandstone Fragments 6.0'	SS 2	17	2-1-1 (2)	1.00		19
830.0	7.5		Moist Very Stiff Brown SILT and CLAY (A-6a), Some Sand, Trace Sandstone Fragments 8.5'	SS 3	11	7-8-11 (19)	NI		16
827.5	10.0		Moist Brown WEATHERED SANDSTONE with SAND and SILT, Trace Clay A-2-4 (0)	SS 4	100	50	NP		11
			10.5'	SS 5	100	50/1"	NP		3 >>
			Bottom of hole at 10.5 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.

Sample Symbols

☒ SS - Split Spoon

■ ST - Shelby Tube

▥ RC - Rock Core

▥ GS - Geoprobe Sleeve

◧ AU - Auger Cuttings

✋ GB - Grab

Notes:

1. Exploratory borings were drilled on December 19, 2024. The borings were advanced utilizing 2¾-inch inside diameter hollow-stem augers.

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

3. The borings were located in the field by Verdantas LLC in accordance with a proposed Boring Location Plan submitted with our proposal.

4. Ground Surface Elevations were obtained by professional surveyors and reported to the nearest foot.

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

SUMMARY OF LABORATORY RESULTS

CLIENT Village of Lowellville

PROJECT NAME Parsons Avenue Sanitary Improvement

PROJECT NUMBER 232475

PROJECT LOCATION Lowellville, OH

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	1.0	32	20	12	9.5	71	CL	21.8			
B-1	3.5							12.2			
B-1	6.0							8.4			
B-1	8.5							9.7			
B-2	1.0							21.3			
B-2	3.5	34	22	12	9.5	84	CL	23.3			
B-2	6.0							13.1			
B-2	8.5							7.3			
B-3	1.0							16.0			
B-3	3.5							19.2			
B-3	6.0							16.2			
B-3	8.5	NP	NP	NP	37.5	27	GM	10.6			
B-3	10.0							3.4			

232475 Parsons Avenue Sanitary Improvements, Lowellville, Ohio

Boring	Sample	Interval	SPT N	Water Content (%)	Dry Density (pcf)	UCS (psf)	Gravel >4.75	CSand >2.00	MSand >.425	FSand >.075	Silt >.005	Clay	Liquid Limit	Plastic Limit	PI	USCS Class	OHDOT Class	OHDOT Group	Total Density (pcf)	SPT Blows
B-1	SS-1	1.0 - 2.5	5	21.8		4500	1	3	5	19	23	48	32	20	12	CL	A-6a	8		4-3-2
B-1	SS-2	3.5 - 4.7	61	12.2		NP														5-11-50/2"
B-1	SS-3	6.0 - 6.5		8.4		NP														50
B-1	SS-4	8.0 - 8.3				NP														50/4"
B-1	-	8.5 -		9.7																
B-2	SS-1	1.0 - 2.5	7	21.3		4000														7-4-3
B-2	SS-2	3.5 - 5.0	7	23.3		6000	0	2	3	11	25	60	34	22	12	CL	A-6a	9		2-3-4
B-2	SS-3	6.0 - 7.3	57	13.1		4000														5-7-50/3"
B-2	SS-4	8.5 - 8.6		7.3		NP														50/1"
B-3	SS-1	1.0 - 2.5	11	16		4000														14-7-4
B-3	SS-2	3.5 - 5.0	2	19.2		2000														2-1-1
B-3	SS-3	6.0 - 7.5	19	16.2		NI														7-8-11
B-3	SS-4	8.5 - 9.0		10.6		NP	47	6	4	16	25	2	NP	NP	NP	GM	A-2-4	0		50

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

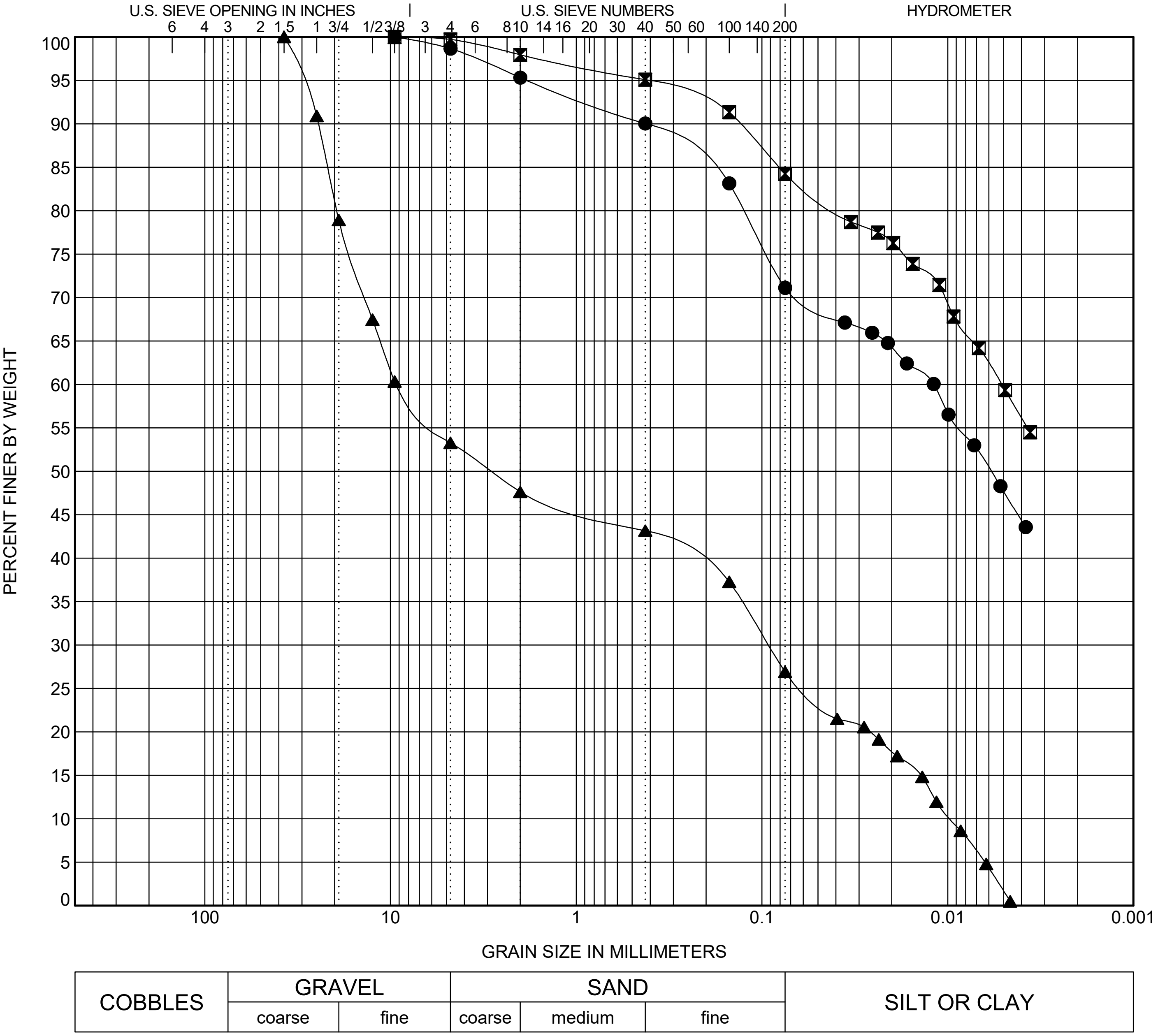
GRAIN SIZE DISTRIBUTION

CLIENT Village of Lowellville

PROJECT NAME Parsons Avenue Sanitary Improvement

PROJECT NUMBER 232475

PROJECT LOCATION Lowellville, OH



	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**1.0**	**SILT and CLAY, Some Sand, Trace Gravel A-6a (8)**	**32**	**20**	**12**		
☒	**B-2**	**3.5**	**SILT and CLAY, Little Sand, Trace Gravel A-6a (9)**	**34**	**22**	**12**		
▲	**B-3**	**8.5**	**SILTY GRAVEL with SAND (GM)**	**NP**	**NP**	**NP**	**0.1**	**953.0**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**1.0**	**9.5**	**0.012**			**1.3**	**27.5**	**23.4**	**47.7**
☒	**B-2**	**3.5**	**9.5**	**0.005**			**0.3**	**15.5**	**24.6**	**59.6**
▲	**B-3**	**8.5**	**37.5**	**9.189**	**0.092**	**0.01**	**46.7**	**26.4**	**25.2**	**1.7**

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

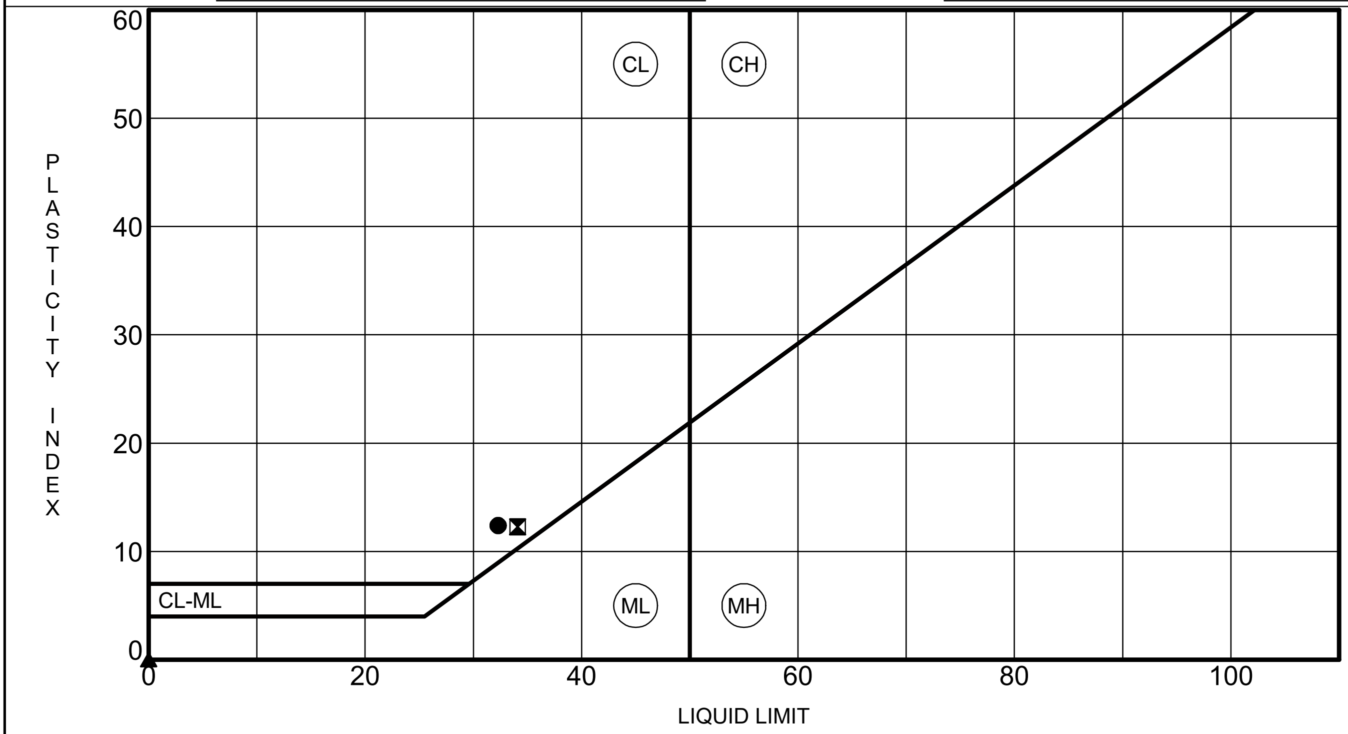
ATTERBERG LIMITS' RESULTS

CLIENT Village of Lowellville

PROJECT NAME Parsons Avenue Sanitary Improvement

PROJECT NUMBER 232475

PROJECT LOCATION Lowellville, OH



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-1**	**1.0**	**32**	**20**	**12**	**71**	**SILT and CLAY, Some Sand, Trace Gravel A-6a (8)**
⧗	**B-2**	**3.5**	**34**	**22**	**12**	**84**	**SILT and CLAY, Little Sand, Trace Gravel A-6a (9)**
▲	**B-3**	**8.5**	**NP**	**NP**	**NP**	**27**	**SILTY GRAVEL with SAND (GM)**