SECTION 00900 – GEOTECHNICAL REPORT

PART I - GENERAL

A. RELATED DOCUMENTS

1. Bowser Morner Report No. 20005485-1025-234r1 dated 4/2/26 is attached for your reference.
2. The report is not a contract document and is only to provide the existing subgrade soil data obtained by the design team for the design of the project.
3. The contractor shall perform his own investigation to verify the subgrade soil conditions.

PART II - PRODUCTS

A. NOT APPLICABLE

PART III - EXECUTION

A. SCOPE OF WORK

1. Based on the testing, the Contractor shall include the following in the scope of work to prepare the building pad:
   a. The unsuitable soil shall be removed to the depths recommended in the soil study report. The building area and pavement area should be proof-rolled with a loaded tandem-axle dump truck or similar heavy rubber tired vehicle (typically with an axial load greater than nine (9) tons). Soils that are observed to rut or deflect excessively (typically greater than one (1) inch) under the moving load should be undercut and replaced with properly compacted low plasticity fill material. The proof-rolling and undercutting activities should be witnessed by a representative of the geotechnical engineer and should be performed during a period of dry weather. If the earthwork activities take place during wet seasons, lime stabilization of the subgrade could be required prior to engineered fill placement. Care should be taken during construction activities not to allow excessive drying or wetting of exposed soils.
   b. Before any soil fill is placed over the excavated area, the top foot at the bottom of the excavations shall be re-compacted to at least 98% of the maximum dry unit weight by standard Proctor method (ASTM D-698). Any weak soil pockets shall be over excavated and replaced with compacted backfill.
   c. The backfill placed below the bottoms of the footing foundations, both exterior and interior foundations, shall be placed in 8-inch-thick loose lifts or as recommended by the Geotechnical Engineer and compacted to at least 98% of the maximum dry unit weight with moisture content within 2% of the optimum moisture content by standard Proctor method (ASTM D-698).
   d. Horizontal benches shall be provided on the face of the cut at no more than 3 feet vertical distance in order for the newly compacted backfill to be keyed into the existing soil layer.
2. The placement of compacted backfill above the bottoms of the footing foundations as the subgrade for the floor slab on-grade and in pavement areas shall be compacted to at least 98% of the maximum dry unit weight with moisture content within 2% of the optimum moisture content by standard Proctor method (ASTM D-698).
3. All prime contractors with work to existing site or proposed new site conditions shall provide all labor and materials to perform all recommendations included in the soils report that is applicable to the work the contractor is to perform.

Revised Soil Study for Proposed Public Works Facility, Vandalia, Ohio

Submitted To:

City of Vandalia

Attn: Mr. Ben Borton

Attn: Mr. Chris Mastrino

333 James E. Bohanan Drive

Vandalia, Ohio 45377

Report No. 20005485-1025-234r1

October 16, 2025

Revised November 5, 2025

Revised April 2, 2026

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April 2, 2026

City of Vandalia
Attention: Mr. Ben Borton
Attention: Mr. Chris Mastrino
333 James E. Bohanan Drive
Vandalia, Ohio 45377

Re: Report No. 20005485-1025-234r2; Revised Soil Study for Proposed Public Works Facility, Vandalia, Ohio

Dear Mr. Borton and Mr. Mastrino:

Bowser-Morner, Inc. is pleased to submit our report of the soil study for the above-referenced project. The purpose of this study is to determine the physical characteristics of the soil strata and allowable bearing capacity for the foundations of structures within the proposed public works facility. Also noted are other conditions that could affect the design and/or construction of the structures.

The samples collected that were not used to perform the laboratory tests will be kept in our laboratory for 30 days unless you advise us otherwise. If you have any questions or if we can help you in any way on this project or future work, please call us.

Christopher R. Ryan

Digitally signed by Christopher R. Ryan
DN: C=US, S=Ohio, L=Dayton, O="Bowser-Morner, Inc.", CN=Christopher R. Ryan, E=cryan@bowser-morner.com
Reason: I am the author of this document
Location:
Date: 2026.04.02 10:47:50-04'00'
Foxit PDF Editor Version: 14.0.1

Respectfully submitted,
BOWSER-MORNER, INC.

Daniel M. Otieno
Geotechnical Engineer

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Sr. Geotechnical Engineer

STATE OF OHIO
CHRISTOPHER R. RYAN
E-76764
REGISTERED
PROFESSIONAL ENGINEER

DO/CRR/an
1-Client
1-WDC Group
Attn. Mr. James Lopez
2-File

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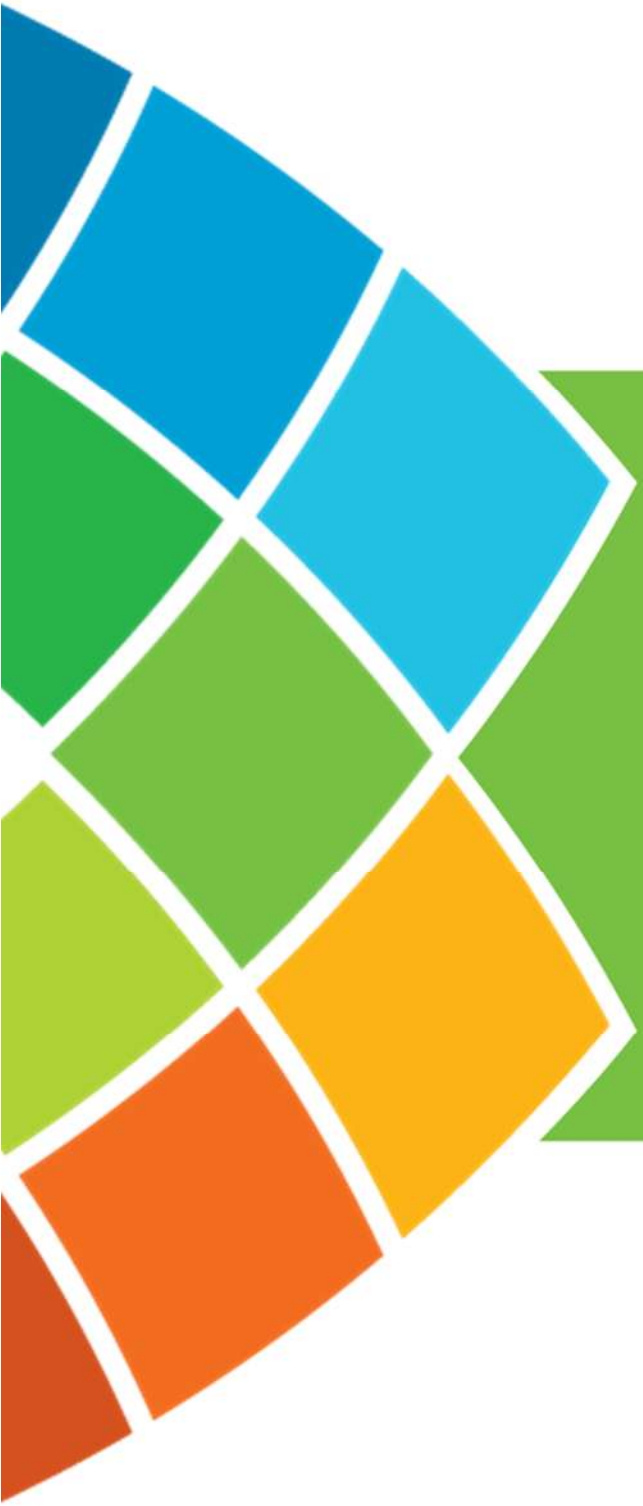


Section I

Text

1.0 INTRODUCTION

A proposed Public Works Facility will be constructed for the City of Vandalia in Vandalia, Ohio. A vicinity map (Figure 1) is included in Section III of this report. Our findings on the soil conditions and groundwater levels with respect to the potential construction problems, and recommendations for the allowable bearing capacity for the construction of the public works facility are given in this report.

Authorization to proceed with this soil study was given by City of Vandalia in a signed City of Vandalia Independent Contractor Agreement sheet dated August 13, 2025. The work was to proceed in accordance with our proposal and agreement, Quotation No. 25-312-057 dated July 10, 2025.

The draft soil boring logs and preliminary foundation recommendations were emailed to Mr. Ben Borton and Mr. Chris Mastrino of the City of Vandalia, and Mr. James Lopez of WDC Group, on September 17, 2025.

2.0 WORK PERFORMED

2.1 Field Work

Fourteen (14) soil borings were made at the locations shown on the boring location plan, Figure 2 in Section III. The boring logs and boring location plan are included in Section III. The borings were made with an ATV boring rig using hollow-stem augers and standard penetration resistance methods. The standard penetration tests were performed in accordance with ASTM D1586, which includes a 140-pound hammer, 30-inch drops, and two-inch-O.D. split-spoon samplers driven at maximum depth intervals of five feet or at major changes in stratum, whichever occurred first. The disturbed split-spoon samples were visually classified, logged, sealed in moisture-proof jars, and taken to the Bowser-Morner, Inc. laboratory for study. The depths where these "SS"-type split-spoon samples were collected are noted on the corresponding boring logs.

2.2 Laboratory Work

Plasticity Testing: Two (2) Atterberg limits tests were performed in accordance with ASTM D4318 to determine the liquid and plastic limits on the most visibly plastic cohesive soil or as needed for soil classification. Plasticity testing is commonly performed to assess seasonal volume change potential of subsurface cohesive materials for use as structural fill and foundation support materials.

Moisture Contents: In addition, 45 moisture content determinations were made in accordance with ASTM D2216. The results of the laboratory tests are summarized in Table 2-1 and included in Section III of this report.

Table 2-1. Summary of Laboratory Test Results

Boring No.	Depth (ft.)	Moisture Content (%)	Atterberg Limits LL	PL	PI
1	1.0 – 2.5	19.6			
	3.5 – 5.0	12.8			
	6.0 – 7.5	11.2			
2	1.0 – 2.5	19.8			
	3.5 – 5.0	21.5			
	6.0 – 7.5	10.4			
3	1.0 – 2.5	25.0			
	3.5 – 5.0	21.0	34	18	16
	6.0 – 7.5	18.6			
	8.5 – 10.0	11.1			
4	1.0 – 2.5	20.3			
	3.5 – 5.0	11.9			
	6.0 – 7.5	12.7			
5	1.0 – 2.5	23.2			
	3.5 – 5.0	12.9			
	6.0 – 7.5	14.3	22	14	8
	8.5 – 10.0	9.9			
6	1.0 – 2.5	24.5			
	3.5 – 5.0	15.4			
	6.0 – 7.5	11.8			
7	1.0 – 2.5	21.8			
	3.5 – 5.0	12.1			
	6.0 – 7.5	11.7			
8	1.0 – 2.5	20.8			
	3.5 – 5.0	12.1			
	6.0 – 7.5	10.4			
9	1.0 – 2.5	19.6			
	3.5 – 5.0	12.0			
	6.0 – 7.5	11.8			
10	1.0 – 2.5	17.7			
	3.5 – 5.0	12.1			
	6.0 – 7.5	10.7			
11	1.0 – 2.5	21.1			
	3.5 – 5.0	10.9			
	6.0 – 7.5	10.3			
12	1.0 – 2.5	22.9			
	3.5 – 5.0	13.7			
	6.0 – 7.5	11.0			

Table 2-1. Summary of Laboratory Test Results

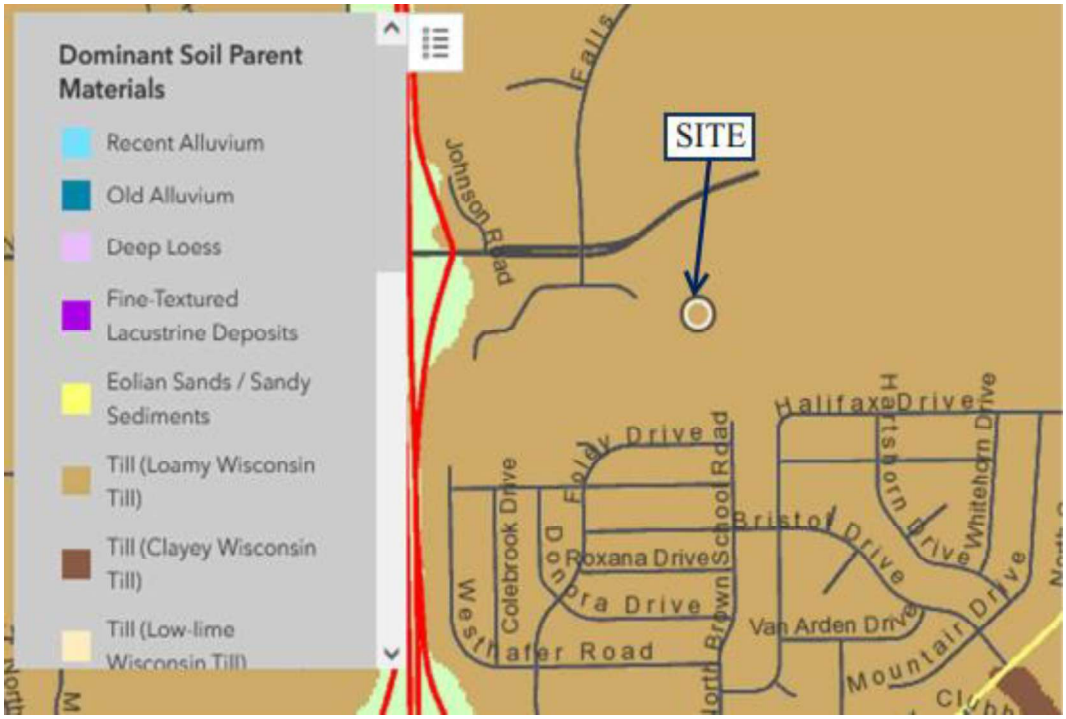
Boring No.	Depth (ft.)	Moisture Content (%)	Atterberg Limits LL	PL	PI
13	1.0 – 2.5	25.1			
	3.5 – 5.0	10.5			
	6.0 – 7.5	14.1			
14	1.0 – 2.5	28.4			
	3.5 – 5.0	18.8	27	18	9
	6.0 – 7.5	18.6			
	8.5 – 10.0	9.4			

3.0 SOIL AND GROUNDWATER CONDITIONS

3.1 Geologic Soil Profile

Geographically, the site is situated in Montgomery County which consists of Wisconsin Age glacial deposits which include glacial till, outwash, associated loess or silty windblown deposits, and lacustrine clays and silts. The bedrock in Montgomery County includes limestone, dolomite, and shale of Ordovician age and the Silurian age.

The glacial soils in the vicinity of the site are what is known as glacial till (specifically, loamy Wisconsin till), which tend to be fairly strong deposits consisting of mixtures of silt, clay, sand, gravel and coarser particles that were left behind once the glaciers retreated from the region. These Wisconsinan aged glacial tills are shaded tan in the diagram below.



(References: Soil Explorer. Online at http://SoilExplorer.net. Accessed 10/09/2025.)

The U.S. Department of Agriculture Soil Survey mapping of this site indicates that the variations of glacial drift on the property include Bs (Brookston silty clay loam, fine texture, 0 to 2 percent slopes), CsA (Crosby Silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes), MIB (Miamian silt loam, 2 to 6 percent slopes), and MIB2 (Miamian silt loam, 2 to 6 percent slopes, eroded). According to the USDA mapping, all the surface deposit variations at the site tend to be the mostly clayey.

3.2 Subsurface Conditions

Based on the information from the fourteen (14) borings made for this study, the subgrade soil conditions are described in descending order below:

STRATUM 1: TOPSOIL: Encountered from Surface to depths of ±3.0 to ±6.0 inches.

Topsoil extending to a depth of between 3.0 and 6.0 inches. Topsoil consists of the semi-organic surface layer of soil that is often mixed with root matter and vegetative materials. Because the organic matter in this soil layer has a high potential for degradation and future volume change, it is not considered to be a reliable stratum for support of buildings or structures. Any surface layer with more than 4% organics (as a percentage of the total dry weight of the soil) should be considered topsoil and should be removed from use for structural fill purposes.

STRATUM 2: GLACIAL DRIFT or OUTWASH: Encountered below stratum 1 to depths of 13.0 to 23.0 feet or to bottom of borings at 20 feet.

Soft-to-hard brown-to-dark brown or gray silty lean clay or silty lean clay with sand, very stiff gray silt, medium dense brown silty sand, and loose-to-medium dense brown or gray sand with gravel or silty sand with gravel. The stratum extends to a depth of between 13.0 to 23.0 feet in Borings 8, 9, 10, 11, 12, and 14, or to the bottom of the boring at a depth of 20 feet in Borings 1, 2, 3, 4, 5, 6, 7, and 13.

STRATUM 3: DOLOMITE Bedrock: Encountered below stratum 2 to bottom of boring at between 13.7 and 23.7 feet.

In Borings 8, 9, 10, 11, 12, and 14, weathered-to-hard gray dolomite rock. The stratum extends to the bottom of all six borings at a depth of 20 feet in Boring 10 and, upon auger refusal, a depth of 18.5 feet in Boring 8, 23.7 feet in Boring 9, 18.8 feet in Boring 11, 18.7 feet in Boring 12, and at 13.7 feet in Boring 14.

Free groundwater was encountered during the advancement of the borings at the depths and elevations summarized in Table 3-1.

Table 3-1. Summary of Groundwater Observations

Boring No.	Depth Groundwater First Observed (ft)		Groundwater Observations at Completion of Boring	
	Depth	Elevation*	Depth	Elevation*
1	No Water		8.0	956.0
2	13.0	948.7	9.5	952.2
3	13.0	945.3	6.0	952.3
4	8.0	954.2	No Water	
5	18.0	943.3	13.0	948.3
6	8.0	949.0	10.5	946.5
7	13.0	947.2	No Water	
8	8.0	948.2	No Water	

Table 3-1. Summary of Groundwater Observations

Boring No.	Depth Groundwater First Observed (ft) Depth	Elevation*	Groundwater Observations at Completion of Boring Depth	Elevation*
9	23.0	935.6	15.0	943.6
10	13.0	945.6	No Water	
11	8.0	947.7	No Water	
12	No Water		11.0	944.3
13	14.8	942.7	No Water	
14	13.0	933.6	9.0	937.6

*In reference to surface elevation based on Ohio South State Plane Coordinate System.

Free groundwater is defined as water that seeps into an open borehole before it is backfilled. Groundwater observations were made during the boring operations by noting the depth of water on the boring tools and in the open boreholes following withdrawal of the boring augers. However, it should be noted that short-term water level readings are not necessarily a reliable indication of the groundwater level and that significant fluctuations may occur due to variations in rainfall and other factors. For specific questions on the soil conditions, please refer to the individual boring logs in Section III.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Project Description

A proposed Public Works Facility will be constructed for the City of Vandalia in Vandalia, Ohio. The new Public Works Facility will include offices, restrooms and lockers, a sign shop, water shop, vehicle storage, equipment storage, service bay, material storage, and wash bay. The proposed facility will be approximately 51,360 square feet and will be a pre-engineered metal building. No specific building design or loading information was provided for this report.

The following recommendations are based on this information. If the above statements are incorrect or changes are made, Bowser-Morner, Inc. should be notified so that the new data can be reviewed and additional recommendations and services can be given if required to meet the needs of your project.

4.2 Foundation Recommendations

4.2.1 Foundation Subgrade Preparation

Based on information from the 14 borings made at this site, the site is covered with topsoil and/or weak soil that extends to the approximate depths outlined in Table 4-1. Based on the results of the standard penetration tests (SPT) in the borings, the recommended net allowable bearing capacities and the depths to bearing strata at each boring are also tabulated in Table 4-1.

Table 4-1. Depths to Bottoms of Unreliable Soils

Boring No.	Depth to Bottom of Bearing Strata (ft)	Elevation* of Bearing Strata (ft)	Topsoil, Fill, and/or Weak Soil	Recommended Net Allowable Bearing Capacity (psf)
1	0.4	963.6	Topsoil	2,500
	3.5	960.5	Topsoil and Weak Soil	3,000
	13.5	950.5	Topsoil and Weak Soil	4,000
2	0.4	961.3	Topsoil	2,000
	6.0	955.7	Topsoil and Weak Soil	4,000
3	0.4	957.9	Topsoil	1,500
	8.5	949.8	Topsoil and Weak Soil	2,500
	18.5	939.8	Topsoil and Weak Soil	4,000
4	0.5	961.7	Topsoil	1,000
	3.5	958.7	Topsoil and Weak Soil	3,000
	8.5	953.7	Topsoil and Weak Soil	4,000
5	0.3	961.0	Topsoil	1,500
	3.5	957.8	Topsoil and Weak Soil	2,000
	8.5	952.8	Topsoil and Weak Soil	4,000
6	0.3	956.7	Topsoil	2,000
	3.5	953.5	Topsoil and Weak Soil	3,000
	13.5	943.5	Topsoil and Weak Soil	4,000
7	0.3	959.9	Topsoil	3,000
	8.5	951.7	Topsoil and Weak Soil	4,000
8	0.4	955.8	Topsoil	1,000
	3.5	952.7	Topsoil and Weak Soil	4,000
9	0.5	958.1	Topsoil	3,000**
	18.5	940.1	Topsoil and Weak Soil	4,000
10	0.4	958.4	Topsoil	2,000
	6.0	952.9	Topsoil and Weak Soil	4,000
11	0.5	955.2	Topsoil	1,500
	3.5	952.2	Topsoil and Weak Soil	3,000
	6.0	949.7	Topsoil and Weak Soil	4,000
12	0.4	954.9	Topsoil	2,000
	3.5	951.8	Topsoil and Weak Soil	3,000
	13.5	941.8	Topsoil and Weak Soil	4,000
13	0.3	957.2	Topsoil	1,500
	3.5	954.0	Topsoil and Weak Soil	3,000
	8.5	949.0	Topsoil and Weak Soil	4,000
14	0.4	946.2	Topsoil	1,000
	6.0	940.6	Topsoil and Weak Soil	3,000
	8.5	938.1	Topsoil and Weak Soil	4,000

*In reference to surface elevation based on Ohio South State Plane Coordinate System.

**Bearing capacity applies only to foundations placed within a depth of 5 feet below the existing grade. The recommended allowable bearing capacity will have to be reduced with foundations to be placed below a depth of 5 feet in the vicinity of Boring 9, because a weaker soil layer was encountered at a depth of 13.5 feet below the existing grade.

Within any building construction limits, the topsoil and/or the weaker soil can be removed to the suitable depths with the desired allowable bearing capacities as outlined in Table 4-1 and replaced with compacted backfill. The topsoil can be stockpiled for landscaping purposes. Any sizable roots and tree stumps should also be removed and wasted.

The bottoms of the foundation excavations should extend to the suitable depths with the desired allowable bearing capacities as outlined in Table 4-1. After the foundation excavations extend to the suitable depths, the over-excavation can be filled with compacted backfill. The bottoms of exterior footing foundations should be placed at least 32 inches below the final adjacent grades to protect against frost penetration and heaving for heated structures. For non-heated structures, the bottoms of exterior footing foundations should be placed at least 36 inches below the final adjacent grades to protect against frost penetration and heaving. Interior footings not subject to frost action may bear at a minimum depth of 18 inches below the floor slab if they are supported on original materials or compacted fill placed in accordance with our recommendations.

The base of each excavation should extend one lateral foot for every foot of excavation below the bottom of the footing foundation as shown in Figure 3 in Section III. If an excavation will extend more than five feet below the existing grade, a maximum allowable side slope of 1 (horizontal) to 1 (vertical) should be maintained in any excavation for stability and for the safety of the workers.

After the foundation excavations extend to the desired grade, the top foot at the bottom of each excavation should be compacted to at least 90% of the maximum dry-unit weight as determined by the modified Proctor test (ASTM D1557) before any new fill or foundation is placed. Any soft soil pockets should be undercut and replaced with newly compacted fill. Any lean clay soils to be imported as backfill or removed from the project site probably will have significantly different Proctor values. Consequently, samples to be tested by the Proctor method should be obtained from a representative area and from the same elevation as the design subgrade.

After the bottoms of the excavations have been compacted, structural fill can be placed to bring the bottoms of the excavations to reach the desired final grade. The fill placed below the bottom of the footing foundations should be placed in eight-inch-thick lifts and compacted to at least 95% of the maximum dry-unit weight as determined by the modified Proctor test (ASTM D1557). Fill placed above the bottom of the footing foundations to serve as the subgrade for the floor slab should be compacted to at least 90% of the maximum dry-unit weight as determined by the modified Proctor test (ASTM D1557). Structural fill should be placed in accordance with the recommendations given in Section 4.4.

The footing foundations for any building can be supported on the original subgrade soil or newly compacted backfill extending to the depths outlined in Table 4-1. The foundations can be designed with the corresponding net allowable bearing capacities outlined in Table 4-1. For these recommended allowable bearing capacities outlined in Table 4-1 for the original soil layer or for the newly compacted backfill, the total estimated amount of settlement of the foundations will be about one inch with differential settlement of about 3/4 inch over a distance of 40 feet.

The soil removed from this site that is free of organic or objectionable materials as defined by a field technician who is qualified in soil material identification and compaction procedures can be reused as fill. Objectionable or undesirable soils are defined as those materials that cannot meet design placement specifications or materials that will deteriorate with time.

When determining the geometric size (the "footprint") of the footing foundation, the total system loads applied to the tops of the foundations should be considered in the bearing pressure calculations.

The bearing capacities recommended in Table 4-1 for foundations supported on structural fill applies to well-graded granular soils, low-to-medium plastic clays, clayey sands, and some silty sands that are placed and compacted in accordance with the recommendations given in this report. However, uniformly graded or gap-graded granular soils (GP or SP), silts (ML), silty fine sands (SM), and high plasticity clays (CH) will be difficult to place and compact, and may result in a reduced bearing capacity. If these soils will be used as backfill, Bowser-Morner should be notified before the soils are placed so that the proposed placement methods and bearing capacity recommendations can be reviewed.

The bearing capacity of a soil is not a unique physical property of the soil. Instead, it depends explicitly on several factors including the footing type, size, and shape; the depth of embedment; the eccentricity and inclination of the applied load; the footing base inclination; the stiffness of the footing; the proximity of the footing to open cuts or slopes; the relative distance between the bottom of the footing and the water table; and the allowable amounts of settlement. The recommended allowable bearing capacity is based on the foundation design parameters given above and the assumptions that the applied load is vertical with no eccentricity, the base is horizontal and level, the footing is rigid, the footing is not close to an open cut or slope, and the water table is below the bottom of footing. If the actual conditions vary from the parameters and assumptions stated above, Bowser-Morner should be notified so that the new information can be reviewed and additional recommendations and services can be given to meet the needs of your project.

Foundations supported on soil settle as the result of externally applied loads. While the foundations should be expected to settle, the amount of settlement should be within the tolerable limits for the structures.

Dolomite bedrock was encountered in six of the 14 borings performed for this study. Based on the samples obtained in the borings and the depths where auger refusal occurred, the depths to apparent bedrock are also tabulated in Table 4-2.

Table 4-2. Depth to Bedrock

Boring No.	Depth to Top of Bedrock (ft)	Elevation* at Top of Bedrock (ft)	Depth to Auger Refusal (ft)	Elevation* at Auger Refusal (ft)
8	18.0	938.2	18.5	937.7
9	23.0	935.6	23.7	934.9
10	18.0	940.6	>20.0	<938.8
11	18.0	937.7	18.8	936.9
12	18.0	937.3	18.7	936.6
14	13.0	933.6	13.7	932.9

*In reference to surface elevation based on Ohio South State Plane Coordinate System.

To avoid differential settlement, if any foundations will be supported on bedrock, all of the foundations for that structure should be supported on bedrock. Alternatively, the bedrock can be over-excavated to at least one foot below the bottoms of the foundations. One foot of compacted backfill should be placed over the bedrock surface, and the foundations for the structure should be supported on the overburden soil layer or on the newly compacted backfill layer. Alternatively, all of the foundation excavations can extend to bedrock. The over-excavation should be backfilled with lean concrete. The foundations can be partially supported on bedrock and partially supported on cured, lean concrete fill.

Alternatively, the weaker soil can remain in-place. The weak subgrade soil can be modified by installing Geopiers® for the construction of the structures. The Geopier® method is a patented method that includes the placement and the compaction of sand and gravel in pre-augered holes. With this method, the sand and gravel fill will be compacted in lifts using a drop hammer. The Geopiers® will be constructed in a pre-set pattern.

The buildings can simply be supported on spread-footing foundations over the Geopier®-improved subgrade soil. The floor slab on-grade also can be supported over the Geopier®-improved subgrade soil. The spacing for the Geopiers® to be installed beneath the floor slabs on-grade will be much wider than the support for the foundations. If the Geopier® method is selected, the Geopier® Foundation Company, Inc. will perform the design of the Geopier® system including the spacing of the piers and the allowable bearing capacity on top of the Geopiers®.

The footing foundations supported on the Geopier®-improved subgrade can be designed with the allowable bearing capacity specified by the Geopier® Foundation Company, Inc. Based on our experiences with other projects, the allowable bearing capacities are about 3,000 to 5,000 pounds per square foot (psf) with Geopier® modified subgrade soil for these type of projects.

In general, for the selection or the installation of any type of aggregate piers, the compaction performed with a hammer should provide vertical impact to the granular fill. Each lift of aggregate should be equal to or less than 36 inches thick and should be placed starting from the bottom of the hole.

If stone-column methods other than the Geopier® method are selected, the compaction of the stone columns should be verified with a dynamic cone-penetration test through the aggregate piers. The "N" values can be obtained continuously through the full length of the aggregate piers. After the tests are completed and the aggregate is still loose, the piers should be recompacted using the installer's equipment. Based on our experience with other projects, a top-feed method of placing the granular material with a vibration device in the open hole cannot achieve the required compaction. The top-feed method with a vibration device is not acceptable and cannot be considered as equal to the Geopiers®.

The Geopier® Foundation Company, Inc. will design the Geopiers® including the length, diameter, and spacing of the piers and the allowable bearing capacities of the improved subgrade soil or with foundations supported directly on top of the piers. If the Geopier® subgrade-improvement method with a displacement mandrel will be used, temporary steel casings will not be needed to extend through the existing fill and weak soil to keep the shafts from caving in. If the Geopier® subgrade-improvement method will be considered, we can contact and provide our study to Geopier® Foundation Company, Inc. on behalf of the client to obtain a preliminary cost estimate for this project.

4.2.2 Lateral Earth Pressure for Below-Grade Wall Design

Any perimeter below grade walls should be designed as retaining walls to resist the lateral earth pressure. Free-draining granular materials should be placed behind the perimeter below grade walls. Water should not be allowed to accumulate behind the walls. With the retaining walls to be backfilled with free-draining granular backfill, an "at-rest," lateral earth-pressure coefficient of 0.5 should be used to determine the lateral earth pressure against the walls. A lateral soil pressure of 63 pounds per square foot per foot depth can be used in the design of the walls. If water will be allowed to accumulate behind the walls, a static water pressure of 62.4 psf per foot depth should be added onto the design lateral pressure against the walls. The design of the sump-pit walls is beyond the scope of the study.

4.2.3 Site Classification For Seismic Design

Based on the results of the standard penetration tests (SPT) in the borings made in the proposed public works facility areas, the average "N" values range from 10 to 24 blows per foot for the soil layer within 13.7 to 23.7 feet of the existing grade. Based on the results of the average "N" value, it is our opinion that the site will be classified as an "E" type in accordance with the *Ohio Building Code*.

However, based on the measured average shear wave velocity, $V_s100' = 2821$, the site can be classified as a "B" type in accordance with the *Ohio Building Code*.

4.3 Slabs On-Grade

The soils at the depths and elevations on the first line for each boring, outlined in Table 4-1, are not reliable to support any floor slab on-grade due to the potential for settlement. We recommend that the unreliable soils be removed from beneath the floor slab areas and that the exposed ground surface be compacted as outlined above for the foundations. The floor slabs on-grade can be supported on compacted fill placed in accordance with the recommendations given above or on the Geopier improved subgrade. We recommend that the upper four to six inches of compacted fill be a well-graded, angular, granular material such as crushed sand with gravel or crushed stone. To help distribute concentrated loads and equalize moisture conditions under the slabs, this granular material should contain less than 5% of fines or particles that can pass through a No. 200 sieve.

Topsoil, fill, and/or other deleterious materials encountered during the site preparation must be removed and replaced with select engineered fill that is compacted to the specifications outlined in this report.

We recommend that slabs on-grade "float" by being fully supported on the ground and not structurally connected to walls or foundations. Floating will minimize the possibility of cracking and displacement of the slabs on-grade as a result of differential movements between the slab and the foundations. Although the movements should be within the tolerable limits for structural safety, such movements could be detrimental to the slabs if they were rigidly connected to the foundations.

4.4 Compaction Requirements

Structural fill placed below the foundation bearing elevation should be compacted to at least 95% of the maximum dry unit weight with moisture contents within 2% of the optimum moisture content as determined by the modified Proctor test (ASTM D1557). Fill placed above the bottoms of the foundations or under pavement areas should be compacted to at least 90% of the maximum dry unit weight with moisture contents within 2% of the optimum moisture content as determined by the modified Proctor test (ASTM D1557). The compaction should be accomplished by placing the fill in successive, horizontal, approximately six- to eight-inch-thick loose lifts and mechanically compacting each lift to at least the specified minimum dry density. Field density tests should be performed at a minimum rate of one per 2,500 square feet of fill area and for each lift to verify that adequate compaction is achieved. Backfill for utility trenches, foundation excavations, etc., within structures or paved areas, is considered structural fill and should be placed in accordance with these recommendations.

It must be emphasized that the excavation and compaction of soil fill are highly influenced by weather conditions. Performing the earthwork under wet and frozen conditions is generally very difficult. As a result, compaction of wet silty and clayey soil should be avoided during wet and frozen conditions because the wet soil cannot be compacted to the required unit weight without drying or other soil stabilization methods. Alternatively, granular soil can be used as backfill to facilitate the backfill and compaction work during winter and wet weather conditions. The construction cost during the winter and wet weather conditions will be higher by the purchase of granular soil from the sand and gravel pits.

Puddling or jetting of the backfill material, including the utility trenches, should not be allowed as a compaction method. Silty or clayey soils encountered above foundation depth will often soften, and the bearing capacity may be reduced if water ponds in the excavation.

Lean concrete that is placed below the bottom of foundation should have a minimum 28-day compressive strength of 2,000 pounds per square inch (psi).

4.5 Foundation Excavations

During the foundation excavations, the subsurface conditions should be verified. Changes in subsurface conditions other than what are shown on the boring logs warrant additional subsurface investigation before any structure foundations are constructed.

The foundation excavations should be observed to ensure that the loose, soft, or otherwise undesirable materials are removed and that the foundations will be supported directly on an acceptable surface. At the time of this observation, it may be necessary to use a hand penetration device in the base of the foundation excavation to ensure that the soils immediately below the foundation base are satisfactorily prepared to support the foundations. Please note that such shallow observations do not replace an adequate deep-boring program and structural fill compaction QA/QC records. The overall performance of the foundations is governed by the soils below the bottom of the footing foundation.

If pockets of soft, loose, or otherwise unsuitable materials are encountered in the footing excavations and it is inconvenient to lower the footings, the proposed footing elevations may be reestablished by backfilling after the undesirable materials have been removed. The excavation under each footing should extend to suitable soils, and the base of the excavation should extend one lateral foot for every foot of excavation below the bottom of the footing foundation as shown in Figure 3 in Section III. The entire excavation should then be refilled with well-compacted, engineered fill. Special care should be taken to remove the sloughed, loose, or soft materials near the base of the excavation slopes. Extra care should also be taken to tie-in the compacted fill with the excavation slopes, with benches as necessary, to ensure that no pockets of loose or soft materials are left along the excavation slopes below the foundation bearing level. The contractor should maintain temporary cut slopes in accordance with the current OSHA regulations governing trenching and slope stability.

Soils exposed at the bases of satisfactory foundation excavations should be protected against any detrimental change in condition such as from construction disturbances, rain, and freezing. Surface runoff should be drained away from the excavation and not allowed to pond. If possible, foundation concrete should be placed the same day the excavation is made. If this is not practical, the foundation excavations should be adequately protected. Also, for this reason, proper drainage should be maintained after construction. It must be emphasized that all excavations must conform to all state, federal, and local regulations relative to slope geometry.

4.6 Construction Dewatering

At the time of our study, free groundwater was encountered in all 14 borings at depths of 6.0 to 23.0 feet below the existing grade as outlined in Table 3-1. Any groundwater and surface water infiltration encountered in the excavations during construction should be lowered to the bottom of the excavation in silt and clay soils and should be lowered to at least three feet below the bottom of the maximum excavation in the sand and gravel layers using sumps and pumps. Sumps can consist of perforated pipes or drums installed vertically in the relatively permeable granular soils and surrounded with free-draining sand and gravel. The perforations of the pipe should be covered with a layer of filter fabric to keep silt and fine sand from pumping through the sumps. Care must be exercised when pumping from sumps that extend into silts or other granular soils since general deterioration of the bearing soils and a localized "quick" condition could result. The groundwater should be kept at a level below the fill operation during the placement and compaction of the backfill materials during the construction of the building foundation.

For the installation of Geopiers®, any groundwater seepage should be considered. If groundwater is encountered, casings may be needed to keep the shafts from caving in the open holes.

The amount and type of dewatering required during construction will depend on groundwater levels at the time of construction. Typically, groundwater levels are highest during winter and spring, and lower in summer and early fall.

We recommend that the storm sewer utilities and site drainage be installed within the site prior to construction of the structures to help dewater the site.

4.7 Drainage

Adequate drainage should be provided at the site to minimize any increase in moisture content of the foundation soils during and after construction. The exterior grade including all pavements or parking areas should be sloped away from the new foundations to keep water from ponding. All drains should provide positive discharge away from the structures.

4.8 Pavement Recommendations

4.8.1 Pavement Subgrade Preparation Recommendations

Based on information from the 14 borings, any proposed pavement areas is covered by topsoil that extends to the depths outlined in the first line of each boring on Table 4-1.

The topsoil, roots, and stumps in any proposed pavement areas should be removed. The topsoil can be stockpiled for landscaping purposes. After the topsoil has been removed and any ground surface in the pavement areas that is higher than the proposed subgrade has been re-graded, the top foot of the subgrade soil layer at the bottom of the excavation should be compacted to at least 90% of the maximum dry-unit weight as determined by the modified Proctor test (ASTM D1557) before any new fill or subgrade is placed. Any soft soil pockets should be undercut and replaced with newly compacted fill. Verification of the subgrade will have to be performed during the re-compaction of the top of the stripped ground surface. A soil technician under the supervision of the geotechnical engineer should be on-site to observe the compaction. Any additional backfill to be

placed over the recompacted ground surface to support the granular base should be placed in eight-inch-thick lifts and compacted to at least 90% of the maximum dry-unit weight as determined by the modified Proctor test (ASTM D1557).

Any weak or loose soil layer encountered during the re-compaction of the subgrade soil layer should be undercut and replaced with newly compacted backfill. Any thin layer of soft clay can be scarified and recompacted to achieve the density to at least 90% of the maximum dry-unit weight as determined by the modified Proctor test. The recompacted subgrade should be firm with the deflection less than 1/2 inches under the compaction equipment.

Alternatively, any weak soil areas can be stabilized with No. 2 stone, cement stabilization, or with geogrid and granular backfill. No. 2 stone can be placed at the bottom of the excavation. This stone should be tracked into the weak soil layer to provide a firm base for the placement of additional fill. Alternatively, a layer of geogrid can be placed over the bottom of the excavation. One foot of ODOT 304 aggregate can be end-dumped over the geogrid, spread with a rubber-tired front-end loader, and compacted. For the cement stabilization, in-place soil should be treated to a depth of 16 inches.

Any additional subgrade fill, which is needed to reach the final proposed subgrade, can be placed and compacted to bring the ground to the desired grade, if needed. The newly placed fill should be placed in horizontal eight-inch-thick lifts and compacted to at least 90% of the maximum dry-unit weight with moisture contents within 2% of the optimum moisture content by the modified Proctor method (ASTM D1557). The granular base can be supported on the newly compacted soil or on the recompacted subgrade.

Silty or clayey soil at subgrade depth will tend to degrade quickly under construction traffic when wet. Degradation of the wet subgrade soils will result in a reduced support value. For this reason, all of the exposed subgrade should be graded to drain and should be protected against any detrimental change in condition such as from disturbances, rain, and freezing. The ground surface near the pavement area should slope away from the car parking lot so that surface runoff is not allowed to pond next to the pavement area. Adequate drainage should be provided at the site to avoid an increase in moisture content of the subgrade soils during and after construction.

4.8.2 Pavement Design Recommendations

Based on the results of the laboratory tests, the subgrade soils on the sites can be classified as A-4 and A-6 types in accordance with the AASHTO Soil Classification System. Our experience has been that the long-term performance records of these types of soils are less than what are predicted by standard design charts. For this reason, after this type of subgrade soil is compacted to 90% of the maximum dry unit weight as determined by the modified Proctor test, a California Bearing Ratio (CBR) value of 3 can be assigned for the pavement design. An equivalent soil support value (SSV) of 2.4 can be used for the asphalt pavement design, and a modulus of subgrade reaction (k) of 90 pci can be used for the concrete pavement design.

Traffic-loading data for the proposed site were provided by the client. An estimated maximum of 50 trucks per day are anticipated for the truck-traffic conditions. The pavement sections outlined in Table 4-3 are recommended for projected, heavy-duty, truck-traffic conditions as provided by others.

Table 4-3. Recommended Heavy-Duty Pavement Sections

	Alternative Pavement Sections (inches)		
Pavement Component	#1	#2	#3
448 Asphalt Concrete, Type 1, Surface	4	3	--
301 Asphalt Concrete	4	4	--
304 Granular Base	8	10	8
Portland Cement Concrete	--	--	6

The pavement sections outlined in Table 4-4 are recommended only for car parking areas that will accommodate traffic with a gross vehicle weight of less than 4,000 pounds. The projected traffic counts and vehicular loading data were not provided. As a result, the pavement recommendations are only intended for low-impact areas, such as parking areas and driving lanes, where only lightweight passenger cars are anticipated.

Table 4-4. Recommended Car Parking Pavement Sections

	Alternative Pavement Sections (inches)		
Pavement Component	**#1**	**#2**	**#3**
448 Asphalt Concrete Surface Course, Type 1	3	2	--
301 Asphalt Concrete	--	3	--
304 Granular Base	8	6	6
Portland Cement Concrete	--	--	3-1/2

One additional inch of asphalt concrete or Portland cement concrete should be placed in the driving lanes in the car parking areas and in the proposed driveways to handle the channelized traffic conditions. We recommend that a Portland cement concrete pavement be used in front of trash bins and within any truck loading dock area to handle the large start-and-stop loads imposed by the heavy truck traffic.

Several items should be carefully considered during the selection of a final design cross section. These factors are:

A. A tack coat should be applied between layers of bituminous concrete.

B. The paved area should have a slope of at least 1.5% for adequate drainage. The base material and/or surface of the subgrade should be allowed to drain through holes in the catch basins or through the shoulders. No undrained granular fill area, including the utility trenches and base course, should be allowed.

C. Before paving, the entire area should be thoroughly compacted or recompacted to a dry unit weight of 90% of the maximum modified Proctor value at no more than 2% over the optimum moisture content.

5.0 CLOSURE

5.1 Basis of Recommendations

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project and our experience with similar sites and subsurface conditions. Data used during this exploration included, but were not necessarily limited to:

- Fourteen (14) exploratory borings performed during this study.
- Observations of the project site by our staff.
- The results of the laboratory soil tests.
- The site plan provided by WDC Group.
- Published soil or geologic data of this area.

In the event that changes in the project characteristics are planned, or if additional information or differences from the conditions anticipated in this report become apparent, Bowser-Morner, Inc. should be notified so that the conclusions and recommendations contained in this report can be reviewed and, if necessary, modified or verified in writing.

5.2 Limitations and Additional Services

The subsurface conditions discussed in this report and those shown on the boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by designers, or that the construction process has altered the soil conditions. As variations in the soil profile are encountered, additional subsurface sampling and testing may be necessary to provide data required to reevaluate the recommendations of this report. Consequently, after submission of this report, it is recommended that Bowser-Morner, Inc. be authorized to perform additional services to work with the designer(s) to minimize errors and omissions regarding the interpretation and implementation of this report.

Before construction begins, we recommend that Bowser-Morner, Inc.:

- Work with the designers to implement the recommended geotechnical design parameters into plans and specifications.

- Consult with the design team regarding interpretation of this report.
- Establish criteria for the construction observation and testing for the soil conditions encountered at this site.
- Review final plans and specifications pertaining to geotechnical aspects of design.

During construction, we recommend that Bowser-Morner, Inc.:

- Observe the construction, particularly the site preparation, fill placement, and foundation excavation or installation.
- Perform in-place density testing of all compacted fill.
- Perform materials testing of soil and other materials as required.
- Consult with the design team to make design changes in the event that differing subsurface conditions are encountered.

If Bowser-Morner, Inc. is not retained for these services, we shall assume no responsibility for construction compliance with the design concepts, specifications or recommendations.

5.3 Warranty

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. No other warranty, express or implied, is made.

The scope of this study did not include an environmental assessment for the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, within or beyond the site studied. Any statements in the report or on the boring logs regarding odors, staining of soils or other unusual items or conditions observed are strictly for the information of our client.

To evaluate the site for possible environmental liabilities, we recommend an environmental assessment, consisting of a detailed site reconnaissance, a record review, and report of findings. Additional subsurface drilling and sampling, including groundwater sampling, may be required. Bowser-Morner, Inc. can provide this service and would be pleased to provide a cost proposal to perform such a study, if requested.

This report has been prepared for the exclusive use of City of Vandalia for specific application to the public works facility in Vandalia, Ohio (see Figure 1 in Section III of this report). Specific design and construction recommendations have been provided in the various sections of the report. The report shall therefore, be used in its entirety. This report is not a bidding document and shall not be used for that purpose. Anyone reviewing this report must interpret and draw their own conclusions regarding specific construction techniques and methods chosen. Bowser-Morner, Inc. is not responsible for the independent conclusions, opinions or recommendations made by others based on the field exploration and laboratory test data presented in this report.

Section II

Specifications

CLEARING AND GRADING SPECIFICATIONS

I. GENERAL CONDITIONS

The contractor shall furnish all labor, materials, and equipment, and perform all work and services necessary to complete in a satisfactory manner the site preparation, excavation, filling, compaction and grading as shown on the plans and as described therein.

This work shall consist of all clearing and grading, removal of existing structures unless otherwise stated, preparation of the land to be filled, filling of the land, spreading and compaction of the fill, and all subsidiary work necessary to complete the grading of the cut and fill areas to conform with the lines, grades, slopes, and specifications.

This work is to be accomplished under the constant and continuous supervision of the Owner or his designated representative.

In these specifications the terms "approved" and "as directed" shall refer to directions to the Contractor from the Owner or his designated representative.

II. SUBSURFACE CONDITIONS

Prior to bidding the work, the Contractor shall examine, investigate and inspect the construction site as to the nature and location of the work, and the general and local conditions at the construction site, including, without limitation, the character of surface or subsurface conditions and obstacles to be encountered on and around the construction site; and shall make such additional investigation as he may deem necessary for the planning and proper execution of the work. Borings and/or soil investigations shall have been made. Results of these borings and studies will be made available by the Owner to the Contractor upon his request, but the Owner is not responsible for any interpretations or conclusions with respect thereto made by the Contractor on the basis of such information, and the Owner further has no responsibility for the accuracy of the borings and the soil investigations.

If conditions other than those indicated are discovered by the Contractor, the Owner should be notified immediately. The material which the Contractor believes to be a changed condition should not be disturbed so that the Owner can investigate the condition.

III. SITE PREPARATION

Within the specified areas, all trees, brush, stumps, logs, tree roots, and structures scheduled for demolition shall be removed and disposed of.

All cut and fill areas shall be properly stripped. Topsoil will be removed to its full depth and stockpiled for use in finish grading. Any rubbish, organic and other objectionable soils, and other deleterious material, shall be disposed of off the site, or as directed by the Owner or his designated representative if on site disposal is provided. In no case shall such objectionable material be allowed in or under the fill unless specifically authorized in writing.

Prior to the addition of fill, the original ground shall be compacted to job specifications as outlined below. Special notice shall be given to the proposed fill area at this time. If wet spots, spongy conditions, or ground water seepage is found, corrective measures must be taken before the placement of fill.

IV. FORMATION OF FILL AREAS

Fills shall be formed of satisfactory materials placed in successive horizontal layers of not more than eight (8) inches in loose depth for the full width of the cross section. The depth of lift may be increased if the Contractor can demonstrate the ability to compact a larger lift. If compaction is accomplished using hand-tamping equipment, lifts will be limited to 4-inch lose lifts.

All material entering the fill shall be free of organic matter such as leaves, grass, roots, and other objectionable material.

The operations on earth work shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing weather, or other unsatisfactory conditions. The Contractor shall keep the work areas graded to provide the drainage at all times.

The fill material shall be of the proper moisture content before compaction efforts are started. Wetting or drying of the material and manipulation to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. The moisture content of the fill material should be no more than two (2) percentage points higher or lower than optimum unless otherwise authorized. Sprinkling shall be done with equipment that will satisfactorily distribute the water over the disced area.

Compaction operations shall be continued until the fill is compacted to not less than 90% above foundation elevation and 95% below foundation elevation, of the maximum density as determined in accordance with the latest ASTM D-1557 (Modified). Any areas inaccessible to a roller shall be consolidated and compacted by mechanical tampers. The equipment shall be operated in such a manner that hardpan, cemented gravel, clay or other chunky soil material will be broken up into small particles and become incorporated with the other material in the layer.

In the construction of filled areas, starting layers shall be placed in the deepest portion of the fill, and as placement progresses, additional layers shall be constructed in horizontal planes. If directed, original slopes shall be continuously, vertically benched to provide horizontal fill planes. The size of the benches shall be formed so that the base of the bench is horizontal and the back of the bench is vertical. As many benches as are necessary to bring the site to final grade shall be constructed. Filling operations shall begin on the lowest bench, with the fill being placed in horizontal eight (8) inch loose lifts unless otherwise authorized. The filling shall progress in this manner until the entire first bench has been filled, before any fill is placed on the succeeding benches. Proper

drainage shall be maintained at all times during benching and filling of the benches, to insure that all water is drained away from the fill area.

When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portion of the areas. Stones or fragmentary rock larger than four (4) inches in their greatest dimensions will not be allowed in the fill unless specifically authorized in writing. Rock fill shall be brought up in layers as specified or as directed, and every effort shall be exerted to fill the voids with the finer material to form a dense, compact mass. Rock or boulders shall be disposed of as deleterious material per Item III.

Frozen material shall not be placed in the fill nor shall the fill be placed upon frozen material.

The Contractor shall be responsible for the stability of all fills made under the contract, and shall replace any portion, which in the opinion of the Owner or his designated representative, has become displaced due to carelessness or negligence on the part of the Contractor. Fill damaged by inclement weather shall be repaired at the Contractor's expense.

V. SLOPE RATIO AND STORM WATER RUN-OFF

Slopes shall not be greater than 2 (horizontal) to 1 (vertical) in both cut and fill, and storm water shall not be drained over the slopes.

VI. GRADING

The Contractor shall furnish, operate, and maintain such equipment as is necessary to construct uniform layers, and control smoothness of grade for maximum compaction and drainage.

VII. COMPACTING

The compaction equipment shall be approved equipment of such design, weight, and quantity to obtain the required density in accordance with these specifications.

VIII. TESTING AND INSPECTION SERVICES

Testing and inspection services will be provided by the Owner.

IX. SPECIAL CONDITIONS

Section III

Boring Log Terminology, Boring Logs, Laboratory Data, And Prints

BORING LOG TERMINOLOGY

Stratum Depth:

Distance in feet and/or inches below ground surface.

Stratum Elevation:

Elevation in feet below ground surface elevation.

Description of Materials:

Major types of soil material existing at boring location. Soil classification based on one of the following systems: Unified Soil Classification System., Ohio State Highway Classification System, Highway Research Board Classification System, Federal Aviation Authority Classification System, Visual Classification.

Sample No.:

Sample numbers are designated consecutively, increasing with depth for each boring.

Sample Type:

"A" Split spoon, 2" O.D., 1-3/8" I.D., 18" in length.

"B" Rock Core

"C" Shelby Tube 3" O.D. except where noted

"D" Soil Probe

"E" Auger Cuttings

"F" Sonic

Sample Depth:

Depth below top of ground at which appropriate sample was taken.

Blows per 6" on Sampler:

The number of blows required to drive a 2" O.D., 1-3/8" I.D., split spoon sampler, using a 140 pound hammer with a 30-inch free fall, is recorded for 6" drive increments. (Example: 3/8/9).

"N" Blows/Ft.:

Standard penetration resistance. This value is based on the total number of blows required for the last 12" of penetration. (Example: 3/8/9: N = 8 + 9 = 17)

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Water Observations:

Depth of water recorded in test boring is measured from top of ground to top of water level. Initial depth indicates water level during boring, completion depth indicates water level immediately after boring, and depth after "X" number hours indicates water level after letting water rise or fall over a time period. Water observations in pervious soil are considered reliable ground water levels for that date. Water observations in impervious soils can not be considered accurate ground water measurements for that date unless records are made over several days' time. Factors such as weather, soil porosity, etc., will cause the ground water level to fluctuate for both pervious and impervious soils.

SOIL DESCRIPTION

Color:

When the color of the soil is uniform throughout, the color recorded will be such as brown, gray, or black and may be modified by adjectives such as light and dark. If the soil's predominant color is shaded by a secondary color, the secondary color precedes the primary color, such as: gray-brown, yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled, such as: mottled brown and gray.

Particle Size	Visual
Boulders	Larger than 8"
Cobbles	8" to 3"
Gravel – Coarse	3" to 3/4"
– Fine	2 mm. To 3/4"
Sand – Coarse	2 mm. – 0.6 mm. (Pencil lead size)
– Medium	0.6 mm. – 0.2mm. Table sugar and salt size)
– Fine	0.2 mm. – 0.06 mm. (Powdered sugar and human hair size)
Silt	0.06 mm. – 0.002 mm.
Clay	0.002 and smaller (Particle size of both Silt and Clay not visible To naked eye

Soil Components

Major Component:	Minor Component Term
Gravel	Trace 1-10%
Sand	Some 11-35%
Silt	And 36-50%
Clay	

Moisture Content

Term	Relative Moisture
Dry	Powdery
Damp	Moisture content below plastic limit
Moist	Moisture content above plastic limit but below liquid limit
Wet	Moisture content Above liquid limit

Condition of Soil Relative to Compactness Granular Material

Very Loose	5 blows/ft. or less
Loose	6 to 10 blows/ft.
Medium Dense	11 to 30 blows/ft.
Dense	30 to 50 blows/ft.
Very Dense	51 blows/ft. or more

Condition of Soil Relative to Consistency Cohesive Material

Very Soft	3 blows/ft. or less
Soft	4 to 5 blows/ft.
Medium Stiff	6 to 10 blows/ft.
Stiff	11 to 15 blows/ft.
Very stiff	16 to 30 blows/ft.
Hard	31 blows/ft. or more

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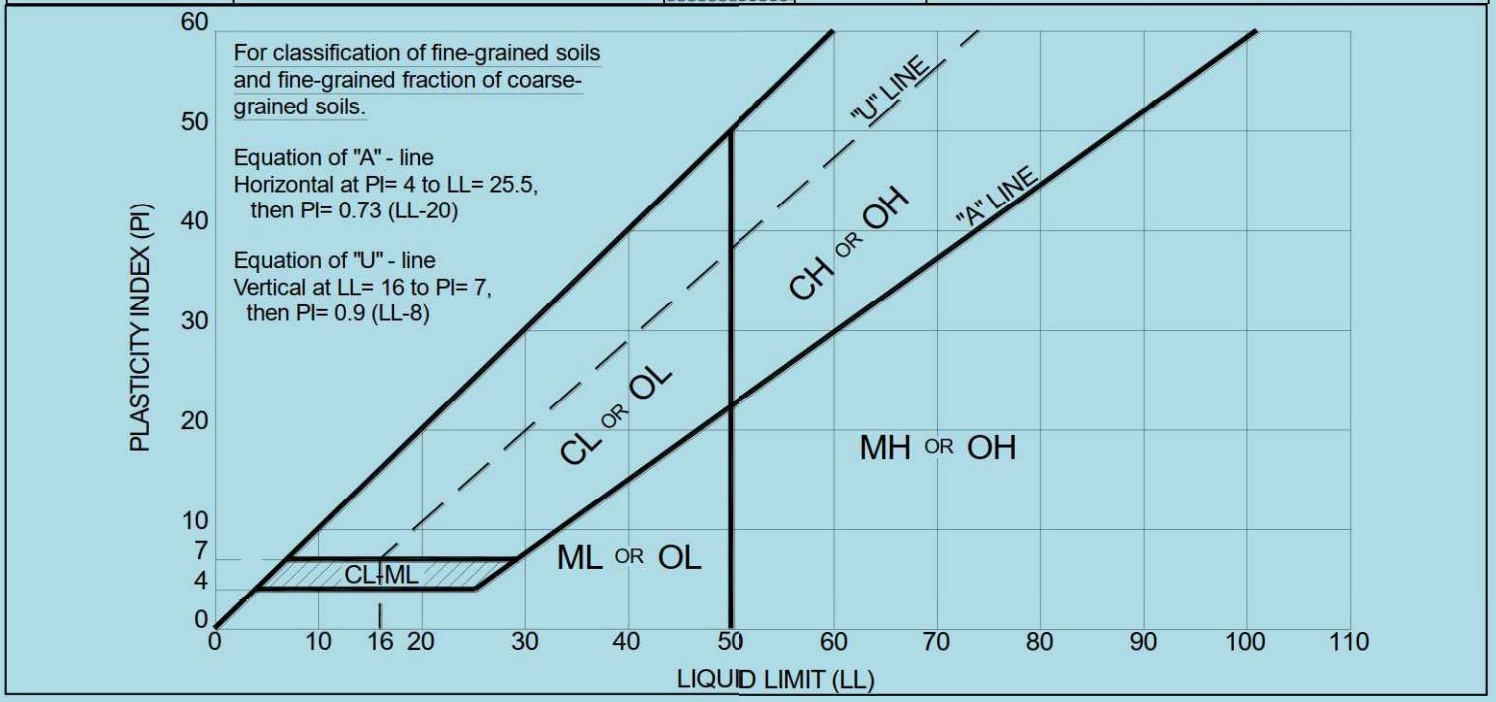
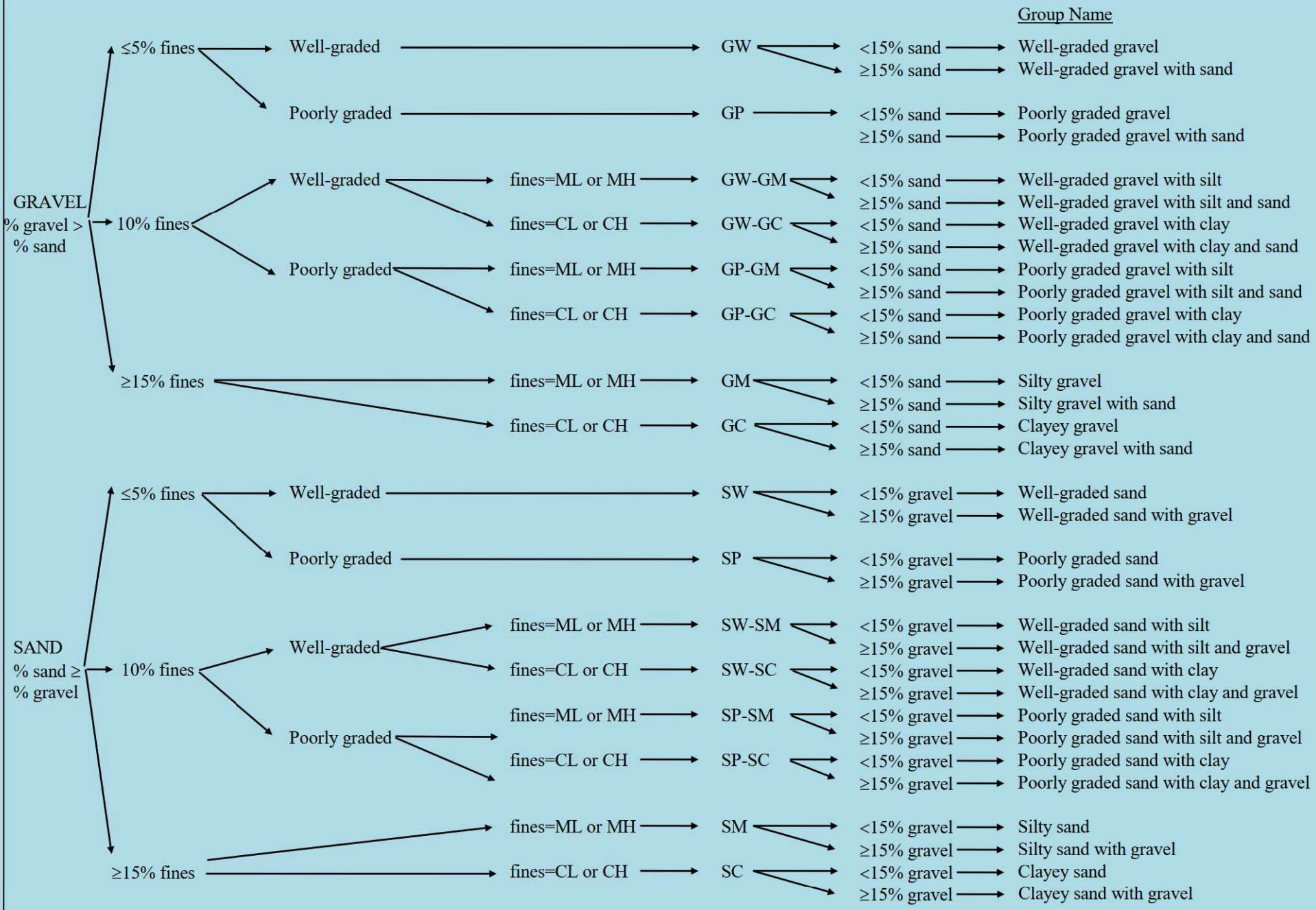
UNIFIED CLASSIFICATION SYSTEM

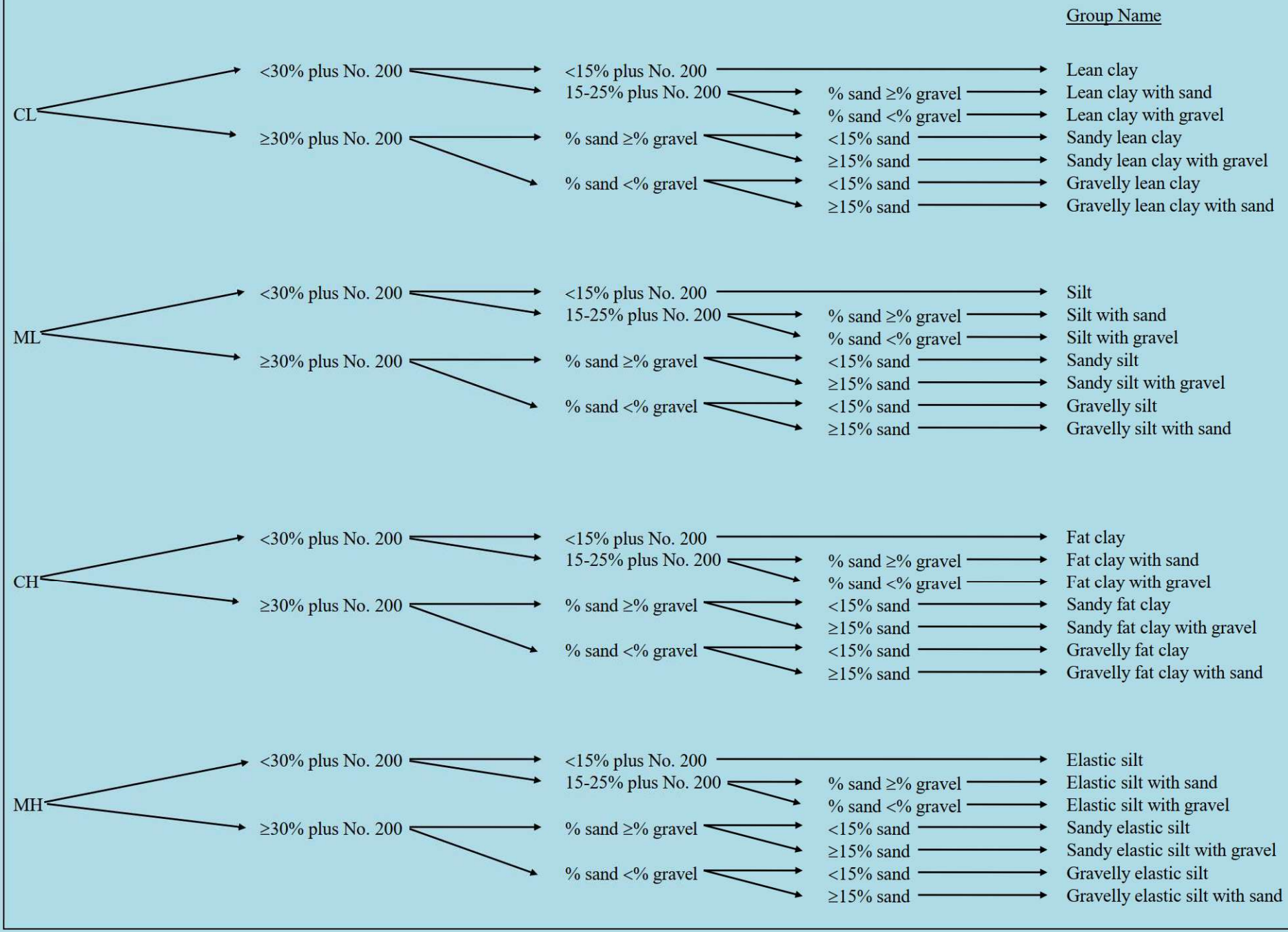
MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVEL WELL-GRADED GRAVEL WITH SAND
				GP	POORLY GRADED GRAVEL POORLY GRADED GRAVEL WITH SAND
		GRAVELS WITH FINES APPRECIABLE AMT. OF FINES)		GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
				GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SAND WELL-GRADED SAND WITH GRAVEL
				SP	POORLY GRADED SAND POORLY GRADED SAND WITH GRAVEL
		SANDS WITH FINES (APPRECIABLE AMT. OF FINES)		SM	SILTY SAND SILTY SAND WITH GRAVEL
				SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILT AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	SILT, SILT WITH SAND, SANDY SILT GRAVELLY SILT, GRAVELLY SILT WITH SAND
				CL	LEAN CLAY WITH SAND, SANDY LEAN CLAY GRAVELLY LEAN CLAY WITH SAND
				OL	ORGANIC CLAY, SANDY ORGANIC CLAY ORGANIC SILT, SANDY ORGANIC SILT WITH GRAVEL
	SILT AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	ELASTIC SILT WITH SAND, SANDY ELASTIC SILT GRAVELLY ELASTIC SILT WITH SAND
				CH	FAT CLAY WITH SAND, SANDY FAT CLAY GRAVELLY FAT CLAY WITH SAND
				OH	ORGANIC CLAY WITH SAND, SANDY ORGANIC CLAY, ORGANIC SILT, SANDY ORGANIC SILT
	HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS



Flow Chart for Visually Identifying Soils Based on ASTM D-2488



Flow Chart for Visually Identifying Soils Based on ASTM D-2488



STANDARD PENETRATION RESISTANCE (ASTM D1586)

The purpose of this test is to determine the relative consistency of the soils in a boring, or from boring over the site. This method consists of making a hole in the ground and driving a 2-inch O.D. split spoon sampler into the soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven 18 inches and the number of blows recorded for each 6 inches of penetration. Values of standard penetration (N) are determined in blows per foot, summarizing the flows required for the last two 6-inche increments of penetration.

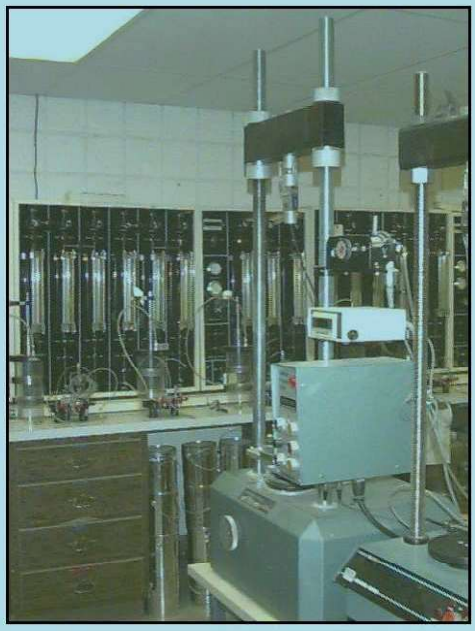
Example : 2-6-8; N = 14

THIN-WALLED SAMPLER (ASTM D1587)

The purpose of the thin-walled sampler is to recover a relatively undisturbed soil sample for laboratory tests. The sampler is a thin-walled seamless tube with a 3-inch outside diameter, which is hydraulically pressed into the ground, at a constant rate. The ends are then sealed to prevent soil moisture loss, and the tube is returned to the laboratory for tests.

BOWSER MORNER

UNCONFINED COMPRESSION OR TRIAXIAL TESTS (ASTM D 2166)



The unconfined compression test and the triaxial tests are performed to determine the shearing strength of the soil, to use in establishing its safe bearing capacity. In order to perform the unconfined compression test, it is necessary that the soil exhibit sufficient cohesion to stand in an unsupported cylinder. These tests are normally performed on samples which are 6.0 inches in height and 2.85 inches in diameter. In the triaxial test, various lateral stresses can be applied to more closely simulate the actual field conditions. There are several different types of triaxial tests. These are, however, normally performed on constant strain apparatus with a deformation rate of 0.05 inches per minute.

CONSOLIDATION TEST (ASTM D 2435)

The purpose of this test is to determine the compressibility of the soil. This test is performed on a sample of soil which is 2.5 inches in diameter and 1.0 inch in height, and has been trimmed from relatively "undisturbed" samples. The test is performed with a lever system or an air activated piston for applying load. The loads are applied in increments and allowed to remain on the sample for a period of 24 hours. The consolidation of the sample under each individual load is measured and a curve of void ratio vs. Pressure is obtained. From the information obtained in this manner and the column loads of the structure, it is possible to calculate the settlement of each individual building column. This information, together with the shearing strength of the soil, is used to determine the safe bearing capacity for a particular structure.

BOWSER MORNER

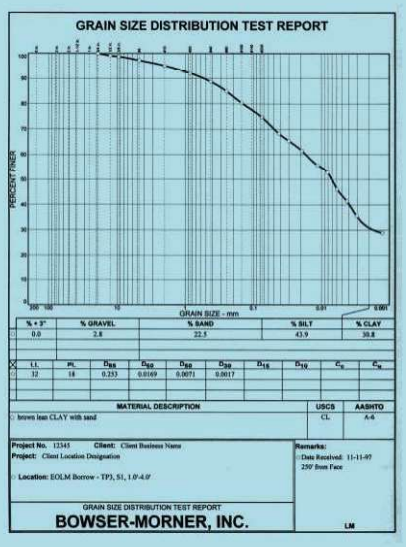
REVISED TO ASTM D4318

ATTERBERG LIMITS (ASTM D423 AND D424)

These tests determine the liquid and plastic limits of soils having a predominant percentage of fine particle (silt and clay) sizes. The liquid limit of a soil is the moisture content expressed as a percent at which the soil changes from a liquid to a plastic state, and the plastic limit is the moisture content at which the soil changes from a plastic to a semi-solid state. Their difference is defined as the plasticity index (P.I. = L.L. - P.L.), which is the change in moisture content required to change the soil from a "semi-solid" to a liquid. These tests furnish information about the soil properties which is important in determining their relative swelling potential and their classifications.

MECHANICAL ANALYSIS (ASTM D422)

This test determines the percent of each particle size of a soil. A sieve analysis is conducted on particle sizes greater than a No. 200 sieve (0.074 mm), and a hydrometer test on particles smaller than the No.200 sieve. The gradation curve is drawn through the points of cumulative percent of particle size, and plotted on semi-logarithmic paper for the combined sieve and hydrometer analysis. This test, together with the Atterberg Limits tests, is used to classify a soil.


GRAIN SIZE DISTRIBUTION TEST REPORT

PERCENT FINER

GRAIN SIZE - mm

% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	2.8	22.5	43.9	30.8

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
32	18	0.253	0.0169	0.0071	0.0017				

MATERIAL DESCRIPTION	USCS	AASHTO
brown lean CLAY with sand	CL	A-6

Project No. 12345 Client: Client Business Name
Project: Client Location Designation
Location: EOLM Borrow - TP3, S1, 1.0'-4.0'
Remarks: Date Received: 11-11-97; 250' from Face

GRAIN SIZE DISTRIBUTION TEST REPORT
BOWSER-MORNER, INC.
LM

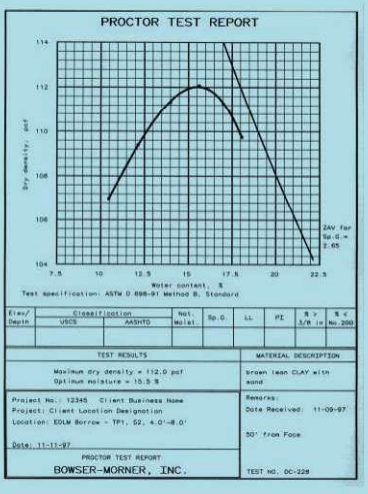
BOWSER MORNER

NATURAL MOISTURE CONTENT (ASTM D2216)

The purpose of this test is to indicate the range of moisture contents present in the soil. A wet sample is weighed, placed in the constant temperature oven at 105° for 24 hours, and re-weighed. The moisture content is the change in weight divided by the dry weight.

PROCTOR TESTS

The purpose of these tests is to determine the maximum density and optimum moisture content of a soil. The Modified Proctor test is performed in accordance with ASTM D1557. The test is performed by dropping a 10-pound hammer 25 times from an 18-inch height on each of 5 equal layers of soil in a 1/30 cubic foot mold, which represents a compaction effort of 56,250 foot pounds per cubic foot. The moisture content is then raised, and this procedure is repeated. A moisture density curve is then plotted, with the density on the ordinate axis and the moisture on the abscissa axis. The moisture content at which the maximum density requirement can be achieved with a minimum compactive effort is designated as the optimum moisture content (O.M.C.). The Standard Proctor test is performed in accordance with ASTM D698. This test is similar to the Modified Proctor test and is performed by dropping a 5.5 pound hammer 25 times from a height of 12 inches on 3 equal layers of soil in a 1/30 cubic foot mold, which represents a compaction effort of 12,375 foot pounds per cubic foot. This test gives proportionately lower results than the Modified Proctor test.


PROCTOR TEST REPORT

Dry density, pcf

Water content, %

ZAV for Sp.G.= 2.65

Test specification: ASTM D 698-91 Method B, Standard

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist	Sp.G.	LL	PI	% > 3/8 in	% < No.200

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.0 pcf Optimum moisture = 15.5 %	brown lean CLAY with sand
Project No.: 12345 Client Business Name Project: Client Location Designation Location: EDLM Borrow - TP1, S2, 4.0'-8.0' Date: 11-11-97	Remarks: Date Received: 11-09-97 50' from Face
PROCTOR TEST REPORT BOWSER-MORNER, INC.	TEST NO.: DC-228

BOWSER MORNER

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

1 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **964.0***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
0.0				TOPSOIL (5")			
1.0	SS1			Medium stiff, brown, silty lean CLAY with sand (some gravel, trace cobbles) - moist	4 5 5	10	
2.0							
3.0							
4.0	SS2			(Stiff at 3.5')	4 6 7	13	
5.0							
6.0	SS3				4 6 7	13	
7.0							
8.0				Medium dense, brown silty SAND - moist			▼
9.0	SS4				11 7 5	12	
10.0							
11.0							
12.0							
13.0				Very stiff, gray, silty lean CLAY with sand (trace cobbles) - moist			
14.0	SS5				8 11 13	24	
15.0							
16.0							
17.0							
18.0							
19.0	SS6				7 7 10	17	
20.0				Bottom of boring at 20.0 feet			
21.0							
22.0							

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	NONE	9/5/2025
AT COMPLETION	8.0	9/5/2025
OTHER	N/A	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

2 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **961.7***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
0.0				TOPSOIL (5")			
1.0	SS1			Medium stiff, brown, silty lean CLAY with sand (trace gravel, trace cobbles, trace gray) - moist	4 4 6	◇ 10	
2.0							
3.0							
4.0	SS2				4 4 5	◇ 9	
5.0							
6.0				(Very stiff at 6.0')			
7.0	SS3				5 8 11	◇ 19	
8.0				Medium dense gray SAND with gravel (trace clay) - moist			
9.0	SS4				6 9 10	◇ 19	▼
10.0							
11.0							
12.0							
13.0				(Water encountered at 13.0')			▽
14.0	SS5				7 10 13	◇ 23	
15.0							
16.0							
17.0							
18.0				Very stiff, gray, silty lean CLAY with sand (some gravel, some cobbles) - wet			
19.0	SS6				7 10 11	◇ 21	
20.0				Bottom of boring at 20.0 feet			
21.0							
22.0							

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	13.0 ▽	9/5/2025
AT COMPLETION	9.5 ▼	9/5/2025
OTHER	N/A ▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

3 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **958.3***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
0.0				TOPSOIL (5")			
1.0	SS1			Medium stiff, dark brown, silty lean CLAY with sand (trace organics) - moist	4 5 5	◇ 10	
3.0	SS2			Medium stiff, brown, silty lean CLAY with sand (trace cobbles) - moist	3 3 4	◇ 7	
6.0	SS3			Loose, brown silty SAND with gravel (trace clay) - moist	3 3 3	◇ 6	▼
8.0	SS4			Stiff, brown, silty lean CLAY with sand (trace cobbles) - moist	4 6 8	◇ 14	
13.0				(Trace water encountered at 13.0')			▽
13.5	SS5			(Medium stiff at 13.5')	3 4 6	◇ 10	
18.5	SS6			(Stiff at 18.5')	4 6 9	◇ 15	
20.0				Bottom of boring at 20.0 feet			

WATER LEVEL MEASUREMENTS

	DEPTH		DATE
INITIAL	13.0	▽	9/5/2025
AT COMPLETION	6.0	▼	9/5/2025
OTHER	N/A	▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

4 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **962.2***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft.	REMARKS
0.0				TOPSOIL (6")			
1.0	SS1			Soft, brown, silty lean CLAY with sand (some gravel, some cobbles) - moist	3 2 3	◇5	
4.0	SS2			(Very stiff at 3.5')	4 8 9	◇17	
6.0	SS3			(Stiff at 6.0')	4 6 5	◇11	
8.0				(Becomes gray. Water encountered at 8.0')			▽
9.0	SS4			(Hard at 8.5')	8 14 17	◇31	
14.0	SS5			(Very stiff at 13.5')	7 8 9	◇17	
19.0	SS6				5 9 11	◇20	
20.0				Bottom of boring at 20.0 feet			

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	8.0 ▽	9/5/2025
AT COMPLETION	NONE ▼	9/5/2025
OTHER	N/A ▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/8/25** | BORING COMPLETED **9/8/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

5 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **961.3***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

VISUAL CLASSIFICATION OF THE MATERIAL

DEPTH (ft. BGL)	SAMPLE NO.	BLOW COUNTS	N VALUE, blows/ft.	REMARKS
0.0				
			TOPSOIL (4")	
1.0			Medium stiff, brown, silty lean CLAY with sand (trace sand, trace gravel, some cobbles) - moist	
2.0	SS1	3 3 3	6	
3.0				
4.0			(Stiff at 3.5')	
5.0	SS2	5 5 6	11	
6.0			(Medium stiff at 6.0')	
7.0	SS3	3 4 5	9	
8.0				
9.0			(Hard at 8.5')	
10.0	SS4	4 14 21	35	
11.0				
12.0				
13.0			(Becomes gray at 13.0')	▼
14.0			(Very stiff at 13.5')	
15.0	SS5	7 9 12	21	
16.0				
17.0				
18.0			(Water encountered at 18.0')	▼
19.0	SS6	7 12 12	24	
20.0			Bottom of boring at 20.0 feet	
21.0				
22.0				

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	18.0 ▽	9/8/2025
AT COMPLETION	13.0 ▼	9/8/2025
OTHER	N/A ▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/8/25** | BORING COMPLETED **9/8/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

6 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **957.0***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

N VALUE, blows/ft.
10 20 30 40 50 60 70 80 90

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE	REMARKS
0.0				TOPSOIL (4")			
1.0	SS1			Medium stiff, brown, silty lean CLAY (trace sand, trace gravel, some cobbles) - moist	5 4 4	8	
2.0							
3.0							
4.0	SS2			(Stiff at 3.5')	3 5 10	15	
5.0							
6.0	SS3			(Very stiff at 6.0')	8 10 8	18	
7.0							
8.0				Medium dense brown SAND with gravel (trace cobbles) - wet			▽
9.0	SS4				3 3 8	11	
10.0							▼
11.0							
12.0							
13.0				Very stiff, gray, silty lean CLAY (trace cobbles) - moist			
14.0	SS5				5 8 13	21	
15.0							
16.0							
17.0							
18.0							
19.0	SS6				12 13 11	24	
20.0				Bottom of boring at 20.0 feet			
21.0							
22.0							

WATER LEVEL MEASUREMENTS

	DEPTH		DATE
INITIAL	8.0	▽	9/8/2025
AT COMPLETION	10.5	▼	9/8/2025
OTHER	N/A	▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/8/25** | BORING COMPLETED **9/8/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

7 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **960.2***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
0.0				TOPSOIL (4")			
1.0	SS1			Stiff, brown, silty lean CLAY (trace sand, trace gravel, some cobbles) - moist	4 5 7	◇12	
4.0	SS2			(Very stiff at 3.5')	8 8 10	◇18	
6.0	SS3			(Stiff at 6.0')	4 5 7	◇12	
9.0	SS4			(Very stiff at 8.5')	7 9 13	◇22	
13.0							▽
13.0	SS5			Very stiff gray SILT (trace sand) - wet	4 8 9	◇17	
18.0	SS6			Very stiff, gray, silty lean CLAY (trace cobbles) - moist	12 13 16	◇29	
20.0				Bottom of boring at 20.0 feet			

WATER LEVEL MEASUREMENTS

	DEPTH		DATE
INITIAL	13.0	▽	9/8/2025
AT COMPLETION	NONE	▼	9/8/2025
OTHER	N/A	▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

8 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **956.2***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

N VALUE, blows/ft.

DEPTH (ft. BGL)	SAMPLE NO.	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE
0.0		TOPSOIL (4")		
1.0	SS1	Soft, brown, silty lean CLAY with sand (trace gravel, some cobbles, trace gray) - moist	3 2 3	5
3.0		(Very stiff at 3.5')		
4.0	SS2		5 7 9	16
6.0	SS3		6 10 13	23
8.0		Medium dense, brown silty SAND with gravel (trace cobbles) - wet		
9.0	SS4		8 9 15	24
13.0		Very stiff, gray, silty lean CLAY with sand (trace cobbles) - wet		
14.0	SS5		3 9 11	20
18.0	SS6	Hard gray DOLOMITE - wet (Auger refusal at 18.5')	50/0"	50
18.5		Bottom of boring at 18.5 feet		

REMARKS

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	8.0	9/5/2025
AT COMPLETION	NONE	9/5/2025
OTHER	N/A	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

9 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **958.6***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

VISUAL CLASSIFICATION OF THE MATERIAL

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

N VALUE, blows/ft.

DEPTH (ft. BGL)	SAMPLE NO.	BLOW COUNTS	N VALUE
		TOPSOIL (6")	
1.0	SS1	Medium stiff, brown, silty lean CLAY with sand (trace gravel, some cobbles, trace gray) - moist	3 4 4 → 8
3.0			
4.0	SS2	(Very stiff at 3.5')	12 9 9 → 18
6.0	SS3	(Stiff at 6.0')	6 6 8 → 14
8.0			
9.0	SS4		4 6 9 → 15
11.0			
12.0			
13.0		(Becomes gray at 13.0')	
14.0	SS5	(Soft at 13.5')	2 2 3 → 5
16.0			
17.0			
18.0		(Becomes brown at 18.0')	
19.0	SS6	(Very stiff at 18.5')	8 11 14 → 25
21.0			
22.0			
23.0	SS7	Hard gray DOLOMITE - wet	50/2" → 50
24.0		(Auger refusal at 23.7')	
25.0		Bottom of boring at 23.7 feet	

REMARKS

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	23.0	9/5/2025
AT COMPLETION	15.0	9/5/2025
OTHER	N/A	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

10 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **958.9***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
0.0				TOPSOIL (5")			
1.0	SS1			Medium stiff, brown, silty lean CLAY with sand (trace gravel, trace cobbles, trace gray) - moist	3 4 4	◇8	
3.0				(Becomes more silty at approx. 3.0')			
4.0	SS2				3 4 5	◇9	
6.0				(Very stiff at 6.0')			
7.0	SS3				4 8 11	◇19	
9.0	SS4				6 11 16	◇27	
13.0				(Water encountered at 13.0')			▽
14.0	SS5				5 7 10	◇17	
18.0				Gray weathered DOLOMITE - wet			
19.0	SS6				7 8 45	◇53	
20.0				Bottom of boring at 20.0 feet			

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	13.0 ▽	9/5/2025
AT COMPLETION	NONE ▼	9/5/2025
OTHER	N/A ▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

11 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **955.7***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

N VALUE, blows/ft.
10 20 30 40 50 60 70 80 90

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE	REMARKS
0.0				TOPSOIL (5.5")			
1.0	SS1			Medium stiff, brown, silty lean CLAY with sand (trace gravel, trace cobble, trace gray) - moist	2 3 4	7	
4.0	SS2			(Stiff at 3.5')	3 3 9	12	
6.0	SS3			(Very stiff at 6.0')	8 10 12	22	
8.0				(Becomes gray. Water encountered at 8.0')			▽
9.0	SS4				7 14 16	30	
14.0	SS5				8 11 15	26	
18.0	SS6			Hard gray DOLOMITE - wet	50/3"	50	
19.0				(Auger refusal at 18.8') Bottom of boring at 18.8 feet			

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	8.0 ▽	9/5/2025
AT COMPLETION	NONE ▼	9/5/2025
OTHER	N/A ▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/5/25** | BORING COMPLETED **9/5/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

12 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **955.3***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

DEPTH (ft. BGL)	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
0.0				TOPSOIL (5")			
1.0 – 3.0	SS1			Medium stiff, dark brown, silty lean CLAY (trace sand, trace organics) - moist	2, 3, 5	◇ 8	
3.0 – 5.0	SS2			Stiff, brown, silty lean CLAY with sand (trace gravel, trace cobbles, trace limestone) - moist	3, 6, 8	◇ 14	
6.0 – 7.0	SS3			(Very stiff at 6.0')	4, 6, 10	◇ 16	
8.0 – 9.0	SS4			(Medium stiff at 8.5')	3, 4, 6	◇ 10	
11.0							▼
13.0 – 15.0	SS5			(Very stiff at 13.5')	6, 8, 10	◇ 18	
18.0	SS6			Hard gray DOLOMITE - moist	50/2"	◇ 50	
18.7				(Auger refusal at 18.7') Bottom of boring at 18.7 feet			

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	NONE	9/5/2025
AT COMPLETION	11.0	9/5/2025
OTHER	N/A	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/8/25** | BORING COMPLETED **9/8/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

13 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **957.5***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

VISUAL CLASSIFICATION OF THE MATERIAL

DEPTH (ft. BGL)	SAMPLE NO.	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)
0.0			TOPSOIL (3")
1.0	SS1	3 3 4	7
2.0			Medium stiff, brown, silty lean CLAY with sand (tracee gravel, trace cobbles) - moist
3.0			
4.0	SS2	4 6 8	14
5.0			(Stiff at 3.5')
6.0	SS3	4 6 7	13
7.0			
8.0			
9.0	SS4	3 6 10	16
10.0			(Very stiff at 8.5')
11.0			
12.0			
13.0			(Sand seam encountered at approx. 13.0')
14.0	SS5	5 7 13	20
15.0			(Trace water encountered at 14.8')
16.0			
17.0			
18.0			
19.0	SS6	5 8 13	21
20.0			Bottom of boring at 20.0 feet
21.0			
22.0			

REMARKS

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	14.8	9/8/2025
AT COMPLETION	NONE	9/8/2025
OTHER	N/A	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

CLIENT
City of Vandalia

PROJECT
Soil Study for Proposed Public Works Facility, Vandalia, Ohio

JOB NO.
20005485

BORING STARTED **9/8/25** | BORING COMPLETED **9/8/25**

DRILLER **Central Star** | METHOD **2 1/4" HSA**

TYPED BY **dmo**

14 Boring No.

Sheet 1 of 1

PROJECT LOCATION
LAT. **39°54'00.5"N** LONG. **84°10'51.5"W**

SURFACE ELEVATION **946.6***

BORING LOCATION
As shown on Boring Location Plan.

It has been necessary to interpolate between samples. Therefore, the contacts between the various soil strata should not be taken as absolute.

COMMENTS
***Surface elevation based on Ohio South State Plane Coordinate System.**

N VALUE, blows/ft.

DEPTH (ft. BGL)	SAMPLE NO.	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE	REMARKS
0.0		TOPSOIL (5")			
1.0	SS1	Soft, dark brown, silty lean CLAY (some organics) - moist	2 1 3	4	
3.0	SS2	Soft, brown, silty lean CLAY (trace sand, some gravel, trace cobbles) - moist	3 2 2	4	
6.0	SS3	(Stiff at 6.0')	3 5 8	13	
8.0		(Cobbles encountered from approx. 8.0')			
8.5	SS4	(Hard at 8.5')	8 42 11	53	▼
13.0	SS5	Hard gray DOLOMITE - wet	50/2"	50	▽
13.7		(Auger refusal at 13.7') Bottom of boring at 13.7 feet			

WATER LEVEL MEASUREMENTS

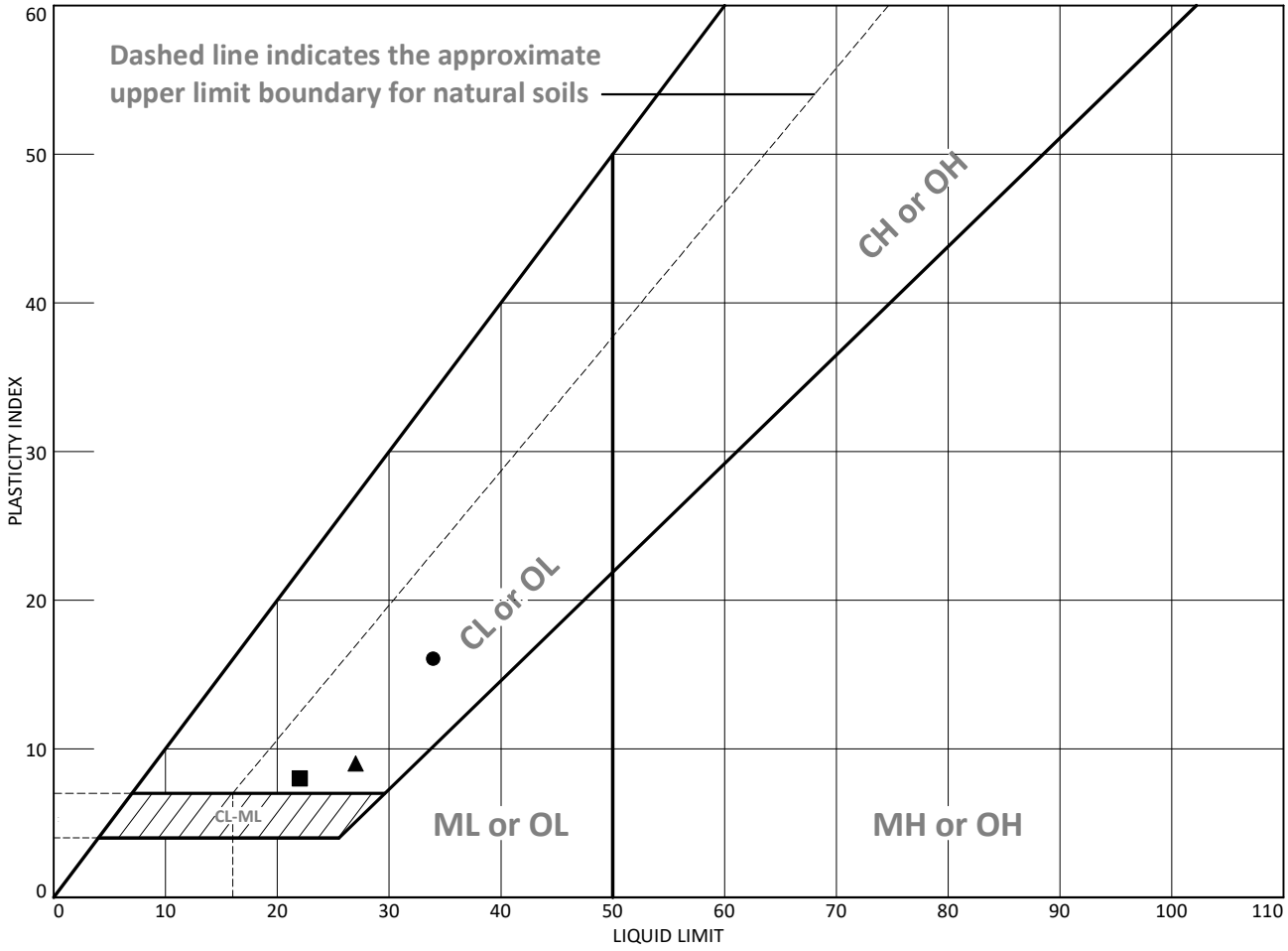
	DEPTH		DATE
INITIAL	13.0	▽	9/8/2025
AT COMPLETION	9.0	▼	9/8/2025
OTHER	N/A	▼	N/A

SS — SPLIT SPOON
SL — SPLIT SPOON W/SOIL LINER
NQ— ROCK CORE
ST — SHELBY TUBE
AS — AUGER CUTTINGS
SC — SONIC

BOWSER MORNER

GINT Report Used: NEWLOGIN Report No.: 20005485.GPJ GINT Template Used: OH DOT.GDT Date Printed: 9/17/25

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	brown silty, sandy clay (visual)	34	18	16			
■	light brown silty clay (visual)	22	14	8			
▲	brown silty clay (visual)	27	18	9			

Project No. 20005485 **Client:** City of Vandalia

Project: Proposed Public Works Facility

●**Location:** B-3 **Depth:** 3.5'-5.0' **Sample Number:** SS-2

■**Location:** B-5 **Depth:** 6.0'-7.5' **Sample Number:** SS-3

▲**Location:** B-14 **Depth:** 3.5'-5.0' **Sample Number:** SS-2

BOWSER-MORNER, INC.

Dayton, Ohio

Remarks:

●As Received Moisture Content: 21.0%

■As Received Moisture Content: 14.3%

▲As Received Moisture Content: 18.8%

Tested By: ○ KA □CC △CC **Checked By:** MR

Moisture Content of Soil

ASTM (D-2216)

BOWSER MORNER

Client: City of Vandalia
Project: Proposed Public Works Facility

Work Order No.: 20005485
Date: 10/08/25

Boring Number	Sample Number	Depth, (ft)	Depth, (m)	Moisture Content, (%)
B-1	SS 1	1.0 - 2.5	0.3 - 0.8	19.6
	SS 2	3.5 - 5.0	1.1 - 1.5	12.8
	SS 3	6.0 - 7.5	1.8 - 2.3	11.2
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-2	SS 1	1.0 - 2.5	0.3 - 0.8	19.8
	SS 2	3.5 - 5.0	1.1 - 1.5	21.5
	SS 3	6.0 - 7.5	1.8 - 2.3	10.4
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-3	SS 1	1.0 - 2.5	0.3 - 0.8	25.0
	SS 2	3.5 - 5.0	1.1 - 1.5	21.0
	SS 3	6.0 - 7.5	1.8 - 2.3	18.6
	SS 4	8.5 - 10.0	2.6 - 3.0	11.1
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-4	SS 1	1.0 - 2.5	0.3 - 0.8	20.3
	SS 2	3.5 - 5.0	1.1 - 1.5	11.9
	SS 3	6.0 - 7.5	1.8 - 2.3	12.7
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-5	SS 1	1.0 - 2.5	0.3 - 0.8	23.2
	SS 2	3.5 - 5.0	1.1 - 1.5	12.9
	SS 3	6.0 - 7.5	1.8 - 2.3	14.3
	SS 4	8.5 - 10.0	2.6 - 3.0	9.9
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-6	SS 1	1.0 - 2.5	0.3 - 0.8	24.5
	SS 2	3.5 - 5.0	1.1 - 1.5	15.4
	SS 3	6.0 - 7.5	1.8 - 2.3	11.8
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested

Moisture Content of Soil

ASTM (D-2216)

BOWSER MORNER

Client: City of Vandalia
Project: Proposed Public Works Facility

Work Order No.: 20005485
Date: 10/08/25

Boring Number	Sample Number	Depth, (ft)	Depth, (m)	Moisture Content, (%)
B-7	SS 1	1.0 - 2.5	0.3 - 0.8	21.8
	SS 2	3.5 - 5.0	1.1 - 1.5	12.1
	SS 3	6.0 - 7.5	1.8 - 2.3	11.7
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-8	SS 1	1.0 - 2.5	0.3 - 0.8	20.8
	SS 2	3.5 - 5.0	1.1 - 1.5	12.1
	SS 3	6.0 - 7.5	1.8 - 2.3	10.4
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-9	SS 1	1.0 - 2.5	0.3 - 0.8	19.6
	SS 2	3.5 - 5.0	1.1 - 1.5	12.0
	SS 3	6.0 - 7.5	1.8 - 2.3	11.8
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
	SS 7	23.5 - 25.0	7.2 - 7.6	Not Tested
B-10	SS 1	1.0 - 2.5	0.3 - 0.8	17.7
	SS 2	3.5 - 5.0	1.1 - 1.5	12.1
	SS 3	6.0 - 7.5	1.8 - 2.3	10.7
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-11	SS 1	1.0 - 2.5	0.3 - 0.8	21.1
	SS 2	3.5 - 5.0	1.1 - 1.5	10.9
	SS 3	6.0 - 7.5	1.8 - 2.3	10.3
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-12	SS 1	1.0 - 2.5	0.3 - 0.8	22.9
	SS 2	3.5 - 5.0	1.1 - 1.5	13.7
	SS 3	6.0 - 7.5	1.8 - 2.3	11.0
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested

Moisture Content of Soil

ASTM (D-2216)

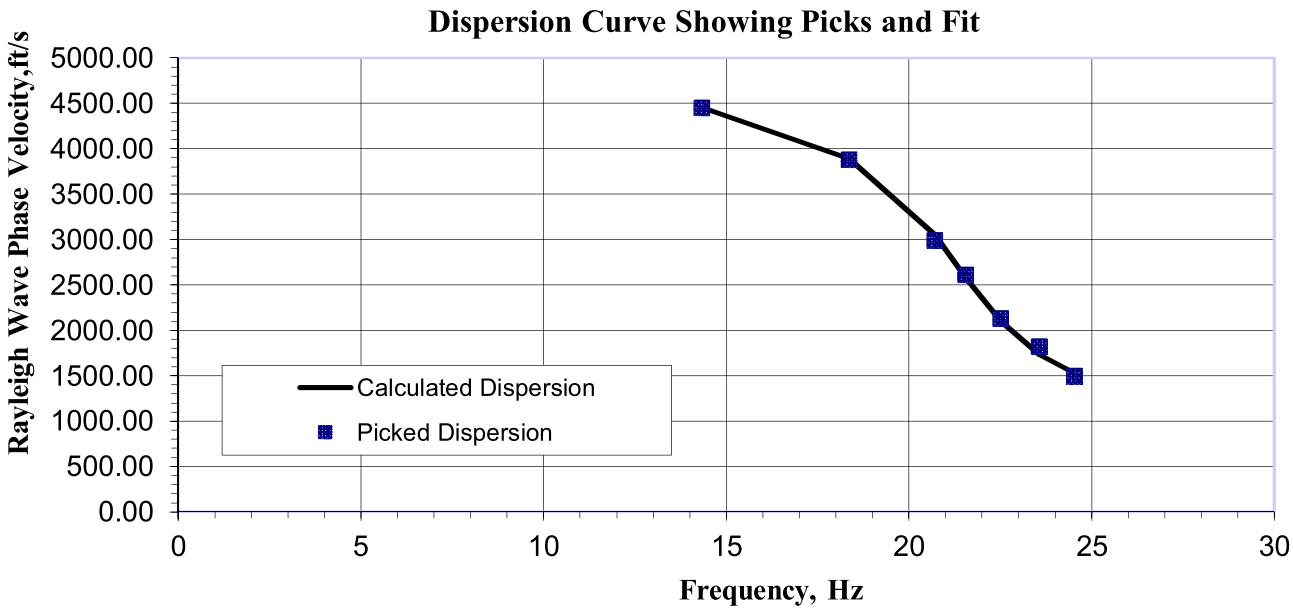
BOWSER MORNER

Client: City of Vandalia
Project: Proposed Public Works Facility

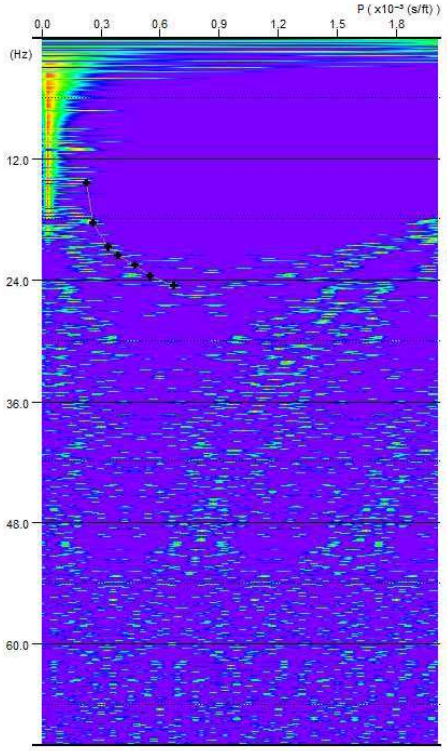
Work Order No.: 20005485
Date: 10/08/25

Boring Number	Sample Number	Depth, (ft)	Depth, (m)	Moisture Content, (%)
B-13	SS 1	1.0 - 2.5	0.3 - 0.8	25.1
	SS 2	3.5 - 5.0	1.1 - 1.5	10.5
	SS 3	6.0 - 7.5	1.8 - 2.3	14.1
	SS 4	8.5 - 10.0	2.6 - 3.0	Not Tested
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested
B-14	SS 1	1.0 - 2.5	0.3 - 0.8	28.4
	SS 2	3.5 - 5.0	1.1 - 1.5	18.8
	SS 3	6.0 - 7.5	1.8 - 2.3	18.6
	SS 4	8.5 - 10.0	2.6 - 3.0	9.4
	SS 5	13.5 - 15.0	4.1 - 4.6	Not Tested
	SS 6	18.5 - 20.0	5.6 - 6.1	Not Tested

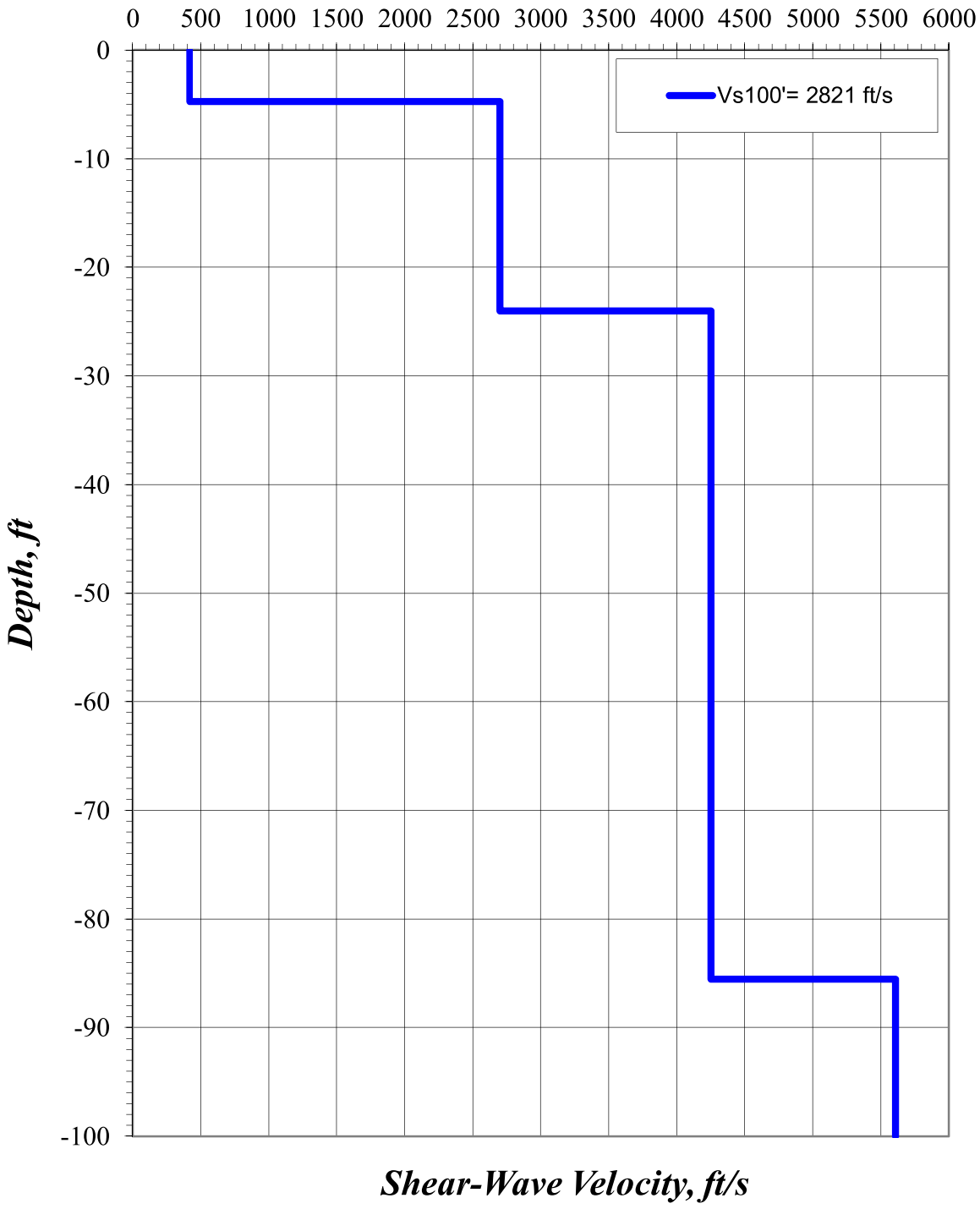
Run 1

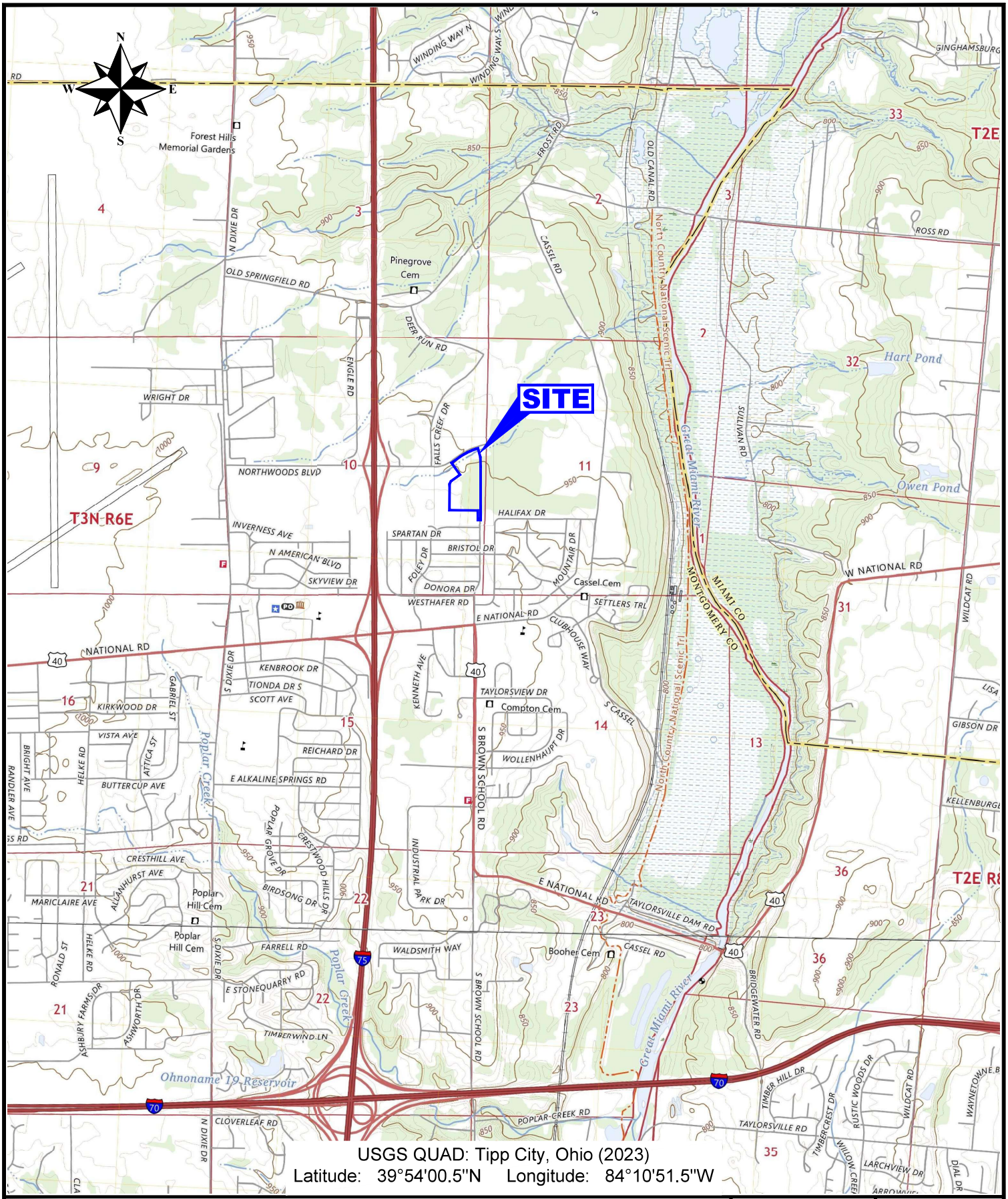


p-f Image with Dispersion Modeling Picks



Run 1: Vs Model





USGS QUAD: Tipp City, Ohio (2023)
Latitude: 39°54'00.5"N Longitude: 84°10'51.5"W

VICINITY MAP

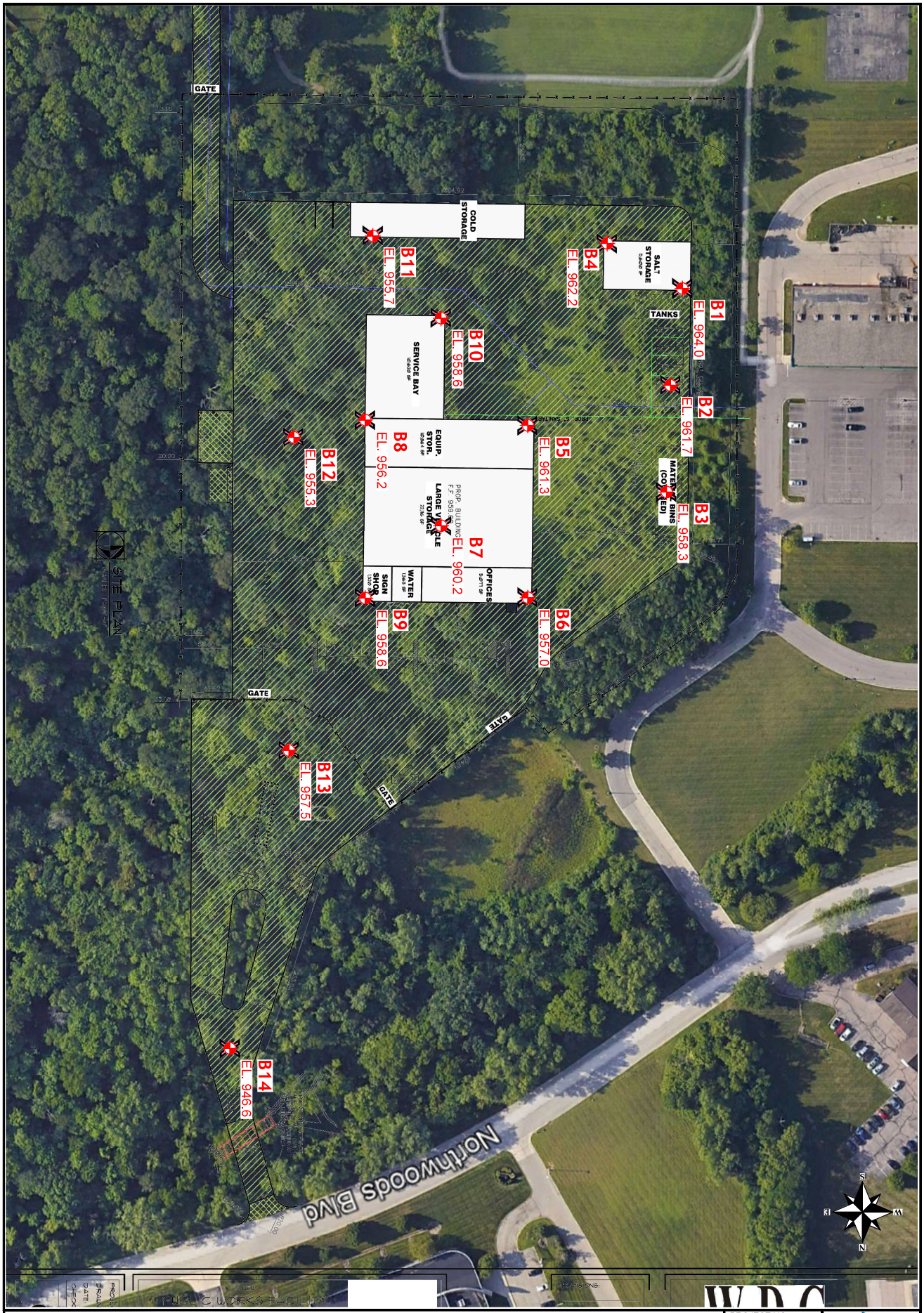
Soil Study for Proposed Public Works Facility
810 Northwoods Boulevard
Vandalia, Montgomery County, Ohio

For: City of Vandalia

09-2025 EM

PROJECT NO.	20005485
SCALE	1" = 1/2 Mile
FIGURE NO.	1

BOWSER MORNER

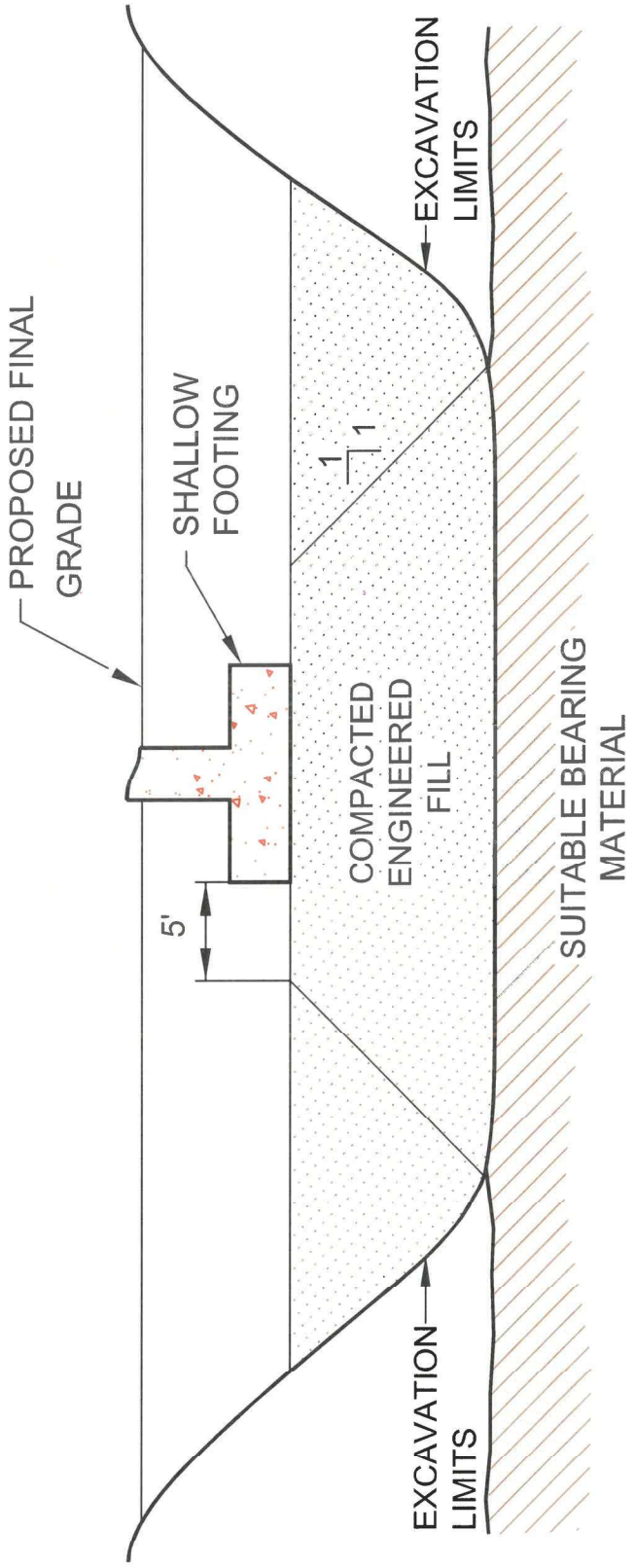


BORING LOCATION PLAN
Soil Study for Proposed Public Works Facility
810 Northwoods Boulevard
Vandalia, Montgomery County, Ohio
For: City of Vandalia

09-2025 EM

PROJECT NO.	20005485
SCALE	1" = ___
FIGURE	2

BOWSER MORNER



DESIGN ILLUSTRATION SHALLOW FOOTINGS IN AN UNDERCUT AREA

SCALE
NONE

FIGURE NO.
3

BOWSER MORNER

ENGINEERING & ENVIRONMENTAL SERVICES:

- Geotechnical Engineering
- Subsurface Exploration
- Civil Engineering
- Environmental Services
- Due Diligence
- Permitting

LABORATORY SERVICES:

- Geotechnical Laboratories
- Construction Materials Laboratories
- Mineral Aggregates
- Concrete
- Stone & Masonry
- Asphalt
- Analytical Services Laboratories
- Industrial Minerals
- Product Testing
- Mechanical/Metallurgical Testing
- Calibration Services
- Chemistry Laboratory
- Consulting Geology
- Radon Reference Laboratory

CONSTRUCTION SUPPORT SERVICES:

- General Construction
- Construction Quality Assurance
- Building Code Special Inspections
- Transportation Projects:
  - Contractor QA/QC
  - Material Supplier QA/QC
  - Owner Quality Assurance
- Materials Consulting:
  - Construction Engineering

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