



GEOTECHNICAL EXPLORATION REPORT

FOR THE

**PROPOSED LARIMAR CULVERT IMPROVEMENTS –
SEAVIEW ROAD & LAKESHORE BOULEVARD,
WILLOWICK, LAKE COUNTY, OHIO
WGE #2026-1-264**

PREPARED FOR

**VERDANTAS
904-2 SAHARA TRAIL
YOUNGSTOWN, OHIO 44514**

BY

**WERTZ GEOTECHNICAL ENGINEERING, INC.
400 COLLIER DRIVE
DOYLESTOWN, OHIO, 44230**



DRILLING | MATERIAL TESTING | ENGINEERING

October 9, 2026

**Verdantas
904-2 Sahara Trail
Youngstown, Ohio 44514**

ATTN: Ms. Maya Griswold – Staff Engineer

**RE: Geotechnical Exploration Report for the proposed Larimar Culvert
Improvements Geotechnical Exploration – Seaview Road & Lakeshore
Boulevard, Willowick, Lake County, Ohio; WGE Project #2026-1-264**

Dear Ms. Griswold:

Wertz Geotechnical Engineering (WGE) has completed the requested subsurface investigation for the proposed manhole at location of the existing Larimar Culvert near Seaview Road and Lakeshore Boulevard in Willowick, Lake County, Ohio. The purposes of this investigation are to define the general subsurface conditions in the areas of the proposed manhole and to make recommendations relative to site preparation and earthwork, foundation design, construction, and other pertinent geotechnical aspects of the project. This report was prepared in accordance with our proposal to you dated September 9, 2026, and authorized by Verdantas via email on September 15, 2026. These professional services have been performed, the findings obtained, and the recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices.

If you have any questions or concerns regarding the information presented in this submittal, or have need of additional services, please contact our office at (330) 991-0041.

Sincerely,

A handwritten signature in blue ink that reads "Eric A. Angyal".

Eric A. Angyal, P.E.
Senior Project Engineer

A handwritten signature in blue ink that reads "Leroy Wertz".

Leroy Wertz, P.E.
Senior Project Engineer



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PROJECT DESCRIPTION

SITE DESCRIPTION

Project information was provided to WGE in a Request for Proposal from Verdantas that was received via email by WGE on August 27, 2026, and our follow-up emails with you between that date and September 22, 2026. The RFP email included a general discussion of the proposed project and requested geotechnical scope as well as an aerial photo showing the approximate site location. An email from Verdantas on September 22, 2026, included Sheets 9 of 18 and 10 of 18 of a partial project plan set showing the plan and profile views of the culvert as well as general plan notes.

Based on the available information, we understand that it is planned to construct a new manhole for the existing Larimar Culvert located northwest of Lakeshore Boulevard (S.R. 283) and east of the east end of Seaview Road in Willowick, Lake County, Ohio. The proposed manhole location will be about 55 feet east of the east end of Seaview Road. The manhole will be located near coordinates 41.636714 degrees North, 81.477286 degrees West. The manhole will bear near Elevation 580 feet MSL and will connect to the 84-inch-diameter storm culvert which will receive a slip liner. No other specific details related to the manhole and associated excavation were available at the time of this report.

Based on topographic data available on the plan and profile drawings, the existing site grade at the location of the manhole appears to be near Elevation 613 feet MSL. The site is within a gated community and can be accessed via the east end of Seaview Road. The area of the proposed manhole consists of a grass lawn with areas of concrete debris at the ground surface.

WGE has been requested by Verdantas to advance one (1) boring to a depth of 35 feet near the location of the proposed manhole, perform laboratory testing to identify and evaluate the strength, support, and settlement characteristics of the encountered soils, and provide analysis and recommendations for design and construction of the proposed manhole associated excavation.

If any of our project assumptions or understanding summarized are incorrect, we should be contacted to determine if our recommendations remain valid.

DESCRIPTION OF REGIONAL GEOLOGICAL SETTING

The project site in Willowick, Lake County, Ohio is situated in the Erie Lake Plain Physiographic Region of Ohio, which is defined by the edge of a very low relief Ice-Age Lake basin separated from modern Lake Erie by shoreline cliffs with major streams

present in deep gorges. The site area is located on lacustrine sand (Ohio Department of Natural Resources Division of Geological Survey, 1998).

According to the USDA Web Soil Survey, the site area is primarily mapped by the local soil and water conservation district as the Conneaut silt loam, a material consisting of glaciolacustrine deposits over till, deposited on lake plains on uplands (USDA, 2020). A USDA Web Soil Survey site map is included as Figure 2.

According to publicly available mine data from ODNR, no active or inactive surface or underground sand and gravel, limestone, or coal mining activities are present within the site footprint or nearby surrounding areas.

According to 24k Ohio Division of Geological Survey (ODNR-DGS) Bedrock Geology Maps, bedrock in the area primarily consists of the Ohio Shale, of which major lithologies consist of shale and black shale (Ohio Department of Natural Resources Division of Geological Survey, 1991). Bedrock is reported by ODNR-DGS at approximately 575 feet MSL in elevation. Bedrock is estimated to be encountered approximately 35 to 40 feet below existing site grades. A Geologic Map is included as Figure 3.

FIELD INVESTIGATION & LABORATORY TESTING

On October 1, 2026, WGE advanced one (1) boring (denoted as B-1) at the project site near the proposed manhole to a termination depth of 35 feet below the existing ground surface to characterize the subsurface conditions in the area of the proposed construction. The boring location was field marked at the approximate location as shown on the attached Geotechnical Boring Location Map (Figure 1) by WGE personnel by utilizing a hand-help GPS and referencing aerial photographs available on Google Earth. The existing ground surface elevation at the boring location was estimated to the nearest foot from topographic information available on the project plan and profile drawings provided by Verdantas.

The boring was advanced utilizing a CME-550, ATV-mounted, rotary drilling rig with 3.25-inch, inside-diameter hollow stem augers. Standard penetration testing and sampling was performed at the depth intervals shown on the attached Boring Log utilizing a 140-lb automatic hammer falling 30 inches to drive a 2-inch outer-diameter split spoon sampler over three (3), six-inch intervals. Collected SPT samples were examined and visually identified by our personnel in the field based on the visual-manual procedure (ASTM D-2488). Representative samples were retained in glass jars and transported to our office, for further classification and the assignment of laboratory testing.

Static groundwater level observations and hole depth soundings were made during drilling and upon completion of the boring followed by backfilling the bore hole with soil cuttings. Groundwater level observations made during the drilling and upon completion of drilling and removal of the augers from the ground are indicated on the attached Boring Log. It should be noted that groundwater levels and zones of saturation should be expected to fluctuate seasonally based on variation in amounts of precipitation, evapotranspiration, runoff from impervious areas, and other factors. The depth at which the bore hole sidewalls caved upon removal of the augers from the ground is also shown on the log.

A total of nine (9) moisture content tests were performed on selected representative samples per ASTM D-2216. Two (2) Atterberg (Liquid and Plastic) Limits tests and two (2) soil particle size analysis (sieve and hydrometer) tests were conducted as well.

A summary of the laboratory test results is shown on the Boring Logs included as Attachment A. The results of the Atterberg limits tests are included as Attachment B. A Boring Log Key is included as Attachment C.

SUBSURFACE CONDITIONS

Data collected at the boring location indicated the presence of topsoil overlying fill consisting of damp to moist, soft to hard lean clay with interbedded layers of dense to very dense concrete fragments with varying amounts of silt and gravel. The fill was underlain by natural soils consisting of damp to moist, very stiff to hard lean clay. These can be described for engineering purposes as follows:

- Approximately four (4) inches of topsoil were encountered beginning at the ground surface in Boring B-1. Sod and topsoil depths may vary away from the boring location.
- In general, underlying the topsoil, and continuing to a depth of about 22 feet in Boring B-1, was fill composed of damp to moist, soft to hard lean interbedded with layers of dense to very dense concrete fragments.
- Beginning beneath the fill soils, and continuing to the 35-foot boring termination depth, was natural soil consisting of damp to moist, very stiff to hard, lean clay with varying lesser amounts of silt, fine to coarse sand, and gravel.
- Groundwater was not encountered during drilling nor was it observed upon completion of drilling and sampling and removal of the augers from the ground.

The bore hole caved at a depth of 26 feet below the ground surface upon removal of the augers from the ground and prior to backfilling the bore hole.

GEOTECHNICAL RECOMMENDATIONS

We offer the following for your consideration based on our analysis of the soil and groundwater conditions encountered at the locations indicated, and the assumption that conditions away from the soil boring are similar to those known:

GENERAL CONSIDERATIONS

The proposed manhole can be supported on the existing, natural, hard, lean clay encountered at and below the planned bearing elevation of 580 feet MSL at the boring location.

Dewatering and sheeting/shoring of the excavations will likely be required during construction of the manhole since the excavation will extend into through soft to medium stiff clay fill soils with interbedded layers of dense to very dense concrete fragments. Sheetting/shoring will need to extend to depths sufficient to counteract basal heave of the excavation bottom.

Based upon the stratigraphy encountered in Boring B-1 and the SPT blow counts, it is the opinion of WGE that the project site is currently best characterized as Seismic Site Class "D".

It may be possible to reuse some of the existing site soils from planned excavation as new engineered fill. However, topsoil and other soils with significant organic content and concrete rubble will be unusable for use as engineered fill. Excavated soils should be stockpiled evaluated by the Geotechnical Engineer prior to their reuse. The natural soils consisting of moist lean clay will require moisture conditioning (drying) prior to placement and compaction.

TEMPORARY EXCAVATIONS

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better ensure the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, excavations for below grade structures, excavations required for undercutting, or footing excavations, be constructed in accordance with the OSHA guidelines. It is our

understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, sheet, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. If an excavation (including a trench) is extended to a depth of more than twenty (20) feet, it will be necessary to have the side slopes or shoring designed by a Professional Engineer registered in the state where the construction is occurring.

We are providing this information solely as a service to our client. WGE does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

With respect to temporary unsupported excavation side slopes, the subsurface profile encountered in Boring B-1 includes soft to hard lean clay (fill) intermixed with dense to very dense concrete fragments (also fill) followed by very stiff to hard natural lean clay. These soils should be classified as Type "C" per OSHA. Therefore, dry temporary excavations should be cut back to a temporary slope no steeper than a 1.5:1 (horizontal:vertical) which is equivalent to a slope angle of 34°. Steeper temporary cut slopes may be acceptable if the exposed soils are evaluated by an on-site qualified person and the encountered soils are judged to be suitable for safely maintaining the required excavation sidewall slopes. Additional recommendations regarding sheeting/shoring of the excavations are included under "*Lateral Earth Pressures for Temporary Shoring*".

The presence of soft to medium stiff clay fill in conjunction with the depth of the excavation will likely require the use of sheeting/shoring in combination with some dewatering in order to safely construct below grade structures and/or install utilities. The sheeting/shoring will need to extend deep enough to eliminate the potential for basal heave of the excavation bottom as well.

The existing, soft to hard clay site soils and dense to very dense granular site soils encountered in Boring B-1 can be excavated by a medium-sized hydraulic excavator equipped with an earth bucket.

EARTHWORK GUIDELINES

- Prior to construction, it is recommended that all existing sod, topsoil, trees, vegetation, granular base and any other subgrades judged unsuitable by the on-site Geotechnical Engineer for support of the planned construction be completely removed from within the project area.
- Sheet piling/shoring for the manhole excavation should be designed such that it extends to sufficient depth to eliminate the potential for basal heave of the excavation bottom.
- Dewatering of the excavations should be performed as necessary during earthwork operations as discussed under “*Construction Groundwater Considerations*” later within this report. Dewatering operations should proceed far enough in advance of any excavation work to sufficiently draw down the groundwater table for earthwork operations and foundation construction to proceed.
- All surfaces cut to subgrade elevation or subgrades to receive engineered fill or engineered backfill should be proof-rolled and/or evaluated under the direction of an on-site geotechnical engineer or his direct assigns, where possible. Any areas of yielding (pumping/rutting) soils, or obviously contaminated zones, should be undercut to underlying, stable soils and replaced with stable, compacted engineered fill as described below, or stabilized in place as directed by the engineer. The appropriate type and depth of stabilization should be determined in the field during earthwork operations by the Geotechnical Engineer or their designated representative.
- Prior to placement of engineered fill (if required), it is recommended that the underlying subgrades soils be densified with multiple passes of compaction equipment selected for the appropriate soil type (vibratory roller for granular soils, sheep's foot for clay soils, etc.), where possible, to provide a more uniform support condition for the planned construction. If the compactive effort results in instability of an excavation bottom or subgrade, then compaction should be halted.
- The engineered fill should be clean, inert (non-expansive), non-frost-susceptible soil which should be approved by the Geotechnical Engineer. The engineered fill should have a dry density greater than 100 pcf, a liquid limit less than 50%, and an organic content less than 1%.

- All engineered fill and backfill material should be placed on a stable, approved subgrade in controlled lifts. Each lift of engineered fill and backfill should be compacted to a stable condition and to at least 98% of its maximum dry density per ASTM D-698 in structure areas with a moisture content between 2% below optimum and 2% over optimum moisture.
- All filling operations should be observed by a qualified Soils Technician under the supervision of the Geotechnical Engineer. Field density tests should be made to determine if the soil is compacted to project specifications.
- All surfaces should be sealed and sloped after each day or prior to inclement weather to promote positive drainage of water offsite.
- Construction traffic should be kept off wet subgrades.
- If site work is performed during times of drier weather, the need for additional repairs and stabilization to the subgrade may be substantially reduced. Therefore, it is recommended that sitework be performed during these times.
- It may be possible to reuse some of the existing inorganic lean clay site soils from excavation areas as new engineered fill. However, topsoil and any natural soils with significant organic content or other debris such as large percentages of concrete fragments will not be suitable for reuse as engineered fill. Excavated soils should be stockpiled and evaluated by the Geotechnical Engineer for their intended reuse. The moist soft to medium stiff lean clay soils could require significant moisture conditioning (drying) prior to placement and compaction in order to achieve the densities specified above.
- The site soils should be moisture conditioned as necessary prior to compaction in order to achieve stability during proof-rolling and to achieve required density during earthwork operations.

CONVENTIONAL SPREAD FOOTING FOUNDATIONS

If the foundation for the new manhole will be designed as a conventional spread footing, then the foundation should be proportioned for the pressure recommended in Table One to resist downward vertical loading. Table One also includes a summary of the anticipated foundation bearing depth/elevation and bearing soil type.

The estimated maximum total settlement for footings designed in accordance with the recommendations provided in this section of the report are less than approximately one (1) inch.

Table One Recommended Net Allowable Bearing Pressure for Design of Foundations			
Boring	Foundation Bearing Depth / Elevation	Soil Type	Recommended Maximum Net Allowable Bearing Pressure (psf)
B-1	32 / 580 ft MSL	Hard gray lean Clay	6,000

The following provisions for foundation design and construction would also apply:

- Foundation subgrades should be evaluated and approved by a geotechnical engineer, or their designated representative, prior to concrete placement. Any deleterious foundation subgrades should be undercut and backfilled with additional foundation concrete.
- Foundation subgrades should be prepared in accordance with the recommendations provided under “*Earthwork Guidelines*” provided earlier in this report.
- All foundation subgrades should be concreted in a dry and frost-free condition as soon as possible on the same day as the foundations are excavated to avoid weakening/further softening of the clay bearing surfaces.
- The ground surface surrounding the structure should be graded to direct surface drainage of water away from all exterior foundation walls and members.
- All footings should also bear below the depth of potential frost penetration (at least 42 inches below surrounding site grades).
- Foundation excavations for the structure will require sheeting/shoring, sloping back, and/or dewatering prior to and during foundation construction.

LATERAL EARTH PRESSURES FOR TEMPORARY SHORING AND BELOW GRADE STRUCTURES

Below grade structures must be designed to withstand lateral earth pressures, hydrostatic pressures, and pressures due to long-term traffic and construction equipment loading that may develop adjacent to the structure. The magnitude of the lateral earth pressure varies on the basis of soil type, permissible wall movement, and the configuration of the backfill.

The unit weights and at-rest, active, and passive earth pressure coefficients provided in Table Two should be used for design of temporary shoring/sheeting and below grade structures. Equivalent fluid pressures can be derived for a given range of elevations by multiplying the appropriate lateral earth pressure coefficient (at-rest, active, or passive) in the table by the corresponding recommended unit weight for the elevation range. Note that no factor of safety is included for the lateral earth pressure design parameters in Table Two.

Table Two Lateral Earth Pressure Design Parameters for Below Grade Structures & Temporary Shoring (Boring B-1)						
Boring	Elevation Range (feet MSL)	Angle of Internal Friction (degrees)	At-Rest Coefficient (K _o)	Active Coefficient (K _a)	Passive Coefficient (K _p)	Recommended Unit Weight (pcf)
B-1	612 – 590	22	0.63	0.45	2.19	135
B-1	590 – 577	25	0.58	0.41	2.46	140

For below-grade walls that are laterally braced at their top and/or internally and not allowed to move, at-rest pressures are recommended for design.

Sheeting/shoring will also need to extend deep enough to eliminate the potential for basal heave of the excavation bottoms.

To estimate vertical loading from soil adjacent to the structure, total unit weights of 125 pcf and 135 pcf may be used for compacted granular and cohesive soil, respectively.

All below grade structures, including temporary sheeting/shoring, must be designed to resist lateral earth pressures generated by the retained soil, hydrostatic forces from groundwater, basal heave, and live load and dead load surcharges (including construction traffic and loading from soil adjacent to the structures), as appropriate.

SEISMIC SITE CLASSIFICATION

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Seismic Site Classification is required to determine the Seismic Design Category for a structure. The Seismic Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, Standard Penetration Test (SPT) resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7. The boring at this site was extended by WGE to a maximum depth of 35 feet in the area of the planned manhole structure. The site properties below

the boring depths to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area.

Based upon the stratigraphy encountered in the borings and the SPT blow counts, it is the opinion of WGE that the area of the manhole is best characterized as Seismic Site Class "D".

CONSTRUCTION GROUNDWATER CONSIDERATIONS

We understand that the new manhole base will bear about 32 feet below existing site grade at the boring location. Groundwater was not encountered in Boring B-1 and the soil at the 35-foot boring termination depth were described as being damp to moist. However, excavations for the new structure may require some dewatering during construction.

It may be possible to remove seepage/groundwater accumulations during construction via the use of sump pumps in shallow sump pits. Note that groundwater elevations can fluctuate with seasonal variations in precipitation.

Since excavations could extend into soft to medium stiff clay soils and/or dense to very dense concrete fragments, a system of sheeting/shoring in conjunction with dewatering may be required. If pumping from sumps in sump pits is not effectively keeping the groundwater below excavation levels, then the Geotechnical Engineer should be retained to provide additional recommendations, if warranted. The water table should be drawn down and kept at least three (3) feet below the excavation bottoms and maintained at those elevations during construction.

Surface water and groundwater should be removed from the excavation during construction, as the soils encountered at planned subgrade elevations could soften and lose strength in the presence of water. WGE recommends that the sides and bottoms of the excavation be closely monitored during the construction. If the soil at the bottom of an excavation become softened, loosened or disturbed by construction activity or softened by standing water, it is recommended that the disturbed/softened material in the excavations be undercut and replaced with additional foundation concrete.

A qualified dewatering and excavation shoring contractor experienced with similar soil and groundwater conditions should design any dewatering and shoring systems by reviewing the available geotechnical information prior to proceeding with construction. We recommend the following items be considered as part of the design plans and notes for the construction and installation of the proposed site improvements:

- 1) Require that the contractor submit a dewatering and excavation shoring plan prepared by a Professional Engineer prior to construction.
- 2) Include dewatering and shoring as pay item in the contract documents. This will assist the design team in verifying that the contractors' bids sufficiently evaluated the cost of these items for this project.
- 3) Include a specification that the groundwater needs to be lowered and must be maintained to a depth of at least 3 feet below undercut, foundation, and utility excavation bottoms prior to construction of the site improvements and during backfilling operations and construction of the proposed site improvements.

STANDARD OF CARE AND LIMITATIONS

Our recommendations for this project were developed utilizing the limited project information provided to WGE and the subsurface information obtained from the test boring that was made at the project site. The test boring only depicts the subsurface conditions at the specified location and time at which it was made. The subsurface conditions at other locations on the site may differ from those occurring at the boring location. Additionally, the conclusions and recommendations have been based upon the available subsurface information and the assumed structural design details (including loading and bearing elevations). We should be immediately notified, if during design and/or construction, any conditions different from those found in this investigation are evident, or if our project assumptions or understanding are incorrect. We will advise you of any modifications to our conclusions and recommendations deemed necessary, after observing the exposed conditions and/or changes to the project scope. The scope of our services does not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. Wertz Geotechnical Engineering, Inc. is not responsible for the conclusions, opinions, or recommendation made by others based upon the data included herein.

We hope you will find this report satisfactory. Please contact our office if we can be of further service or you have questions regarding this submittal.

Respectfully submitted,



Eric A. Angyal, P.E.
Senior Project Engineer



Leroy Wertz, P.E.
Senior Project Engineer

FIGURE 1

Geotechnical Boring Location Map



LEGEND

 **2026 WGE Boring Location**



**GEOTECHNICAL
ENGINEERING**

400 Collier Drive, Doylestown, Ohio 44230

330-991-0041

OFFICE@WERTZGEO.COM

GEOTECHNICAL BORING LOCATION MAP

CLIENT
VERDANTAS
904-2 SAHARA TRAIL
YOUNGSTOWN, OHIO 44514

SITE
**SEAVIEW ROAD,
WILLOWICK, LAKE
COUNTY, OHIO**

PROJECT NAME
**LARIMAR CULVERT
IMPROVEMENTS**

LAYOUT BY
EA

DRAWN BY
EA

CHECKED BY
LW

DATE: 10/9/2026

FIGURE NO.

1

Wertz Geotechnical Engineering (WGE) shall not be held liable for improper or incorrect use of the data presented and/or contained herein. These data and related graphics are not legal documents and are not intended to be used as such. WGE does not guarantee the positional or thematic accuracy of the GIS data presented in this figure. WGE gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data.

FIGURE 2

USDA Web Soil Survey Map

Soil Map—Lake County, Ohio



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lake County, Ohio

Survey Area Data: Version 24, Sep 8, 2026

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 2, 2025—Jul 12, 2025

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CtA	Conneaut silt loam, 0 to 1 percent slopes	0.4	100.0%
Totals for Area of Interest		0.4	100.0%

FIGURE 3

Geologic Map

LARIMAR CULVERT IMPROVEMENTS PROJECT GEOLOGIC MAP



10/9/2026

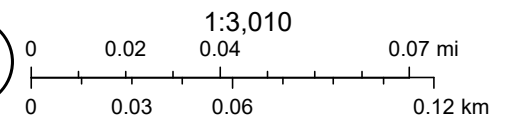
Bedrock Geology 24K - Units Ply

— Doh - Ohio Shale

Bedrock Geology 24K - Units Contacts

— BT Contour

— exposed



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community, Ohio Department of Natural

ATTACHMENT A

WGE Geotechnical Boring Logs



WERTZ GEOTECHNICAL ENGINEERING, INC.
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PROJECT: Larimar Culvert Improvements **PROJECT NO.:** 2026-1-264 **DRILL RIG:** CME 550X **BORING ID:** B-1 **Page 1 of 1**
LOCATION: Seaview Road & Lakeshore Boulevard, Willowick, Lake County, Ohio **METHOD:** Hollow Stem **DATE STARTED:** 10/1/2026
LOGGED BY: M.B. **AUGER SIZE:** 3.25 inches **DATE COMPLETED:** 10/1/2026
DRILL CREW: M.B. & R.J. **HAMMER:** Automatic SPT **ELEVATION:** 612 feet MSL
GROUNDWATER ENCOUNTER DEPTH: None **GROUNDWATER AT COMPLETION:** None **TOTAL DEPTH:** 35' **CAVE DEPTH:** 26'

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	BLOW COUNTS (BLOWS PER 0.5 FOOT)	N60	RECOVERY (INCHES)	POCKET PEN (TSF)	GRAPHIC LOG	LITHOLOGY
1		AS	--	--	--	--		4" TOPSOIL
2	1	1.0-2.5	9-6-3	14	18	3.75		FILL: Damp, stiff, brown, lean CLAY, some silt, minor fine to coarse sand and gravel, trace organics and rubble fragments. Wn%: 13.4
3								
4	2	3.5-5.0	1-1-1	3	14	0.5		FILL: Moist, soft, gray, lean CLAY, minor gravel and organics, trace silt, sand and rubble fragments. LL: 33, PL: 18, Wn%: 20.7
5								
6								
7	3	6.0-7.5	50/5"		5			FILL: Damp, very dense, gray, CONCRETE FRAGMENTS, minor silt and gravel, trace organics. Wn%: 16.6
8								
9	4	8.5-10.0	3-2-2	6	10	1.5		FILL: Moist, medium stiff, gray, lean CLAY, some asphalt fragments, minor silt and stone fragments, trace sand. Wn%: 21.0
10								
11								
12								
13								
14	5	13.5-15.0	8-18-6	37	9			FILL: Damp to moist, hard, gray, lean CLAY, some concrete fragments, minor silt and gravel, trace sand and organics. Wn%: 19.7
15								
16								
17								
18								
19	6	18.5-20.0	13-13-9	34	9			FILL: Damp, dense, gray, CONCRETE FRAGMENTS, minor silt and gravel, trace sand and clay. Wn%: 12.9
20								
21								
22								
23								
24	7	23.5-25.0	6-6-9	23	18	1.75		Damp to moist, very stiff, gray, lean CLAY, minor silt, fine to coarse sand and gravel. Wn%: 15.9
25								
26								
27								
28								
29	8	28.5-30.0	8-10-12	34	18	5+		Damp to moist, hard, gray, lean CLAY, minor silt, fine to coarse sand and gravel. LL: 23, PL: 15, Wn%: 10.5
30								
31								
32								
33								
34	9	33.5-35.0	9-10-13	35	18	4.25		Damp to moist, hard, gray, lean CLAY, minor silt, fine to coarse sand and gravel. Wn%: 10.1
35								Note: Ground surface elevation at boring location estimated from plan and profile drawing provided by client.

ATTACHMENT B

Atterberg Limits Test Results

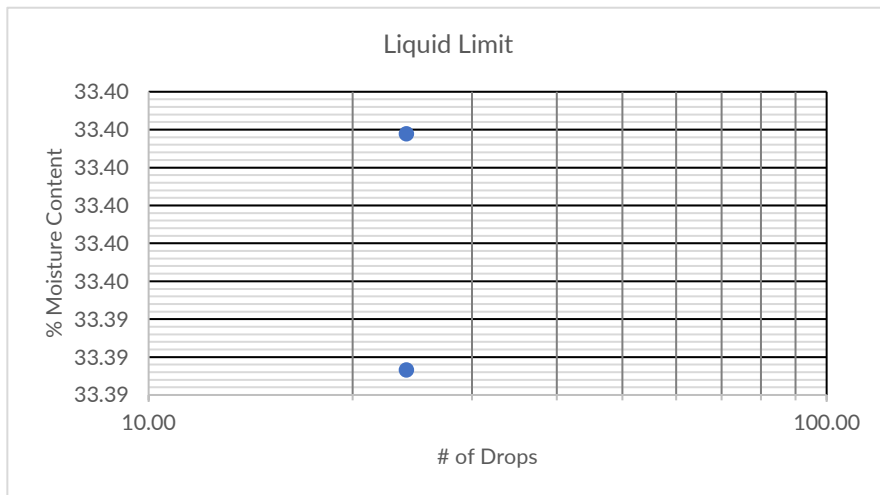
Technician Name: RE
 Date: 10/6/2026
 Notes:

Liquid Limit, Plastic Limit, And Plastic Index
Reference ASTM D4318
FORM: TR-D4318-BT

Project #: 2026-1-264	Project Name: Larimar Culvert	Test Date(s): 10/5/2026
Boring #: B-1	Sample #: S-2	Sample Depth: 3.5'-5.0'
Location: N/A	Method: Onepoint, Air-dried	Elevation: N/A
Sample Description: Gray lean CLAY.		Offset: N/A

Type & Specification	Wertz ID#	Type & Specification	Wertz ID#
Balance (0.01g)	L-0005	Liquid Limit Device	L-0001
Grooving Tool	L-0008		
Oven	L-0007		

Pan #: M-3		Liquid Limit			Plastic Limit		
Tare #		J-21	J-22		J-24	J-25	
A	Wet Soil Weight + C	26.41	26.04		26.76	26.83	
B	Dry Soil Weight + C	24.57	24.29		25.59	25.66	
C	Tare Weight	19.06	19.05		19.10	19.09	
D	Water Weight (A-B)	1.84	1.75		1.17	1.17	
E	Dry Soil Weight (B-C)	5.51	5.24		6.49	6.57	
F	% Moisture (D/E)*100	33.39	33.40		18.03	17.81	
N	# of Drops	24.00	24.00				
Avg.	Average	33.40			17.92		



NP, Non-Plastic	N
Correction Factor	0.995
Liquid Limit	33
Plastic Limit	18
Plastic Index	15
Group Symbol	CL



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 Doylestown, OH 44230

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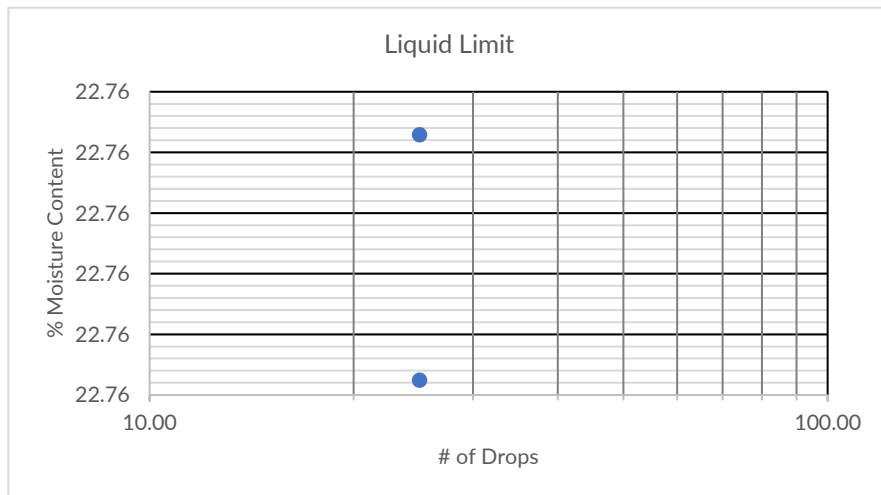
Technician Name: RE
Date: 10/6/2026
Notes:

Liquid Limit, Plastic Limit, And Plastic Index
Reference ASTM D4318
FORM: TR-D4318-BT

Project #: 2026-1-264	Project Name: Larimar Culvert	Test Date(s): 10/5/2026
Boring #: B-1	Sample #: S-8	Sample Depth: 28.5'-30.0'
Location: N/A	Method: Onepoint, Air-dried	Elevation: N/A
Sample Description: Gray lean CLAY.		Offset: N/A

Type & Specification	Wertz ID#	Type & Specification	Wertz ID#
Balance (0.01g)	L-0005	Liquid Limit Device	L-0001
Grooving Tool	L-0008		
Oven	L-0007		

Pan #: M-5		Liquid Limit			Plastic Limit		
Tare #		J-16	J-17		J-19	J-20	
A	Wet Soil Weight + C	27.93	27.34		27.04	27.25	
B	Dry Soil Weight + C	26.28	25.79		26.03	26.22	
C	Tare Weight	19.03	18.98		19.13	19.14	
D	Water Weight (A-B)	1.65	1.55		1.01	1.03	
E	Dry Soil Weight (B-C)	7.25	6.81		6.90	7.08	
F	% Moisture (D/E)*100	22.76	22.76		14.64	14.55	
N	# of Drops	25.00	25.00				
Avg.	Average	22.76			14.59		



NP, Non-Plastic	N
Correction Factor	1
Liquid Limit	23
Plastic Limit	15
Plastic Index	8
Group Symbol	CL



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Document Revised: 10/31/2022

ATTACHMENT C

WGE Boring Log Key

BORING LOG KEY

RANGE OF PERCENTAGES FOR SOIL DESCRIPTORS

Modifier	Range of Percentage
Trace	1-10
Minor	11-20
Some	21-35
"-y"	35-50

Blow Counts (Cohesive)

Blow Count (N)*	Consistency
<2	Very Soft
2-4	Soft
5-8	Medium Stiff
9-16	Stiff
17-32	Very Stiff
>32	Hard

$$*N_{60} = N_{\text{field}} \times (\text{ETR}/60)$$

Blow Counts (Noncohesive)

Blow Count (N)*	Compactness
<4	Very Loose
4-9	Loose
10-29	Medium Dense
30-50	Dense
>50	Very Dense

$$*N_{60} = N_{\text{field}} \times (\text{ETR}/60)$$

TYPICAL MATERIAL GRAPHIC SYMBOLS



TOPSOIL



COAL



PEAT



CLAY



SHALE



MINE SPOILS or FILL MATERIALS



SILT



SILTSTONE



MARL or ORGANIC SILT AND CLAY



SAND AND GRAVEL



SANDSTONE



LIMESTONE or DOLOSTONE

USCS CLASSIFICATION SYMBOLS

GW: Well-Graded Gravel

SW: Well-Graded Sand

CL: Lean Clay

OL: Organic Silt or Organic Clay

GP: Poorly-Graded Gravel

SP: Poorly-Graded Sand

CH: Fat Clay

CL-ML: Silty Clay

GM: Silty Gravel

SM: Silty Sand

ML: Silt

PT: Peat

GC: Clayey Gravel

SC: Clayey Sand

MH: Elastic Silt

BORING LOG ABBREVIATIONS AND SYMBOLS

LOI: Loss on Ignition (%)

PL: Plastic Limit

SO₄: Sulfate Content

W_n: Moisture Content (%)

PI: Plasticity Index

RQD: Rock Quality Designation

pH: Hydrogen Potential

LL: Liquid Limit

REC: Sample Recovery

%<200: Percentage of the sample passing #200 sieve (fines)

Q_p: Pocket Pen Reading

Q_u: Unconfined Compressive Strength

MSL: Mean Sea Level

N_{field}: Field Measured Blow Counts per 12"

ETR: Energy Transfer Ratio

▽: Groundwater Depth

N₆₀: Corrected Blow Counts per 12"

AS: At Surface

TYPICAL SAMPLING SYMBOLS

SPT: Standard Penetration Test

NX: Rock Core Sample

CPT: Cone Penetration Test

RP: Rock Probe

TP: Test Pit

DP: Direct Push

ST: Shelby Tube

HA: Hand Auger