Preliminary Geotechnical Investigation Report

Agricola Wind Project

Cayuga County, NY

July 17, 2024

PREPARED FOR:

liberty renewables

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PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT

Agricola Wind Project

Cayuga County, NY

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Attachments

Executive Summary

Westwood Professional Services (Westwood) is pleased to present this geotechnical investigation report to Liberty Renewables for the proposed Agricola Wind Project (Project) located in Cayuga County, New York. The scope of work for this investigation included subsurface exploration, field and laboratory testing, engineering analysis, and preparation of this report for the proposed wind project. The investigation has generally revealed no subsurface conditions that would preclude development of the proposed Project.

Based on the information obtained from standard penetration test (SPT) borings advanced up to 40 feet below ground surface (bgs), the subsurface conditions at the wind turbine and substation locations generally consist of 3 to 4 inches of topsoil overlying lean clay with varying amounts of sand and gravel and sand/gravel with varying amounts of clay that transitions into likely residual bedrock or saprolite. Underlying the residual bedrock/saprolite is a more competent shale bedrock layer, which was observed in rock cores performed at two (2) locations (B-02 and B-04) and inferred due to auger refusal at the remaining locations between depths of approximately 13 and 40 feet bgs. The shale typically decreased in weathering with depth and increased in rock continuity.

Groundwater was encountered between depths of 2 feet and 4.5 feet bgs based on piezometer measurements recorded approximately three months after installation. Groundwater level fluctuations occur due to seasonal variation in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed; therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than those observed during the investigation. Long-term depth to groundwater should be confirmed with additional piezometer measurements and piezometers installed at each turbine location during the final investigation.

The below summary of recommendations may be used for preliminary wind turbine foundation designs for the locations investigated. These recommendations assume turbines will bear on stiff clay, medium dense sand, or shale bedrock, and should be reevaluated during the final geotechnical investigation:

- Minimum depth to groundwater = 7 ft
- Foundation backfill density (moist) = 105 pounds per cubic foot (pcf)
- Gross allowable bearing capacity, normal loads = 3,800 pounds per square foot (psf)
- Gross allowable bearing capacity, extreme loads = 6,000 psf
- Differential settlement = 1.5 inches (approximately 0.17 degrees rotation)

The clayey sand and lean clay encountered below the topsoil is generally considered adequate subgrade for gravel access roads. Access roads constructed on native clay subgrade compacted to 95% of the maximum dry density may be designed using a California bearing ratio (CBR) of 4, assuming the subgrade is prepared in accordance with the recommendations in this report.

This executive summary should be read in context of the entire report for full understanding of the subsurface conditions encountered and associated recommendations. This report is considered preliminary and the recommendations within should be reevaluated after a comprehensive final geotechnical investigation.

1.0 Introduction

This report presents the findings of the preliminary geotechnical investigation conducted by Westwood Professional Services (Westwood) for the proposed Agricola Wind Project (Project or Project Site) located in Cayuga County, New York, approximately 20 miles north of Ithaca, New York (Exhibit 1). The primary purpose of this report is to provide geotechnical test data and analysis to support the preliminary design and construction of the proposed Project. This investigation focused on 5 proposed wind turbine generator (WTG) locations, the proposed substation, and one horizontal directional drill (HDD) location. The services provided were in general conformance with the scope of work and assumptions outlined in Westwood's proposal dated July, 2023. This report is intended for exclusive use by Liberty Renewables (Client) for the Agricola Wind Project.

Westwood understands that the proposed Project will consist of up to 24 wind turbine generators (WTGs) and associated access roads, electrical collection system, collector substation, and ancillary structures, such as meteorological towers, one aircraft detection lighting system tower, switchyard, and the operations and maintenance (O&M) building, that were not investigated as part of this preliminary investigation. Topography across the span of the entire proposed Project Site can be described as generally lightly to moderately undulating. The present land use is predominately agricultural fields.

2.0 Methods

A geotechnical investigation program was completed by Westwood with field work performed between July 7th and 27th, 2023. Earth Dimensions Inc.was retained by Westwood to perform geotechnical drilling with standard penetration testing (SPT). Westwood and Soil Engineering Testing (SET) performed laboratory testing on soil samples collected during the investigation. A Westwood geotechnical representative coordinated the field work, logged the borings, collected samples, and performed the electrical resistivity testing. The field investigation consisted of the following scope of work:

- Conducting soil borings at five (5) proposed WTG locations to a target depth of 60 feet below ground surface (bgs). If auger refusal was encountered beyond a depth of 35 feet bgs, the boring was terminated. If auger refusal was encountered prior to a depth of 35 feet, rock coring would be performed to a maximum depth of 35 feet bgs. It should be noted that, after communication with the client, one proposed boring (T-17) was not drilled due to the addition of an HDD boring and schedule constraints.
- Conducting one (1) soil boring at a HDD location to a target depth of 25 feet bgs or auger refusal, whichever is shallower.
- Conducting one (1) borings at the proposed substation (SUB-01) to 40 feet bgs. If auger refusal was encountered beyond a depth of 20 feet bgs, the boring would be terminated. If auger refusal was encountered prior to a depth of 20 ft, rock coring would be performed to a target depth of 20 feet bgs.
- Installing a temporary polyvinyl chloride (PVC) standpipe piezometer at each proposed turbine boring to a depth of approximately 17 feet bgs.
- Performing electrical resistivity surveys along two perpendicular profiles at four (4) proposed preliminary turbine locations to a maximum 'a' spacing of 100 feet and at one (1) location within the proposed substation location to a maximum 'a' spacing of 200 ft.

- Collecting soil and rock samples at all boring locations for laboratory testing.

Geotechnical test locations are shown on Exhibit 1 of this report. Preliminary turbine locations were provided by the Client and boring locations selected from the array based on geologic mapping, spatial coverage, site access, and property accessibility. All test locations were staked by a Westwood representative. Coordinates are provided on the boring logs.

2.1 Soil Borings

Soil borings were drilled using hollow stem augers and soil samples were obtained using an automatic hammer and split-spoon samplers in general accordance with American Society for Testing and Materials (ASTM) D1586. Rock coring was performed in general conformance with ASTM D2113 (Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration). The SPT N-values are recorded on the boring logs and a summary is provided in Appendix B. A Westwood geotechnical representative logged the borings and collected the soil/rock samples. Bulk soil samples were also collected from shallow auger cuttings at the substation and two preliminary turbine locations for laboratory testing. Rock coring was performed after auger refusal to a maximum depth of 36 feet bgs. Soil and rock samples were shipped to Westwood and SET for laboratory testing. Soil boring and rock core logs are included in Appendix A.

2.2 Laboratory Testing

Laboratory tests were conducted on representative soil and rock samples to aid in classification and evaluation of the physical properties and engineering characteristics of the material. Soil samples were sent to Westwood and SET for testing, which included the following:

- Moisture content (ASTM D2216)
- Sieve analysis (ASTM D6913 and D7928)
- Atterberg limits (ASTM D4318)
- Standard Proctor moisture-density relationship (ASTM D698)
- Unconfined compression (ASTM D2166 & ASTM D7012)
- Chemical analysis (pH, Sulfates, Chlorides)
- California bearing ratio (ASTM D1883)
- Thermal resistivity with dry-out curves (ASTM D5334)

See Appendix C for a summary of laboratory testing results and complete test reports.

Bulk samples collected for thermal resistivity tests were prepared near the as-received moisture contents and compacted to 90% of the standard Proctor maximum dry density, representing the compaction conditions typical of a backfilled utility trench, and subsequently dried out to zero moisture. Thermal resistivity measurements were taken at the compacted moisture content, zero moisture, and at several intermediate moisture contents during drying. Results of the thermal resistivity tests are discussed in Section 4.1.8 and test reports are included in Appendix C.

2.3 Electrical Resistivity Testing

Electrical resistivity measurements were recorded at four proposed preliminary turbine locations and one at the proposed substation, as shown on Exhibit 1 of this report. Tests were performed using the Wenner Four-Electrode Method and an Appliances, Electrical, and Electronics Manufacturing (AEMC)

Instruments Model 6470-B Multi-Function Digital Ground Resistance Tester, in general accordance with ASTM G57. At each test location, resistivity tests were performed along two perpendicular profiles with a minimum electrode spacings of 5, 10, 20, 30, 50, 100 and 200 feet (substation only). Refer to Section 4.1.7 and the attached Appendix D for results of the electrical resistivity tests.

3.0 Site Conditions

3.1 Regional Geology

The Project Site is located within the Appalachian Plateaus Province within the Appalachian Highlands physiographic region (USGS, 2013). The Appalachian region was formed near the equator beneath a shallow sea, where sedimentary rocks formed over time, such as limestone and shale. As Pangea assembled and the oceanic plates collided in the mid-Paleozoic era, around 480 million years ago (mya), the sedimentary rocks were uplifted into mountainous formations. Fluvial deposits (sediments deposited by a stream) eroded the mountains and were deposited into the lowlands nearby, creating the Appalachian Plateaus. Eventually, after a period of uplift approximately 65 mya, the highland topography of today was formed. In the New York state area of the Appalachian Plateaus, glaciers and their remnants have contributed to shaping the nearby Finger Lakes, which were carved out during the Pleistocene ice age approximately 2 mya.

The Geologic Map of New York maps the bedrock beneath the Project Site as one primary unit, the Genesee Group, and two minor units, Tully Limestone and the Moscow Formation:

- **Genesee Group:** comprised of five units – the West River Shale, Genundewa Limestone, Penn Yann Shale, Geneseo Shale, and North Evans Limestone – and is described as 10 to 150 feet thick. Primarily composed of shale and limestone with minor/incidental units of siltstone and black shale. Age: Upper Devonian.
- **Tully Limestone:** associated with the Genesee Group and is described as limestone. Age: Middle Devonian.
- **Moscow Formation:** sub-unit of the Hamilton Group and is described as primarily sandstone and shale. Age: Middle Devonian.

According to Web Soil Survey available through the United States Department of Agriculture (USDA, 2023), a number of soil units have been mapped within the Project boundary, as shown on Exhibit 3 of this report. The two primary soil units are:

- **Honeoye silt loam:** described as calcareous loamy glacial till derived from limestone, sandstone, and shale and classified as silt (ML)
- **Lima silt loam:** described as calcareous loamy glacial till derived from limestone, sandstone, and shale and classified as silt (ML)

The remaining minor and incidental units are primarily described as glacial till, calcareous glacial till, glaciolacustrine and glaciofluvial deposits, alluvium, and organic material with classifications of silt (ML), lean clay (CL), silty clay (CL-ML), clayey sand (SC), and peat (PT).

See Exhibit 3 of this report for mapped soil units and associated soil classifications.

3.2 Geohazards

3.2.1 Karst

Karst features generally develop in areas with wet subsurface conditions and soluble bedrock including carbonate rock (limestone and dolomite) or evaporite rock (e.g., gypsum, anhydrite, and halite minerals) that may dissolve over time to form underground caves and create ground instability. Karst geology can be particularly hazardous as caves develop slowly while failures are rapid, often causing several feet of subsidence and sinkholes at the surface. The risk to wind turbines ranges from slight tilting to catastrophic failure.

According to the United States Geological Survey (USGS) map of Karst Hazard Potential in the United States (USGS, 2014), the Project Site is mapped overlapping Tully Limestone, a noted area of karst potential in the form of carbonate rocks greater than 50 feet below the surface in a humid climate (Exhibit 4 of this report). Results of the field investigation indicate the depth to weathered shale bedrock at the investigated preliminary turbine locations ranges between approximately 13.5 feet to 39.8 feet bgs. At B-02 and B-04, where rock coring was performed, no core barrel drops (indicative of subsurface voids in the rock) were observed. In general, the potential for aggressive groundwater or karst features to develop on site is considered low due to the bedrock being classified as shale, a non-carbonate rock, although care should be taken during the final investigation to identify potential karst-prone bedrock, particularly at turbines located adjacent to the Tully Limestone formation.

3.2.2 Seismicity

In general, the state of New York is not considered a seismically active region. According to the USGS fault database (USGS, 2023a), there are no active Quaternary faults within or near the Project Site, and there is very little potential for surface fault rupture to occur. According to the USGS (2023b), eight earthquakes greater than magnitude (M) 3.0 have been recorded within 100 miles of the Project Site in the past 100 years. The largest of these events was a M4.7 earthquake that occurred approximately 95 miles west of the Project Site in 1929. The most recent of these events was a M3.6 earthquake that occurred approximately 83 miles north of the Project Site in 2023. The nearest of these events was a M3.5 earthquake that occurred approximately 52 miles southwest of the Project Site in 2001. The overall hazard from earthquakes and associated seismicity is generally considered low.

3.2.3 Expansive Soils

Expansive or swelling soils have the potential to undergo volume expansion upon wetting or drying. Swell potential depends strongly on physicochemical interactions between particles, and swelling soils predominantly occur in arid and semiarid areas where the soil contains large amounts of lightly weathered clay minerals. The majority of surficial soils on site are classified as lean clay by the USDA (2023; Exhibit 4 of this report) and are not expected to have significant expansion potential. The units are primarily mapped as having a low to moderate linear extensibility with a small, isolated region of very high linear extensibility (USDA, 2023), which is a laboratory measured soil property that describes the difference in soil volume between dry and moist state. The United States Army Corps of Engineers technical manual for foundations in expansive soils (USACE, 1983) maps the Project Site in an area of non-expansive soil to extremely limited expansion occurrence. The overall risk of expansive soil is considered low.

3.2.4 Collapsible Soils

Collapsible soils are found throughout the world in soil deposits that are eolian, subaerial, colluvial, mudflow, alluvial, residual, or manmade fills. They are defined as any unsaturated soil that undergoes a radical rearrangement of particles and greatly decreases in volume upon wetting, additional loading, or both. Collapsible soils are typically found in arid or semiarid regions with a loose soil structure, and a water content far less than saturation. Typically the structure of these low-unit weight, unconsolidated sediments consists of coarser particles bonded at their contact points by the finer silt and/or clay fraction, or possibly by surface tension in the water at the air-water interfaces. Collapse is unlikely to occur in soils which lie below the water table.

According to Web Soil Survey (USDA, 2023) and the laboratory testing performed on soil samples, most shallow soils at the Project Site have a significant clay fraction and are relatively dense. In the presence of moisture, the clay particles will act as binder and counteract soil collapse. The potential for collapsible soil is considered low for this site due to the relatively high clay content, humid climate, and relatively dense nature of the shallow soil.

3.2.5 Mining, Oil, and Gas

New York is an active mining state and ranks as the third leading state in terms of value produced (NY DEP, 2023a). The primary extracted mineral commodities come in the form of salt from Central New York and crushed stone, sand, and gravel for construction scattered throughout the state. The remaining mineral resource in the state is largely comprised of metal ores and gem minerals in the mountainous regions. According to the New York Department of Environmental Conservation (NYSDEC, 2023b), no mines or oil/gas wells are mapped within the Project Site, although three reclaimed sand and gravel mines are mapped within approximately five miles of the Project Site. The overall risk of mining or oil/gas activity to affect the Project is generally considered low. A detailed mine study was beyond the scope of this investigation.

3.3 Subsurface Stratigraphy

Based on the conditions encountered at the soil boring locations within the Agricola Wind Project Site, the general subsurface stratigraphic profile is described as follows:

Topsoil. Topsoil on site generally ranges from approximately 3 to 4 inches thick, although the rootzone typically extends deeper. The topsoil encountered was generally brown and clayey with moderate organics and active roots. Topsoil depths could be greater in some portions of the site, particularly in topographic low areas.

Overburden Soil

Lean Clay, Lean Clay w/ Sand/Gravel, Sandy Lean Clay, Gravelly Lean Clay, Gravelly Lean Clay w/ Sand, Silty Clay w/ Sand/Gravel, Gravelly Silt w/ Sand, Clayey Sand w/ Gravel, Silt with Sand/Gravel (CL, CL-ML, ML). Underlying the topsoil is a lean clay to silt with varying amounts of gravel and sand. This unit is typically various shades of brown and gray, damp to wet, and stiff to hard. This unit ranged in thickness between approximately 2 and 38 ft, occasionally extending to the bedrock below.

Poorly Graded Gravel w/ Clay/Sand, Poorly Graded Sand w/ Clay/Gravel (GP, GP-GC, SP-SC). Underlying and interbedded within the clay was sand and gravel with varying amounts of clay. This unit was typically various shades of brown and gray, loose to very dense, and dry to wet. This unit ranged in thickness between approximately 0.5 and 7 ft, occasionally extending to the bedrock and may consist of weathered bedrock fragments.

Bedrock

Shale. Shale bedrock was visually observed at two boring locations (B-02 and B-04) across the site between 13.5 and 25 feet below grade. The shallower portion of the bedrock was typically weathered and transitioned into more competent bedrock with depth. Rock cores were typically light gray to gray with rock quality designation (RQD) values generally ranging from approximately 0% to 55%. The majority of shallow rock cores had RQD values less than 40%, indicating generally poor to moderate rock quality with very limited rock continuity.

More detailed descriptions of the subsurface conditions are provided on the boring logs found in Appendix A. Rock coring photo logs are also provided in Appendix A.

3.4 Groundwater

Boreholes were observed during and shortly after drilling for the presence and level of groundwater. Piezometers were also installed after completion of drilling and measured shortly after installation, as well as approximately three months later in December 2023. During the investigation, a static groundwater level was observed at five of the seven boring locations (B-02, B-03, B-04, HDD-01, and Sub-01) at depths ranging from approximately 7 to 28 feet bgs. It should be noted that rock coring and drilling techniques introducing water were used at several turbine boring locations, which prevents accurate short-term groundwater measurements. In addition, a predominately clay subsurface profile does not lend itself to accurate short-term groundwater level measurements due to clay's low permeability and tendency to create perched water tables. Auger drilling techniques can also "seal" the borehole sidewalls in clayey soil preventing accurate groundwater infiltration and measurements from being made following completion of the borehole.

Depth to groundwater were measured following a piezometer monitoring trip in December 2023, approximately 3 months after installation. The depth to groundwater on site varied from approximately 7 feet to greater than 40 feet bgs during drilling and between 4.25 feet and greater than 25 feet bgs during the piezometer monitoring trip in December 2023. It should be noted that three of the piezometers (B-01, B-02, B-04) appear to have been damaged/destroyed by the landowners, which may have impacted the results if surface water was able to percolate into the piezometer. The depths to groundwater measured during drilling and after the piezometer monitoring trip are recorded Table 3.4 below. The water level encountered during drilling was generally deeper compared to the longer-term water level measured in the piezometers, as expected in clayey soil.

Table 3.4 Groundwater depth summary

Boring ID	Groundwater Measured During Drilling (ft)	Groundwater Measured in Piezometer (December 2023) (ft)
B-01	-	2.0[(2)]
B-02	6.9	2.0[(2)]
B-03	28	2.0
B-04	11.2	2.2[(2)]
B-05	>18[(1)]	4.5

(1) Measurements past this depth not recorded due to water added for drilling.
(2) Piezometer damaged prior to monitoring.

Groundwater level fluctuations occur due to seasonal variation in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed; therefore, groundwater levels observed during construction or at other times in the life of the structure may be higher or lower than those observed during the investigation. Depth to groundwater should be recorded during the final geotechnical investigation, and piezometers should be installed at proposed preliminary turbine locations for dynamic observation of water levels. Refer to Sections 4.2.2, 4.4.4, and 4.5.2 for recommendations regarding water control.

4.0 Discussion and Recommendations

4.1 Soil Properties

4.1.1 Moisture and Density

The in situ gravimetric moisture content of the soil on site ranges from approximately 7% to 24%. The recommended in situ moist unit weight of the overburden soil is 125 pcf based on the laboratory-measured density of an undisturbed sample collected on site, correlations to SPT blowcounts, and Westwood's experience with similar sites and geology.

For preliminary wind turbine foundation design purposes, the recommended long-term moist unit weight of the native soil backfill compacted to 95% of the standard Proctor maximum dry density is 105 pcf, which is based on a dry density of 95 pcf and 10% long-term moisture content.

4.1.2 Shear Strength of Soil

The undrained shear strength of the clayey soil at or below the anticipated turbine foundation depths on site generally ranges from approximately 1,500 psf to greater than 4,500 psf based on correlations to SPT blowcounts and pocket penetrometer tests. Zones of lower-strength clay were also periodically encountered. The recommended undrained shear strength used for preliminary design of bearing capacity for turbine and shallow substation foundations is 2,000 psf, provided that lower strength material, if encountered, is over-excavated and replaced with compacted structural fill or deep soil improvement is performed, such as stone columns, if needed. Refer to Sections 4.4.4 and 4.5.1 for foundation subgrade recommendations.

4.1.3 Dynamic Shear Modulus

No shear wave velocities were measured on site as part of this preliminary investigation, and the dynamic shear modulus was evaluated based on correlations to geotechnical investigation findings and available literature. Wind loading of a turbine system induces a cyclic tower vibration, which is then transferred through the tower base into the underlying foundation subgrade. Should the subgrade stiffness be insufficient, the magnitude of the tower vibration can become excessive, potentially reducing the efficiency of the turbine system, and in extreme cases, induce large fatigue loads resulting in tower buckling long-term. A sufficiently stiff foundation and bearing soil is necessary to adequately reduce this vibration, and the dynamic shear modulus is needed to analyze the rotational stiffness.

The dynamic shear modulus is best determined via measurements of shear wave velocity; however, shear wave velocity measurements were not recorded as part of the scope of this preliminary investigation. Correlations (Det Norske Veritas, 2002) indicate that the estimated shear wave velocity in the overburden soil strata at the boring locations is approximately 800 ft/s, which corresponds to a shear modulus of approximately 2,400 ksf. Based on these findings, there is no indication that the proposed site will be prohibitive to turbine construction on the grounds of rotational stiffness; however, shear wave velocity measurements should be taken at preliminary turbine locations during the final geotechnical investigation to verify suitable subsurface conditions.

4.1.4 Poisson’s Ratio

Poisson’s ratio is a unit-less material parameter defined as the ratio of transverse strain and axial strain for a material under loading. The parameter measures the phenomenon in which a material tends to expand or contract in a direction orthogonal to the direction of compression or tension. Poisson’s ratio is often used to relate various elastic parameters of a given material and is a factor in calculating the rotational stiffness of a wind turbine foundation system. Poisson’s ratio was evaluated based on correlations to geotechnical investigation findings and available literature. For the clayey overburden, a Poisson’s ratio of 0.4 is recommended for preliminary design, but should be confirmed with seismic shear and compression wave velocities measured during the final geotechnical investigation. For rock, a Poisson’s ratio of 0.1 may be used.

4.1.5 California Bearing Ratio

The field strength of access road subgrade may be assessed using the CBR. One shallow soil sample was collected between 0 feet and 4 feet bgs at the proposed substation location (Sub-1). The sample was classified as clayey sand with gravel (CL). A design CBR of 4.0 is recommended for road subgrade compacted to 95% of the standard Proctor MDD. Refer to Section 4.6 for recommendations on access road design.

4.1.6 Electrical Resistivity

Electrical resistivity measurements were collected at three wind turbine boring locations using the Wenner Four-Electrode Method in accordance with ASTM G57 using electrode spacings between 2 feet and 200 feet. Electrical resistivity generally varies with material type and moisture content, and ranges on site between 3,720 ohm-cm (Ω-cm) and 37,000 Ω-cm based on test results. These observed values are generally in agreement with typical published values for clay and limestone (Palacky, 1987). Results of the electrical resistivity tests are presented in Appendix D. Refer to Section 2.3 for additional information on the electrical resistivity test method.

4.1.7 Thermal Resistivity

Thermal resistivity dry-out curves were developed for shallow soil samples collected at two proposed preliminary turbine locations, TH-01 (formerly T-17) and B-04, and one at the proposed substation location (Sub-1) with all samples collected between 0 and 4 feet bgs. Bulk samples were re-compacted at the natural moisture content to approximately 90% of the standard Proctor maximum dry density. The thermal resistivity of the soil varied with soil type, moisture content, and density, and ranged from 60°C·cm/W (moist) to 211°C·cm/W (dry). Results of the thermal resistivity tests are included in Appendix C. The underground cable designer shall choose an appropriate thermal resistivity (rho) value for trench backfill with consideration to soil drying due to environmental factors as well as cable heat generation.

4.1.8 Soil Corrosivity

The chemical constituent test results indicate that the soil is relatively neutral with a pH ranging from 7.3 to 7.8. Soluble sulfates were measured as high as 37 mg/kg and soluble chlorides measured as high as 6 mg/kg. Chloride exposure is considered to be class C1, and sulfate exposure is considered low with concrete exposure class S0 (ACI, 2014). Test results are presented in Appendix C and summarized in the Lab Test Summary Table.

4.2 General Earthwork Considerations

General earthwork includes activities such as mass grading, electrical trenching, and site preparation for future activities. Subgrade preparation and fill recommendations specific to foundations and access roads are provided in those design recommendation sections, respectively.

4.2.1 Clearing and Grubbing

Prior to site grading activities, existing vegetation, trees, stumps, brush, large roots, boulders, cobbles, old structures/foundations, uncontrolled fill, and abandoned underground utilities, if encountered, should be removed from the proposed concrete foundation areas, as well as areas to receive fill. Areas disturbed during clearing and grubbing should be properly backfilled and compacted as described in Sections 4.2.6, 4.4.4, and 4.6.1.

Topsoil or organic material should not be used for structural fill and should be stockpiled away from native excavated soil. This material may be used as fill in non-structural areas outside of the foundation, assembly area, access road, crane pad, and crane walk areas where soil strength and compressibility would not impact site infrastructure or construction.

4.2.2 Excavations and Water Control

Overburden soil at the site can generally be excavated with conventional excavation equipment, such as backhoes, dozers, loaders, or scrapers. Four of the investigated proposed preliminary turbine locations (B-01, B-02, B-03, and B-05) encountered very dense soil, potentially indicative of residual bedrock or saprolite, shallower than the anticipated excavation depth of 10 feet bgs. See Table 4.2.2 for a summary of depth to bedrock, and Section 4.2.3 for more discussion on rock rippability.

Table 4.2.2 Depth to Weathered/Competent Bedrock Encountered During Investigation

Boring Location	Depth to Weathered Bedrock[1] (ft)	Depth to Competent Bedrock[2] (ft)
B-01	8	38.2
B-02	8	13.5
B-03	12	34
B-04	20	25
B-05	6	38.5
HDD	18	19
Sub-01	15	38.25

(1) Estimated based on split-spoon refusals and sample texture.
(2) Estimated based on depth of auger refusal.

Excavations should be constructed using safe side slopes unless adequately shored and/or braced as necessary for construction and safety. Per Occupational Safety and Health Administration (OSHA) Part 1926, the clayey overburden soil on site may generally be inferred to be a Type B soil, although it is the responsibility of the competent field personnel to verify in-situ conditions during construction. Excavations should be constructed in conformance with applicable federal, state, and local standards.

Groundwater may accumulate in excavations on site at select preliminary turbine locations. Although the high clay content of the subgrade soil will generally limit the amount of groundwater infiltration into foundation excavations, some dewatering of excavations may be required to remove precipitation and surface water runoff, groundwater seepage through sandy/gravelly layers, or upwelling through exposed fractured bedrock. Water and snow should be prevented from accumulating in foundation excavations at the time of foundation material placement. Sumps and portable pumps can generally be used to control water within these excavations for relatively short time periods. Excavations should be kept free of standing water and snow during foundation construction. The foundation subgrade should be inspected by the construction-phase geotechnical engineer, or their representative, after excavation and before placement of materials to verify water control.

4.2.3 Rock Rippability

Bedrock with varying degrees of weathering was encountered within anticipated foundation excavation depths (less than 10 to 12 feet bgs) at four of the five preliminary turbine locations investigated (see Table 4.2.2). The rock generally consisted of shale with the degree of weathering ranging from residual bedrock/saprolite near the surface to slightly weathered at greater depths. Based on observations of hollow stem auger and rock coring operations and Westwood's experience with similar sites, the possible residual bedrock encountered within the upper 10 to 12 feet is generally expected to be rippable. It should be noted that competent bedrock may exist at locations uninvestigated as a part of this preliminary investigation, which may require specialized rock ripping equipment or blasting. A rock trencher may be needed in isolated portions of the site to excavate collector trenches in areas with very shallow bedrock. A geophysical survey including seismic refraction testing to measure P-wave velocities should be performed during the final geotechnical investigation to better assess rock rippability. In Westwood's experience, blasting may be required wherever shallow, non-rippable bedrock or bedrock containing large boulders is encountered within 6-10 feet of the ground surface and seismic refraction testing returns velocities greater than 5,000 fps.

4.2.4 Permanent Cut and Fill Slopes

Cut and fill slopes in native soil may be preliminarily designed at an inclination of 3H:1V or flatter. Fill slopes should be constructed in horizontal lifts in accordance with the recommendations in Section 4.2.5 and 4.2.6. Although generally not anticipated, slopes greater than 5 feet in height should be benched into the existing slope to prevent movement between the fill and native soils. A 2 foot deep by 8 foot wide keyway should be cut down into native soil at the toe of fill slopes, extending back under the toe of the fill. As fill placement progresses up the existing slope, benches should be cut into the existing slope to bond the mass of the fill to the existing ground. Benches should generally follow the existing ground slope, with a minimum of 3 feet high and approximately 10 feet wide. Benches should be approved by the construction phase geotechnical engineer prior to placement of fill. Positive drainage is required at benched areas and at the toe of fill to remove surface water and minimize soil saturation. Appropriate erosion control measures (e.g., vegetation or erosion control matting) should be implemented immediately after cut and fill slopes are constructed to reduce the potential for significant erosion. See figure 4.1 for a detail of the benching requirements.

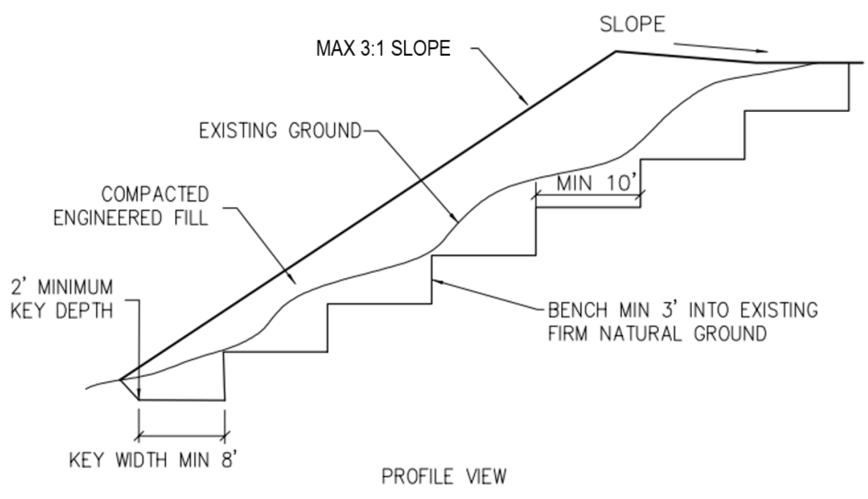

Figure 4.1 Benching detail for fill slopes greater than 5 ft

Steeper cut and fill slopes may be acceptable if adequate erosion control and/or reinforcement are utilized. Additional testing and/or analyses should be performed for steeper slopes, and the geotechnical engineer should be consulted if steeper slopes are desired. Vehicles, cranes, material storage, and foundations should be located a safe distance (as determined by the construction phase geotechnical engineer) from the top of steep slopes to avoid slope instability. Detailed global slope stability analyses are beyond the scope of this investigation, but should be performed as needed once design grades and site specific surcharge loading (e.g., cranes, component storage, etc.) information becomes available.

4.2.5 Subgrade Preparation

After clearing and grubbing, exposed areas to receive general fill used for raising site grades should be scarified, moisture conditioned to within 3% of optimum moisture content, and compacted to 95% of the standard Proctor maximum dry density (ASTM D698). The depth of subgrade compaction should extend at least 12 inches below fill areas. Where possible, subgrade below general fill areas should be proof-rolled prior to placing fill to identify soft areas. Proof-rolling can be performed with a fully loaded dump truck. Soft areas with rutting greater than 1.5 inches should be removed or re-compacted prior to placing fill. Refer to Sections 4.4.4, 4.5.1, and 4.6 for more information on turbine foundations, substation shallow foundations, and access road subgrade preparation, respectively.

Disturbance to areas prepped for subgrade fill should be minimized. Repeated traffic loading and excessive moisture due to precipitation may degrade subgrade soil. Native clayey soils are expected to be sensitive to the addition of water and may become unstable if not carefully monitored. Repeated traffic loading and excessive moisture due to precipitation may degrade subgrade soil. Care should be taken to limit disturbance to subgrade soils across the site and prevent ponding water by promoting positive drainage and minimizing the time of exposure to precipitation. Where unsuitable subgrade, such as soft clay or loose sand/gravel, is encountered, the subgrade should be moisture conditioned and re-compacted as described above, or unsuitable subgrade should be over-excavated as recommended by the construction-phase geotechnical engineer and replaced with structural fill in accordance with Sections 4.4.4 and 4.5.1.

4.2.6 Fill and Backfill

The native non-organic soil encountered throughout the site may be used as general fill for road embankments and wind turbine assembly areas and may be suitable for backfilling around and above foundations provided that organics, frozen soil, foreign material, and rock fragments larger than 6 inches in diameter are removed and all compaction requirements are met. Organic clay should not be used as general fill. Backfill material within 1 foot of all foundations should have no particle sizes greater than 1 inch. Cobbles and boulders, if encountered, should be removed from general fill, and excavated bedrock should be crushed to appropriate particle sizes prior to use as fill. General fill shall be placed in maximum loose lifts of 9 inches thick and compacted to a minimum 95% of the standard Proctor maximum dry density (ASTM D698) and within 3% of optimum moisture content. See Table 4.2.6 below for additional recommendations.

Trenches may be backfilled using native material, provided that it is screened of particles larger than 3/8" and moisture conditioned to near optimum moisture content and compacted to a minimum of 90% of the standard Proctor maximum dry density (ASTM D698) in non-structural areas and 95% of the maximum dry density in structural areas (i.e., within 5 feet of foundations and below access roads). Highly organic soil, if encountered, may be challenging to achieve adequate compaction and typically has unfavorable thermal properties, so consideration should be given to using imported material for trench backfill in areas where highly organic soil is encountered.

Table 4.2.6 Fill and Backfill Material Recommendations.

Material	Uses	Loose Lift Thickness	Required Compaction(1)	Moisture Content(1)
Imported select structural fill	Fill below turbine foundations or crane pad over-excavations	≤ 12" with heavy compaction equipment	≥ 98%	As-needed
Non-frost susceptible structural fill	Fill below shallow foundations bearing within the frost depth	≤ 12" with heavy compaction equipment	≥ 98%	As-needed
Non-organic native clay general fill	Foundation backfill, embankments, access road subgrade, and general site grading	≤ 9" with heavy compaction equipment ≤ 6" with hand compaction equipment	≥ 95%	±3% of optimum moisture
Native topsoil and organic soil	Landscaping non-structural areas	N/A	N/A	N/A

[1] Relative to the standard Proctor maximum dry density and optimum moisture content (ASTM D698)

4.3 General Foundation Considerations

4.3.1 Lateral Resistance

A friction factor of 0.35 may be used for the ultimate frictional resistance to lateral sliding along the base of concrete footings founded on properly compacted subgrade. We recommend a factor of safety of 1.5 or greater to determine the allowable frictional resistance to lateral sliding.

4.3.2 Seismic Considerations

At the time of this report the State of New York has adopted the 2018 International Building Code. The maximum considered earthquake spectral response accelerations are presented in Table 4.3.2 below (ATC, 2023).

Table 4.3.2 Seismic Design Parameters

Parameter	Design Value
Reference	2018 IBC
Site Class	C, D(1)
Coordinates (Lat., Long.)	42.757141, -76.530109
Mapped Spectral Acceleration for Short (0.2 sec) Periods – S_s	0.133 g
Mapped Spectral Acceleration for 1-second Periods – S_1	0.058 g
Peak Ground Acceleration, PGA	0.06 g

(1) Refer to Table 1 (attached) for site class recommendations for each preliminary turbine location.

4.3.3 Frost Depth

Frost action can result in differential heaving and a reduction in soil strength during periods of thaw. The degree of frost action is based on frost depth, availability of water, and frost-susceptibility of shallow soil. The most severe effects of frost heave occur when ice lenses form in the voids of soil containing fine particles (i.e., silt and clay). Shallow foundations (or the structures they support) can be damaged if the foundations bear above soils that experience frost heave. The bearing capacity of soil is also reduced during periods of thaw, which can reduce the lateral capacity of pile foundations and cause bearing capacity and/or settlement issues for shallow foundations bearing above the frost depth.

The recommended design frost depth for the area is 4 feet (Bowles, 1996). Critical foundations and pipes should be placed a minimum of 6 feet below final grade or on non-frost susceptible soil extending to a depth of at least 5 feet for protection against frost, unless they are designed to accommodate the effects of frost.

4.4 Wind Turbine Foundation Design

Westwood understands that a number of turbine models are being considered for the Project. Preliminary load documents from a nearby site were provided by the Client. No preliminary foundation designs or turbine loading documents were provided prior to preparation of this report, and therefore for the basis of this analysis it was assumed turbines will be supported on approximately 70 foot diameter octagonal or circular spread footings bearing approximately 10 feet below grade with an estimated effective bearing area of 30 feet by 45 feet. The recommendations provided in this report should be re-evaluated during the final geotechnical investigation when Project-specific loading documents and preliminary foundation designs are available, including alternate buoyant foundation designs for turbines bearing below the expected groundwater depth. Soil parameters recommended for use in turbine spread foundation design are discussed in Section 4.1.

4.4.1 Bearing Capacity

Although no preliminary turbine locations contained weak material below the anticipated foundation bearing depths, subgrade strength should be confirmed in the field per Section 4.4.4. Typical turbine spread footing foundations supported on natural soil or select structural fill should be designed for the following maximum allowable bearing capacities, provided ground improvement is performed, where required, in accordance with Section 4.4.4.

Table 4.5: Bearing capacity summary.

Loading Condition	Controlling Condition	Safety Factor	Allowable Bearing Capacity (psf)	
			Gross	Net(2)
Normal	Bearing Capacity	3.0	3,800	3,500
Extreme	Bearing Capacity	2.25	6,000	5,600

(1) Net allowable bearing capacity assumes a bulk soil unit weight of 105 pcf.

4.4.2 Differential Settlement

Differential settlement or rotation of the foundation was evaluated under normal operating loads. Normal operating loads result in an eccentrically loaded foundation with a higher bearing pressure than the dead load condition. Under normal operating loads the leeward side of the foundation carries the majority of the load compared to the windward side of the foundation, causing differential settlement or rotation of the foundation.

Results of the settlement analyses indicate that the assumed turbine foundation, consisting of an assumed 70-foot diameter spread footing embedded 10 feet bgs with a gross bearing pressure of 3,800 psf will experience a total settlement of approximately 1.5 inches and a differential rotation of 0.17 degrees across the foundation width, which is within the assumed maximum allowable differential foundation tilt of 0.17 degrees.

4.4.3 Buoyancy

The depth to groundwater was evaluated with short-term observations in boreholes and long-term observations in piezometers installed during drilling. It should be noted that drilling rock coring techniques introducing water were used at several turbine boring locations, which prevents accurate short-term groundwater measurements. In addition, short term observations in clayey soil typically do not accurately reflect the long-term water level, and fluctuations should be expected. During the investigation, groundwater was encountered either during or after drilling at five of the seven of the borings (B-02, B-03, B-04, HDD-01, and Sub-01) between depths of 7 and 28 feet bgs.

Depth to groundwater measured during piezometer monitoring trip in December, 2023 varied from approximately 2 feet and 4.5 feet bgs during the piezometer monitoring trip in December, 2023. It should be noted that three of the piezometers (B-01, B-02, B-04) appear to have been damaged/destroyed by the landowners, which may have impacted the results if surface water was able to percolate into the piezometer. The depths to groundwater measured during drilling and after the piezometer monitoring trip are summarized in Section 3.4. The water level encountered during drilling was generally deeper compared to the longer-term water level measured in the piezometers, as expected in clayey soil.

It Is expected that, due to the shallow long-term groundwater depths observed on site, groundwater depth is expected to be shallower than the anticipated foundation bearing depth at a majority of turbines. Foundations bearing below groundwater should be designed to resist overturning while accounting for buoyant forces. Due to the limited number of borings on site and undulating topography, it is possible that groundwater may be deeper elsewhere on site, although this should be confirmed during the final geotechnical investigation. The foundation designer may consider providing at least two different foundation designs based on varying depths to groundwater. Additional groundwater measurements through the use of piezometers installed at each preliminary turbine location are recommended during the final geotechnical investigation to confirm seasonal groundwater fluctuation prior to final foundation design.

4.4.4 Subgrade Preparation

Turbine foundations should bear on native medium stiff to stiff clay, medium dense to dense sand or gravel, or, if required, compacted select structural fill. Based on the conditions encountered during this investigation, the soil beneath the anticipated turbine foundation bearing depths typically exhibits sufficient properties to support spread foundations. It should be noted that the possibility still exists for undetected weak clay or loose sand/gravel within the turbine footprint at the locations investigated, as well as at preliminary turbine locations not investigated as a part of this preliminary investigation, particularly if they are set in topographic lowlands, valleys, or near wetlands where water may pond.

Disturbance to the subgrade within foundation excavations should be minimized throughout construction. Fine-grained soils are particularly sensitive to disturbance from repeated traffic loading and excessive moisture due to surface water runoff, seepage, or precipitation, which are likely to degrade subgrade soil. If encountered, soft/loose soil, frozen soil, and rock fragments larger than 6 inches should be removed. Care should be taken to prevent ponding water by promoting positive drainage and minimizing the time of exposure to precipitation. The foundation subgrade should be also protected against freezing and snow/water accumulation after inspection and prior to foundation placement. During winter construction, heating of the subgrade may be necessary to protect the subgrade from freezing. To facilitate turbine foundation construction and to protect the subgrade, a minimum 2- to 3 inch–thick layer of lean concrete (mud mat) over the subgrade is recommended. If disturbed, foundation subgrade should be scarified and recompacted in accordance with Section 4.2.5 prior to the placement of the mud mat or select structural fill.

Field inspection and quality control of the subgrade may identify the need for additional subgrade modification. The foundation subgrade should be inspected by a qualified geotechnical engineer, or their representative, after excavation and before placement of materials to confirm conditions. If soft/loose, disturbed, or otherwise unsuitable turbine foundation bearing soil is encountered, as determined by the quality control testing described below, the excavation should be remediated based on the depth of unsuitable subgrade.

Static Cone Penetrometer (SCP) or Dynamic Cone Penetrometer (DCP) testing is recommended to confirm subgrade soil strength and identify areas of soft clay or loose sand/gravel, respectively. Subgrade testing should be performed at a minimum of five (5) locations on the excavation and foundation bearing surface, one in each quadrant and one in the middle. Testing should extend a minimum of 3 feet below the surface. Foundation subgrade should exceed the undrained shear strength or friction angle necessary to achieve the minimum required bearing capacities noted in Section 4.4.1. The foundation subgrade should also consist of a uniform bearing material, such that the foundation does not bear on part soil and part rock. Field inspection and quality control of the subgrade may identify the need for additional subgrade modification, such as over-excavation of unsuitable material and replacement with select structural fill. The design-phase geotechnical engineer-of-record should be notified in the event that unsuitable subgrade conditions are encountered. Although generally not anticipated to be required based on the results of this preliminary investigation, subgrade remediation options should be recommended and discussed as needed based on the results of the final geotechnical investigation.

4.5 Substation Foundations

4.5.1 Subgrade Preparation

After clearing and grubbing, exposed areas to receive fill, including the subgrade below shallow foundation over-excavations and road aggregate, should be scarified to a minimum depth of 9 inches, moisture conditioned to within 3% percent of optimum moisture, and re-compacted to 95% of the standard Proctor maximum dry density (ASTM D698). Subgrade below shallow foundations should have the native soil over-excavated to a minimum depth of 4 feet below final grade, or 1 foot below the bottom of the foundation, whichever is deeper, and replaced with non-frost susceptible structural fill (see Section 4.5.1.2) to minimize differential heave/movement. Subgrade should also be inspected by the construction-phase geotechnical engineer, or their representative, to ensure adequate bearing capacity and water control.

Disturbance to subgrades prepared for foundations should be minimized. Repeated traffic loading and excessive moisture due to surface water runoff, seepage, or precipitation may degrade subgrade soil. Where unsuitable subgrade is encountered, such as areas with soft soil, the unsuitable subgrade should be over-excavated as recommended by the construction-phase geotechnical engineer and replaced with structural fill in accordance with Section 4.2.6.

4.5.2 Fill Placement and Compaction

Native soil should not be used as structural fill for supporting shallow foundations. Imported non-frost susceptible structural fill should consist of well-graded aggregate with less than 5% fines. The fill should be sampled and tested prior to use on site. Non-frost susceptible structural fill placed beneath foundations and slabs shall be moisture conditioned as needed, placed in loose lifts of 12 inches thick, and compacted to a minimum 98% of the standard Proctor maximum dry density (ASTM D698).

4.5.3 Bearing Capacity and Settlement

Provided the recommendations of this report are followed, including over-excavation and replacement in accordance with Section 4.5.1.2, preliminary designs of large slab-on-grade equipment foundations (i.e., 10 to 20 feet wide) and conventional spread and strip footing foundations (i.e., 4 feet wide) may use a preliminary maximum allowable gross bearing capacity of 3,500 psf.

A total estimated settlement of less than 1 inch is anticipated for shallow foundations. Differential settlement can generally be assumed to be ½ to ¾ of the total settlement. Proper drainage should be provided around foundations to minimize the potential for foundation movement. Shallow foundations should be reinforced as necessary to reduce the potential for damage caused by differential movement.

A vertical modulus of subgrade reaction of 125 pounds per cubic inch (pci) may be used for mat foundations bearing on a minimum 2 feet of structural fill. This vertical modulus of subgrade reaction represents a 1 foot square foundation and should be modified as needed for larger foundation sizes.

4.5.4 Deep Foundations

Deep foundations, such as concrete piers/shafts, may be used to support the equipment at the proposed substation. The recommendations provided may be used for design of drilled shaft foundations at the substation. Drilled shafts should have a minimum diameter of 2 feet.

4.5.4.1 Constructability

The overburden soil profile within the substation area generally consists of topsoil overlying lean clay that transitions into likely residual bedrock or saprolite. Underlying the residual bedrock/saprolite is a more competent bedrock layer, which was inferred due to auger refusal at a depth of approximately 38 feet bgs. The depth to and competency of bedrock should be confirmed during the final geotechnical investigation and construction.

The relative ease of drilling will depend on the hardness/density of the soil, amount of gravel, cobbles, and boulders present, as well as the depth to and competency of bedrock. Conventional auger drilling is expected to be feasible while drilling though the overburden soil but may be ineffective when drilling through cobbles, boulders, and residual/weathered bedrock. Specialized rock drilling equipment will be required to extend deep foundations to their target embedment depths. If the foundation design embedment depth relies on bearing in competent bedrock, the foundation should be socketed a minimum of 1.0 times the foundation diameter into competent rock. Shallower rock sockets may be acceptable if the design does not rely on the rock strength for axial or lateral support. Soil and rock conditions, along with lateral pile capacity and deflection values, should be considered when determining embedment into rock. See Appendix E for further details.

During the investigation, a static groundwater level or wet soil was observed at a depth of approximately 28 feet bgs. Perched groundwater above or within the likely residual bedrock may also be possible, particularly during periods of extended/heavy rainfall. The accumulation of groundwater within boreholes/excavations may occur based on the depth to groundwater observed during the geotechnical investigation. The depth to groundwater recommended for design is included in Appendix E. Borehole sidewalls may collapse if casing is not used through sand and gravel layers, especially if they are saturated. Should any water collect within the excavations, the bottom of foundation excavations should be cleared of any water and loose material prior to the placement of concrete or pole, or concrete may be poured using tremie method. Concrete should be placed as soon as possible after foundation excavation to minimize the potential for sidewall disturbance and water accumulation.

4.5.4.2 Axial and Lateral Capacity

The proposed substation structures may be supported on concrete piers/shafts. Drilled shaft foundations will develop their axial capacity through a combination of skin friction and end bearing when in compression and skin friction alone when in uplift, although skin friction should be ignored and only end bearing relied upon when for drilled shafts in compression and bearing on bedrock. Skin friction should be applied to the surface area of the pier, and end bearing should be applied to the full area at the bottom of piers in compression. Skin friction and end bearing values for concrete shafts are provided in Appendix E. These values are allowable and include a safety factor of 2.0 for skin friction and 3.0 for end bearing.

The lateral capacity of drilled pier foundations was evaluated with correlations to laboratory and field test results. The lateral response of the shafts/poles may be modeled using the program MFAD (Moment Foundation Analysis and Design) by FAD Tools. The recommended soil and rock model input parameters for design of drilled shafts are also provided in Appendix E.

Consideration should be given to neglecting at least the upper 2 feet of embedment to account for the potential for erosion/scour, frost, and moisture/strength changes, as shown in Appendix E.

4.6 Access Roads/Laydown Yard

Access roads will be required during construction to accommodate construction equipment and deliveries. The access roads will also facilitate long-term operation and maintenance of the Project. These roads will be subjected to heavy loads, but only for limited duration and frequency. The suitability of the shallow site soil for use as access roads will depend primarily on the strength and moisture condition of the soil at the time the traffic occurs. The shallow clayey sand and lean clay soil on site below the root zone is generally considered adequate subgrade for gravel access roads, although special consideration should be given to the moisture sensitivity of the shallow clayey soil. Access roads should have an aggregate surface to help ensure accessibility during wet conditions.

4.6.1 Subgrade Preparation

For areas on site with non-organic lean clay or sand, clearing and grubbing of the topsoil should be performed. Exposed areas for access road construction should be scarified, moisture conditioned to within 3% of optimum moisture content, and compacted to 95% of the standard Proctor maximum dry density (MDD) (ASTM D698). The depth of subgrade compaction should extend at least 12 inches below access road areas. Subgrade below access roads areas should be proof-rolled prior to placing fill to identify soft areas. Proof-rolling can be performed with a fully loaded dump truck. Soft areas with rutting greater than 1.5 inches should be removed or re-compacted prior to placing fill. Where unsuitable subgrade, such as soft clay, is encountered, the subgrade should be moisture conditioned and re-compacted as described above, or over-excavated as recommended by the construction-phase geotechnical engineer and replaced with structural fill in accordance with Section 4.2.6.

4.6.2 Aggregate Section

A preliminary subgrade CBR of 4.0 is recommended for the design of aggregate-surfaced roads on non-organic clayey sand and lean clay constructed in accordance with the recommendations in this report based on the results of laboratory testing. Aggregate-surfaced roads should consist of well-graded aggregate in accordance with New York State Department of Transportation (NYSDOT) Section 733-11A Type I or Type II Subbase and shall be moisture conditioned as needed and compacted to a minimum 98% of the standard Proctor maximum dry density (ASTM D698). In general, at least 8 to 10 inches of aggregate may be required to support construction traffic, although conditions vary with subgrade moisture, strength, compaction effort, and soil type. Less aggregate, such as 6 to 8 inches, may be used if the subgrade is stabilized (e.g., with a mid-strength geotextile reinforcement, lime, or cement).

Loose, saturated, and highly organic subgrade material are typically the limiting conditions for access roads. Strengthening the subgrade with crushed rock, geosynthetics, or other suitable material, and/or mixing the base material with additives such as cement will minimize damage to the subgrade. Project specific tests are recommended to more accurately define the mix design and access road cross section. Establishing adequate side ditches and other surface water control features will help to reduce damage caused by surface water and saturated road subgrade conditions.

4.6.3 Maintenance

It is expected that aggregate-surfaced access roads will require ongoing maintenance to keep them in a serviceable condition, regardless of the aggregate thickness and subgrade preparation. It is not practical to design an aggregate section of adequate thickness that prevents ongoing maintenance. Ruts, depressions, and soft/loose subgrade should be repaired as needed to facilitate traffic. Additional aggregate may be placed in ruts and depressions, or the entire aggregate section and soft subgrade may be removed and replaced with a new aggregate section.

Surface vegetation root zones and other soft or otherwise unsuitable material should be stripped from access roadways and the surface graded to provide positive drainage. In order to identify potentially unsuitable soil, the road subgrade should be compacted and subsequently proof-rolled with a fully loaded tandem axle or tri-axle truck with a minimum gross weight of 25 tons and minimum axle loading of 10 tons. Subgrade preparation should be monitored by a representative of the construction-phase geotechnical engineer at the time of construction. At locations where pumping or unacceptable rutting of the subgrade occurs, the soft soil should be removed and replaced with properly compacted fill in accordance with Section 4.2.6.

4.7 Horizontal Directional Drilling

One soil boring, HDD-01, was performed at a proposed HDD location to assess the drilling feasibility and risk of inadvertent return (i.e. “frac-out”). A frac-out occurs when the drilling fluid pressure exceeds the confining ability of the soil overburden, resulting in a release of drilling fluid at the surface. Frac-out is most common in soils with limited clay and silt content, artesian groundwater, weak overburden soil, and a large elevation gap between HDD entry and exit.

Based on the results of the soil boring, the subsurface consists of approximately 18 feet of stiff to hard lean clay with varying amounts of sand and gravel and medium dense to dense clayey sand with varying amounts of gravel. Auger refusal on inferred bedrock was encountered at approximately 18 feet bgs. The relative ease of directional drilling will depend on the hardness/density of the soil, amount of gravel, cobbles, and boulders present, as well as the depth to and competency of bedrock. Conventional directional drilling is expected to be feasible while drilling though the soft overburden soil, but may be ineffective when drilling through cobbles, boulders, or weathered bedrock, which may be present along portions of the HDD route.

Although the overburden soil observed has a relatively high clay content, which will generally limit permeability, the shallow soil is expected to have a significant sand and gravel content, which may provide pathways for drilling fluid to pass to the surface. The shallow soil conditions may be softer in the hydric soil units mapped adjacent to the HDD boring location (USDA, 2032). Groundwater is expected to be relatively deep based on measurements taken during drilling, although it should be noted that groundwater may be shallower adjacent to the HDD boring location where units of hydric soils were identified. The entry and exit points of the HDD were not known at the time of this investigation, but should be considered in future frac-out analyses. In general, the risk of frac-out during directional boring at this location is considered low to moderate if not properly accounted for.

4.8 Construction Considerations

To a large degree, satisfactory foundation and earthwork performance depends on construction quality control; therefore, subgrade preparation, subgrade compaction, proof-rolling, cut slopes, and placement and compaction of fill and backfill material should be observed and tested by qualified personnel. In addition, qualified staff who are experienced with the foundation design requirements should monitor and document foundation preparation and construction activities. A qualified geotechnical engineer should also inspect cut faces in rock to evaluate overall stability.

5.0 Limitations

This report has been prepared in accordance with generally accepted geotechnical engineering practice for the exclusive use by Liberty Renewables, for the Agricola Wind Project. The primary focus of this report was preliminary recommendations for site grading activities, wind turbine foundation design, and access roads. This report is considered preliminary, and a comprehensive geotechnical investigation should be performed prior to final design of the proposed Project.

The borings are representative of the subsurface conditions at the sampled locations and intervals, and therefore do not necessarily reflect strata variations that may exist between sampled locations and intervals. If variations from the subsurface conditions described in this study are noted during construction, recommendations in this report must be re-evaluated. Any user of this report should verify all boring locations against the final location of the respective infrastructure to determine if infrastructure has moved prior to using the recommendations provided by Westwood. In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing by Westwood. Westwood is not responsible for any claims, damages, or liability associated with the interpretation of subsurface data by others.

After plans for the facility are developed in sufficient detail and Project-specific wind turbine foundation load documents and preliminary foundation designs are available, Westwood should be consulted regarding additional subsurface information required to arrive at final recommendations for design and construction. The current recommendations are based on previous Projects that are similar in size, however the loads experienced by the subsurface and foundations will likely be different due to specific turbine parameters.

6.0 References

Applied Technology Council (ATC). 2023. Hazard by Location: Seismic. Accessed from: https://hazards.atcouncil.org/

American Concrete Institute (ACI). 2014. ACI 318-14 Building Code Requirements for Structural Concrete.

Cadwell, D.H., Connally, G.G., Dineen, R.J., Fleisher, P.J., Franzi, D.A., Fuller, M.L., Gurrieri, J.T., Haselton, G.M., Kelley, G.C., LaFleur, R.G., Muller, E.H., Pair, D.L., Rich, J.L., Sirkin, Les, Street, J.S., Young, R.A., and Wiles, G.C. (1989). *Surficial geologic map of New York*. map, Albany, NY; New York State Geological Survey.

Det Norske Veritas (DNV/Risø). 2002. Guidelines for Design of Wind Turbines (2nd ed.). Copenhagen, Denmark: Det Norske Veritas & Risø National Laboratory.

International Code Council. 2018. International Building Code.

Naval Facilities Engineering Command (NAVFAC) (1982). DM7.1, Soil Mechanics, US Department of the Navy.

Palacky, G. J. (1987). Resistivity Characteristics of Geologic Targets. In M. N. Nabighian (Ed.), Electromagnetic Methods in Applied Geophysics Theory: Tulsa, Okla (Vol. 1, pp. 53-122). Society of Exploration Geophysicists.

Rickard, L.V., et. al. (1970). Geologic Map of New York. Map and Chart Series 15. New York State Museum and Science Service.

United States Department of Agriculture (USDA). 2023. Natural Resources Conservation Service. Web Soil Survey. Accessed from https://websoilsurvey.sc.egov.usda.gov/

United States Geological Survey (USGS). 1946. A Tapestry of Time and Terrain. Accessed from: https://www.nrc.gov/docs/ML0933/ML093340269.pdf

United States Geological Survey (USGS). 2014. Karst in the United States: A Digital Map Compilation and Database. D.J. Weary, and D.H. Doctor.

United States Geological Survey (USGS). 2023a. Quaternary Fault and Fold Database of the United States. Accessed from: https://earthquake.usgs.gov/hazards/qfaults/

United States Geological Survey (USGS). 2023b. Earthquake Hazards Program. Accessed from: https://earthquake.usgs.gov/earthquakes/

New York State Department of Environmental Conservation. (NYDEC). 2023. *Water Well Information*. Dec Water Well Applications. https://www.dec.ny.gov/cfmx/extapps/WaterWell/index.cfm?view=searchByCounty

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SPT N-Value and (RQD) Summary
Agricola Wind Project - Cayuga County, New York

	B-01	B-02	B-03	B-04	B-05
Seismic Site Class	**C**	**C**	**C**	**D**	**C**
Depth (ft)					
0 - 1.5	18	10	8	10	9
2 - 3.5	25	9	7	9	7
4 - 5.5	REF	4	23	16	20
6 - 7.5	REF	-	84	29	79
8 - 9.5	REF	50	REF	48	60
10 - 11.5	REF	REF	REF	31	REF
12 - 13.5	REF	REF	REF	24	REF
14 - 15.5	REF	(0)	REF	33	REF
18 - 19.5	REF	(0)	REF	REF	REF
23 - 24.5	REF	(38)	REF	REF	REF
28 - 29.5	REF	(40)	REF	(22)	REF
33 - 34.5	REF	(52)	REF	(55)	REF
38 - 39.5	REF				REF
***Depth To Rock (ft)**	38.2	13.5	34	25	38.5

*Depth to rock is an estimate and gradual transitions between soil and rock make it challenging to define a top of rock surface. Excavations may still encounter challenges above this depth.

Legend

- Lean Clay
- Granular
- Weathered Rock
- Bedrock

(##) = Rock Quality Designation (RQD)

REF = SPT Refusal

Exhibits

Data Source(s): Westwood (2023); ESRI WMS National Geographic & World Streets Basemaps (Accessed 2021); Census Bureau (2020).

Legend

- Boring Location
- Electrical Resistivity Test Location
- Substation
- State Boundary
- County Boundary

N

0 2,000 Feet

Agricola Wind

Cayuga County, NY

Project Overview Map

EXHIBIT 1

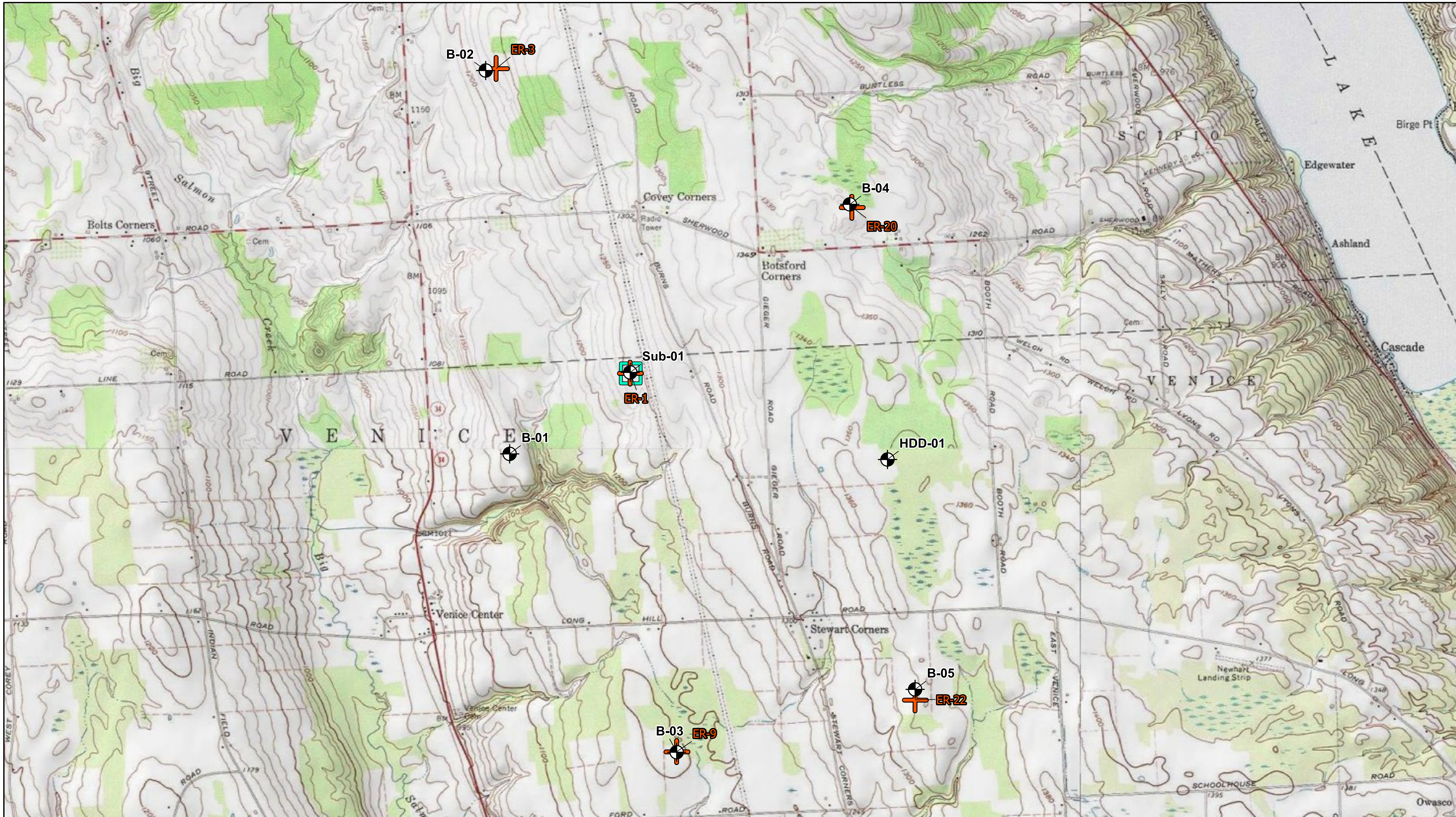
October 4, 2023

Westwood

Toll Free (888) 937-5150 westwoodps.com

Westwood Professional Services, Inc.

Map Document: \\westwoodps.local\Global Projects\0042617.01_GIS\R0042617_080_Agricola_Geotech\R0042617_080_Agricola_Geotech.aprx 2023-10-04 6:15 PM CHeins



Data Source(s): Westwood (2023); ESRI WMS USA Topo Basemap (Accessed 2021); Census Bureau (2019).

Legend

- Boring Location
- Electrical Resistivity Test Location
- Substation

Westwood

Toll Free (888) 937-5150 westwoodps.com

Westwood Professional Services, Inc.

N

0 2,000 Feet

Agricola Wind

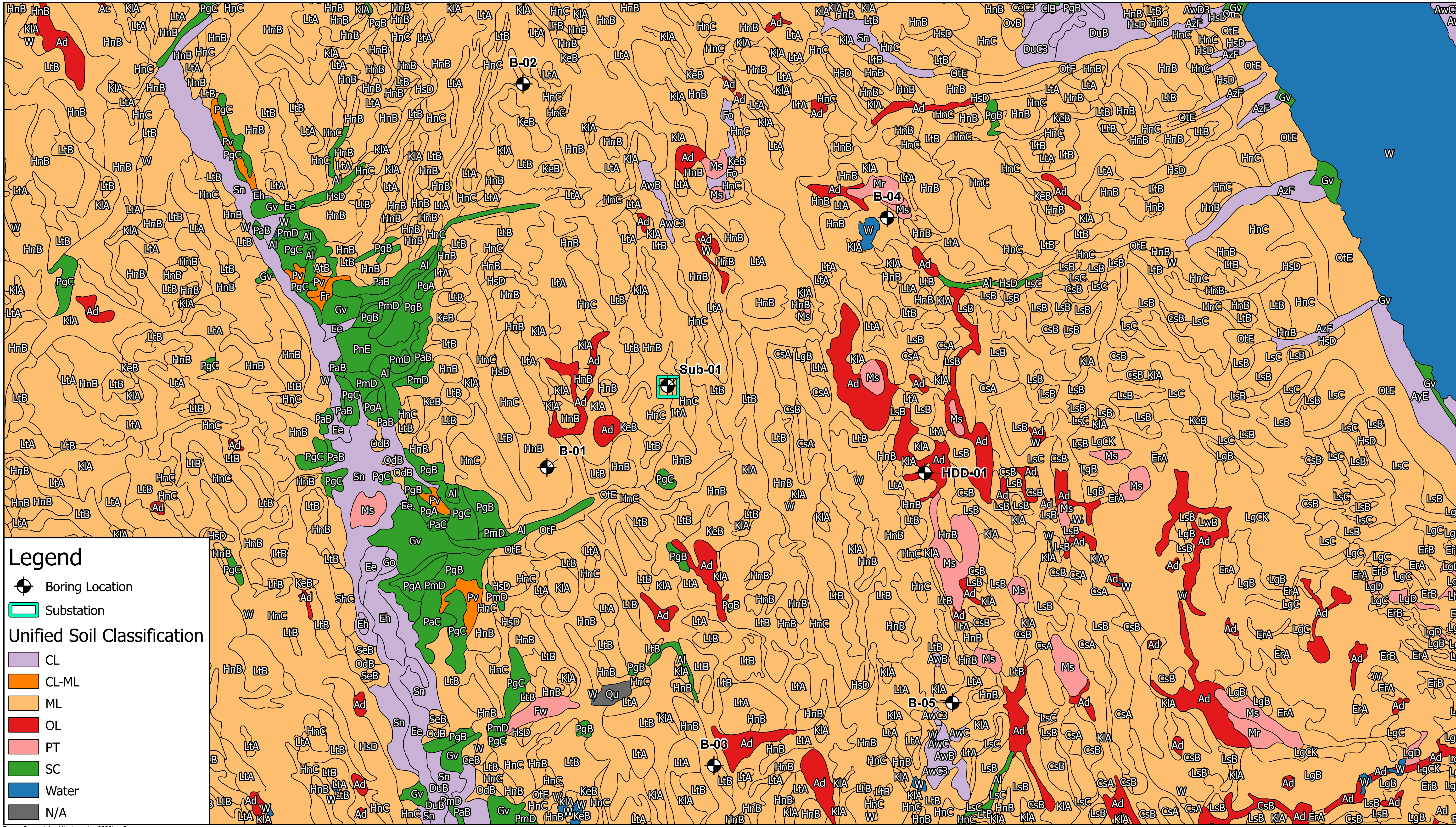
Cayuga County, NY

USGS Topography Map

EXHIBIT 2

October 4, 2023

Map Document: \\westwoodps.local\Global Projects\0042617.01_GIS\R0042617_080_Agricola_Geotech\R0042617_080_Agricola_Geotech.aprx 2023-10-04 6:25 PM CHeins



Data Source(s): Westwood (2023); Census Bureau (2019); U.S. Department of Agriculture, Natural Resources Conservation Service (2021). USGS Web Soil Survey data (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Map Unit Symbol | Unified Soil Classification | Map Unit Name

- Ac | OL | Alden mucky silt loam
- Ad | OL | Alden mucky silt loam, till substratum
- Al | SC | Alluvial land
- AtB | ML | Arkport fine sandy loam, 1 to 6 percent slopes
- AwB | CL | Aurora silt loam, 2 to 6 percent slopes
- AwC | CL | Aurora silt loam, 6 to 12 percent slopes
- AwC3 | CL | Aurora silt loam, 6 to 12 percent slopes eroded
- AwD3 | CL | Aurora silt loam, 12 to 18 percent slopes, eroded
- AwE | CL | Aurora silt loam, 18 to 30 percent slopes
- AyE | CL | Aurora and Farmington channery silt loams, 18 to 40 percent slopes
- AzF | CL | Aurora, Farmington, and Benson very rocky soils, 20 to 70 percent slopes
- CeB | ML | Cazenovia silt loam, 2 to 8 percent slopes
- CeC3 | ML | Cazenovia silt loam, 5 to 14 percent slopes, eroded
- ClB | CL | Collamer silt loam, 2 to 6 percent slopes
- CsA | ML | Conesus gravelly silt loam, 0 to 3 percent slopes
- CsB | ML | Conesus gravelly silt loam, 3 to 8 percent slopes
- DuB | CL | Dunkirk silt loam, 1 to 6 percent slopes
- DuC3 | CL | Dunkirk silt loam, 6 to 12 percent slopes, eroded
- Ee | CL | Eel silt loam
- Eh | CL | Eel silt loam, high bottom
- ErA | ML | Erie channery silt loam, 0 to 3 percent slopes
- ErB | ML | Erie channery silt loam, 3 to 8 percent slopes
- Fo | CL | Fonda mucky silt loam
- Fr | CL-ML | Fredon loam
- Fw | PT | Fresh water marsh
- Go | CL | Genesee silt loam, high bottom
- Gv | SC | Genesee gravelly loam, fan
- HnB | ML | Honeoye silt loam, 3 to 8 percent slopes
- HnC | ML | Honeoye silt loam, 8 to 15 percent slopes
- HsD | ML | Honeoye and Lansing soils, 14 to 20 percent slopes
- KeB | ML | Kendaia silt loam, 3 to 8 percent slopes
- KlA | ML | Kendaia and Lyons soils, 0 to 3 percent slopes
- LgB | ML | Langford channery silt loam, 2 to 8 percent slopes
- LgC | ML | Langford channery silt loam, 8 to 15 percent slopes
- LgCK | ML | Langford channery silt loam, rolling
- LgD | PT | Langford channery silt loam, 15 to 25 percent slopes
- LhE | PT | Langford-Howard complex, 25 to 45 percent slopes
- LsB | ML | Lansing gravelly silt loam, 3 to 8 percent slopes
- LsC | ML | Lansing gravelly silt loam, 8 to 15 percent slopes
- LtA | ML | Lima silt loam, 0 to 3 percent slopes
- LtB | ML | Lima silt loam, 3 to 8 percent slopes
- LwB | ML | Lordstown channery silt loam, 2 to 8 percent slopes
- Mr | PT | Muck, deep
- Ms | PT | Muck, shallow
- OdB | ML | Odessa silt loam, 3 to 8 percent slopes
- OtE | ML | Ontario, Honeoye, and Lansing soils, 20 to 35 percent slopes
- OtF | ML | Ontario, Honeoye, and Lansing soils, 35 to 50 percent slopes
- OvB | ML | Ovid silt loam, 2 to 6 percent slopes
- PaB | SC | Palmyra gravelly sandy loam, 3 to 8 percent slopes
- PaC | SC | Palmyra gravelly sandy loam, 8 to 15 percent slopes
- PgA | SC | Palmyra gravelly loam, 0 to 3 percent slopes
- PgB | SC | Palmyra gravelly loam, 3 to 8 percent slopes
- PgC | SC | Palmyra gravelly loam, 8 to 15 percent slopes
- PmD | SC | Palmyra soils, 15 to 25 percent slopes
- PnE | SC | Palmyra, Howard, and Alton soils, 25 to 40 percent slopes
- Pv | CL-ML | Phelps gravelly silt loam
- Qu | N/A | Quarries
- SeB | ML | Schoharie silt loam, 2 to 6 percent slopes
- ShC | ML | Schoharie silty clay loam, 6 to 12 percent slopes
- Sn | CL | Sloan silt loam
- W | Water | Water

Westwood

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Westwood Professional Services, Inc.

N

0 2,000 Feet

Agricola Wind

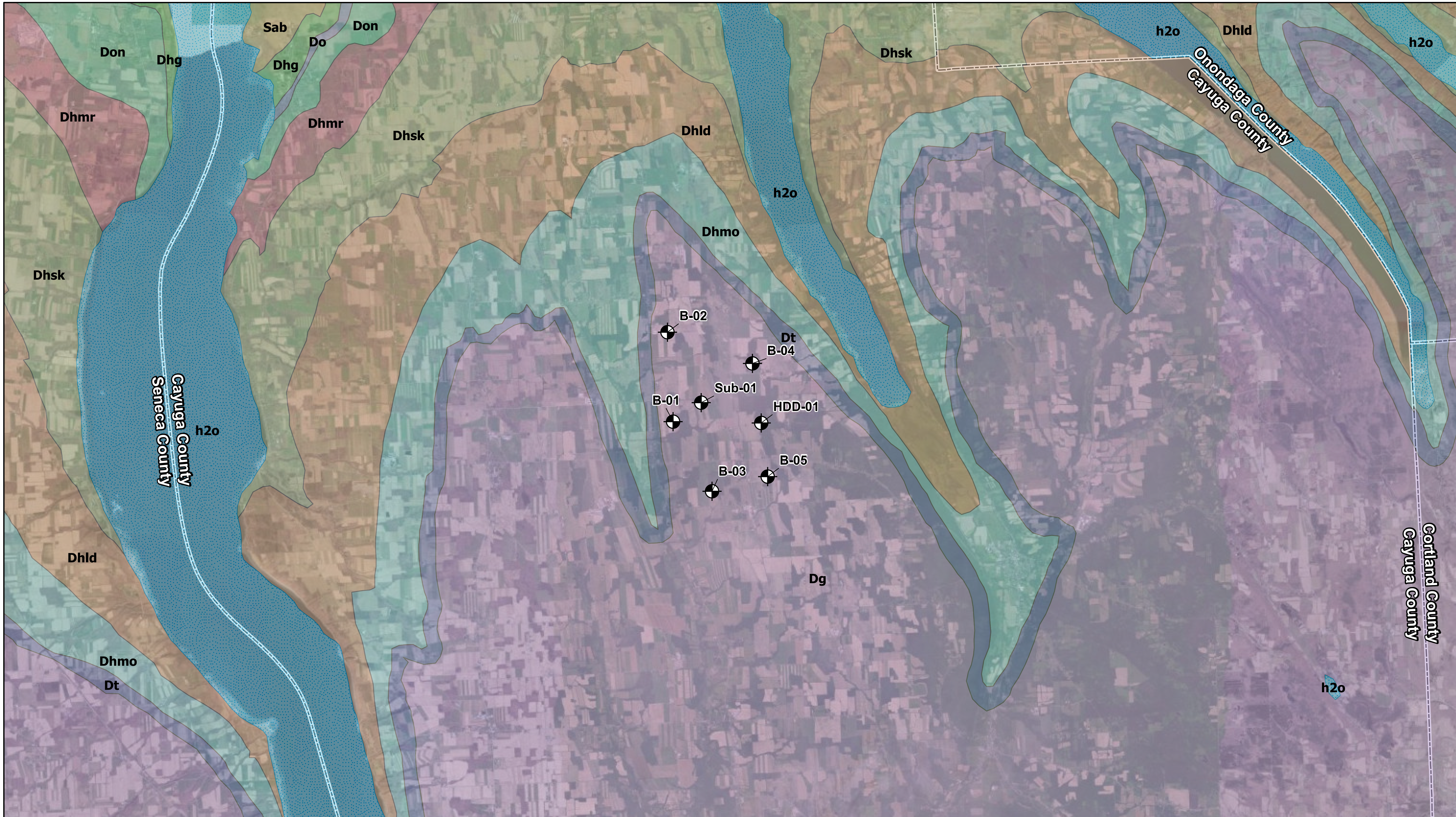
Cayuga County, NY

Surficial Soils Map

EXHIBIT 3

October 4, 2023

Map Document: \\westwoodps.local\Global Projects\0042617.01_GIS\R0042617_080_Agricola_Geotech\R0042617_080_Agricola_Geotech.aprx 2023-10-04 6:11 PM CHeins



Data Source(s): Westwood (2023); Iowa NAIP Imagery (2019); Census Bureau (2020); USGS (2018).

Legend

- Boring Location
- County Boundary

Geologic Unit Symbol | Geologic Unit Name | Geologic Unit Age

- Dg | Genesee Group | Phanerozoic - Paleozoic - Devonian - Late-Devonian
- Dhg | Helderberg Group | Phanerozoic - Paleozoic - Devonian - Early-Devonian
- Dhld | Ludlowville Formation | Phanerozoic - Paleozoic - Devonian - Middle-Devonian - Givetian
- Dhmo | Moscow Formation | Phanerozoic - Paleozoic - Devonian - Middle-Devonian - Givetian
- Dhmr | Marcellus Formation | Phanerozoic - Paleozoic - Devonian - Middle-Devonian - Eifelian
- Dhsk | Skaneateles Formation | Phanerozoic - Paleozoic - Devonian - Middle-Devonian
- Do | Oriskany Sandstone | Phanerozoic - Paleozoic - Devonian - Early-Devonian
- Don | Onondaga Limestone | Phanerozoic - Paleozoic - Devonian - Middle-Devonian - Eifelian
- Dt | Tully Limestone | Phanerozoic - Paleozoic - Devonian - Middle-Devonian
- Sab | Akron Dolostone | Phanerozoic - Paleozoic - Silurian - Pridoli
- h2o | Water

Westwood

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Westwood Professional Services, Inc.

N

Feet

0 5,000

Agricola Wind

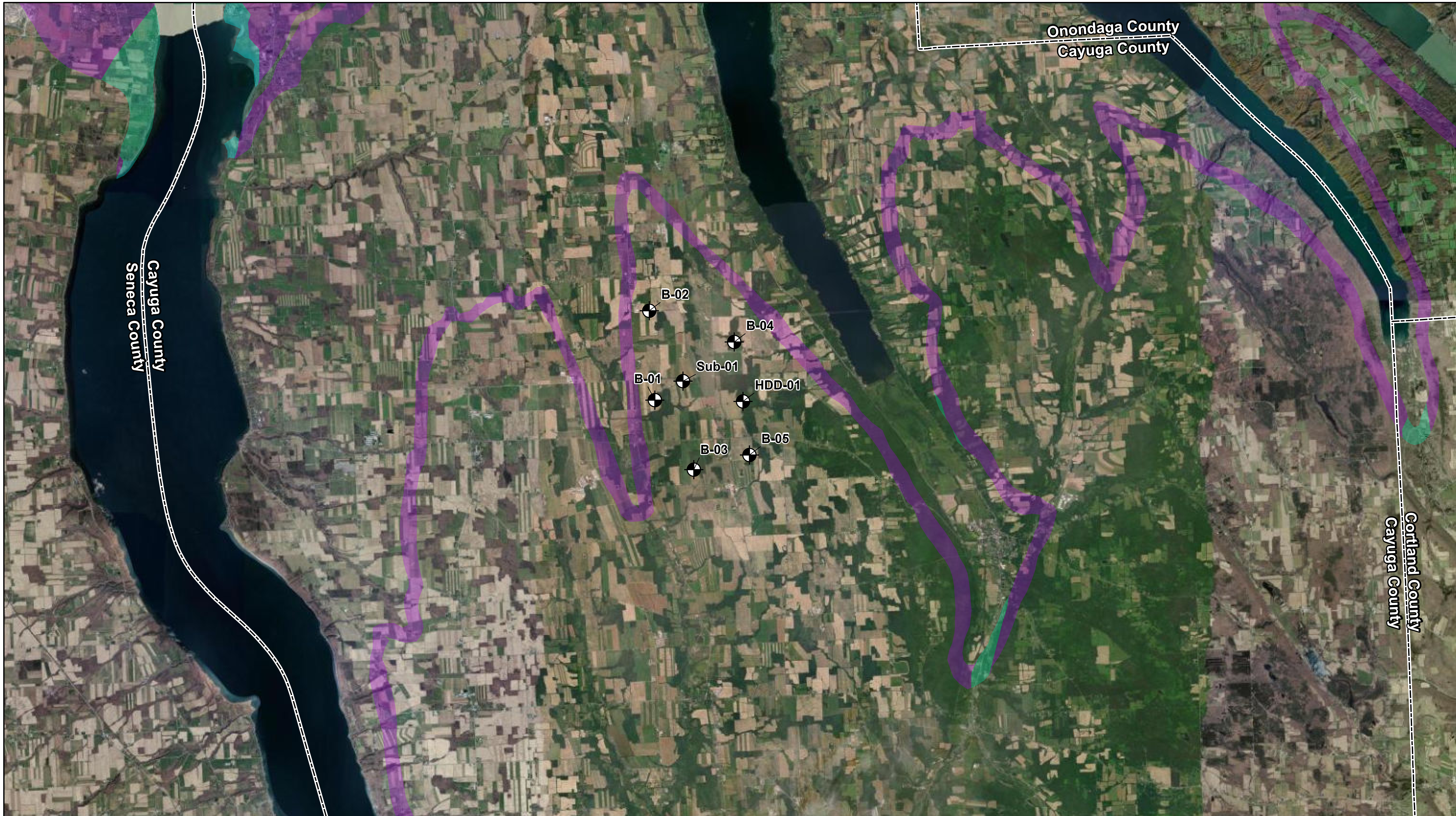
Cayuga County, NY

Local Geology Map

EXHIBIT 4

October 4, 2023

Map Document: \\westwoodps.local\Global Projects\0042617.01_GIS\R0042617_080_Agricola_Geotech\R0042617_080_Agricola_Geotech.aprx 2023-10-04 6:11 PM CHeins



Data Source(s): Westwood (2023); ESRI WMS National Geographic & World Streets Basemaps (Accessed 2021); Census Bureau (2020).

Legend

Boring Location

County Boundary

Carbonate Karst

- Carbonate rocks at or near the land surface in a humid climate
- Carbonate rocks buried under >50 ft of glacially derived insoluble sediments in a humid climate
- Carbonate rocks buried under ≤50 ft of glacially derived insoluble sediments in a humid climate

N

0 5,000 Feet

Agricola Wind

Cayuga County, NY

Karst Map
EXHIBIT 5

October 4, 2023

Westwood

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Map Document: \\westwoodps.local\Global Projects\0042617.01_GIS\R0042617_080_Agricola_Geotech\R0042617_080_Agricola_Geotech.aprx 2023-10-04 6:17 PM CHeins

Data Source(s): Westwood (2023); ESRI Aerial Imagery Basemap (Accessed 2020); USGS (2020). Areal Fault Data Source: Quaternary Faults and Fold Database, the U.S. Geological Survey. Earthquake Data Source: https://earthquake.usgs.gov/earthquakes/search (2023)

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Legend

- Boring Location
- State Boundary
- County Boundary

Earthquakes by Magnitude

- < 3.0
- 3.1 - 3.5
- 3.6 - 4.0
- 4.1 - 4.4
- > 4.4

Agricola Wind

Cayuga County, NY

Seismic Hazards Map

EXHIBIT 6

October 4, 2023

Map Document: \\westwoodps.local\Global Projects\0042617.01_GIS\R0042617_080_Agricola_Geotech\R0042617_080_Agricola_Geotech.aprx 2023-10-04 6:17 PM CHeins

Appendix A

Soil Boring Logs

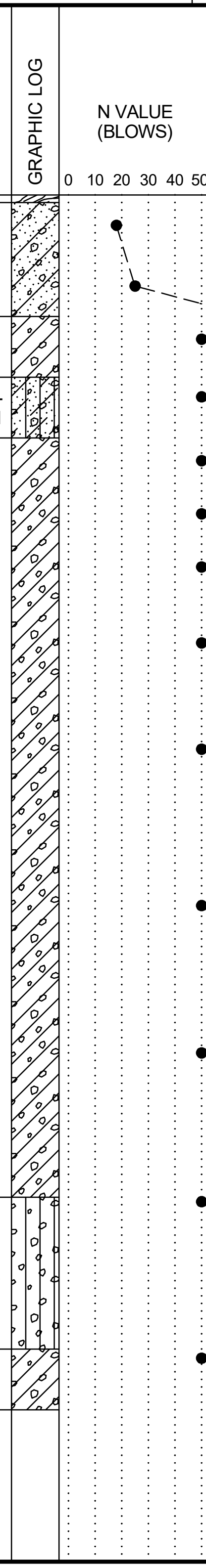
Westwood

SOIL BORING LOG

BORING NO. B-01

Facility/Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.749669 Long: -76.549239	---	39.8	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	Hollow Stem Auger CME 55	Logger - D. Riedemann Driller - A. Kempisty	7/19/23	7/20/23	DNE



SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	POCKET PEN (tsf) (* = brittle failure)	COMPRESSIVE STRENGTH (TSF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	P 200 (%)	COMMENTS
01 SS	67	3-6-12		**Topsoil** - 3" thick, brown, moderate organics		2.75* 4.25*						Coordinates are NAD83 Datum.
02 SS	54	12-14-11		**Lean Clay with Sand (CL)** - brown, moist, very stiff to hard	CL	4.5+ 4.5+		9.0				
03 SS	128	15-20-50/5"	5	**Gravelly Lean Clay (CL)** - brown, moist, hard	CL	4.25* 3.0*		8.2				
04 SS	90	39-38-50/4"		**Silty Clayey Sand with Gravel (SC-SM)** - brown, moist, very dense	SC-SM	1.75* 4.0*		8.3	17	4	40.6	
05 SS	111	24-42-50/5"		**Gravelly Lean Clay (CL)** - brown, moist, hard, possible residual bedrock or saprolite	CL							
06 SS	108	30-50/5"	10									
07 SS	83	50/5"										
08 SS	94	11-30-50/5"	15	- gray								
09 SS	83	50/5"										
			20									Piezometer installed to a depth of 20 ft bgs with 5 ft of screen.
10 SS	94	35-50/4"	25									
11 SS	83	50/5"	30	- moist to wet								
12 SS	167	50/4"	35	**Gravelly Silt with Sand (ML)** - gray, moist, hard, possible residual bedrock or saprolite	ML							
13 SS	69	43-50/2"	40	**Lean Clay with Gravel (CL)** - gray, moist, hard, possible residual bedrock or saprolite	CL							Auger Refusal.

BORING TERMINATED AT 38.2 FT DUE TO AUGER REFUSAL.

Checked By:	Date:	Approved By:	Date:	Firm:
C. Enos	9/20/23	S. Jorgensen	9/22/23	Westwood Professional Services (952) 937-5150 12701 Whitewater Drive, Suite 300 Minnetonka, MN 55343

Westwood

SOIL BORING LOG

BORING NO. B-02

Facility/Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.774123 Long: -76.55132	---	36.0	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	Hollow Stem Auger CME 55	Logger - D. Riedemann Driller - A. Kempisty	7/17/23	7/17/23	6.9

SAMPLE NUMBER AND TYPE	RECOVERY (%) (RQD)	BLOW COUNTS	POCKET PEN (tsf) (* = brittle failure)	COMPRESSIVE STRENGTH (TSF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	P 200 (%)
01 SS	75	3 4 6	4.5+ 3.75					
02 SS	75	6 5 4	2.0 4.5+		12.4			
03 SS	75	3 2 2	2.0 0.5					
04 ST	58		4.5+		10.4	28	10	40.1
05 SS	75	7 18 32	4.25 4.5+					
06 SS	93	33 50/4"	4.25					
07 SS	100	50/4"						
01 RC	33 (0)							
02 RC	100 (0)							
03 RC	100 (0)							
04 RC	100 (38)							
05 RC	100 (40)							
06 RC	100 (52)							

LITHOLOGIC DESCRIPTION	USCS
Topsoil - 4" thick, dark brown, moderate organics	
Lean Clay with Sand (CL) - brown, moist, stiff to hard - gray	CL
Clayey Sand with Gravel (SC-SM) - brown, moist, very dense	SC-SM
Lean Clay with Sand (CL) - dark brown , moist, hard	CL
Sandy Lean Clay (CL) - dark brown, moist, hard, possible residual bedrock or saprolite	CL
Shale - dark gray, extreme to moderate rock continuity, hard field hardness, slightly weathered, flakey	

BORING TERMINATED. TARGET DEPTH REACHED.

COMMENTS:

Coordinates are NAD83 Datum.

Auger Refusal at 13.5 ft.

Piezometer installed to a depth of 20 ft bgs with 5 ft of screen.

WW_BORING LOG_PP_AGRICOLA WIND_SOIL BORING LOGS.GPJ RMT_CORP.GDT 0042617.01 10/3/23

Checked By:	Date:	Approved By:	Date:	Firm:
C. Enos	9/20/23	S. Jorgensen	9/22/23	Westwood Professional Services (952) 937-5150 12701 Whitewater Drive, Suite 300 Minnetonka, MN 55343

Westwood

ROCK CORE PHOTO

BORING NO. B-02

Project Name: Agricola Wind Project, Cayuga County, New York		**Boring Location:** Lat: 42.774123° Long: -76.551320°	**Surface Elev. (ft):** -	**Total Depth (ft bgs):** 36.0	**Borehole Dia. (in):** 8.0
Drilling Firm: Earth Dimensions, Inc.	**Drilling Method:** RC - Rock Core	**Personnel:** Logger: D. Riedemann Driller: A. Kempisty	**Date Started:** 7/18/2023	**Date Completed:** 7/18/2023	**Water Depth (ft bgs):** 6.9

Westwood

SOIL BORING LOG

BORING NO. B-03

Facility/Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.730633 Long: -76.534724	---	36.5	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	Hollow Stem Auger CME 55	Logger - D. Riedemann Driller - A. Kempisty	7/21/23	7/24/23	28

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	POCKET PEN (tsf) (* = brittle failure)	COMPRESSIVE STRENGTH (TSF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	P 200 (%)	COMMENTS
01 SS	96	2 3 5		**Topsoil** - 4" thick, dark brown, roots, moderate organics		2.0* 3.75*						Coordinates are NAD83 Datum.
02 SS	50	3 4 3		**Lean Clay with Sand (CL)** - brown, moist, stiff to hard	CL	2.0* 4.25		15.7				
03 SS	92	6 7 16	5	**Lean Clay with Gravel (CL)** - brown, moist, hard	CL	1.5* 3.25*						
04 SS	96	22 53 31		**Gravelly Lean Clay with Sand (CL)** - brown, moist, hard	CL	3.5 4.25*						
05 SS	100	30 44 50/5"		**Silty Clay with Sand and Gravel (CL-ML)** - brown, moist, hard	CL-ML	2.75* 2.5*		7.0	17	4		
06 SS	107	29 48 50/3"	10	**Lean Clay with Gravel (CL)** - reddish brown, moist, hard	CL							
07 SS	50	50/5"		**Poorly Graded Sand with Clay and Gravel (SP-SC)** - brown, moist, very dense, possible residual bedrock or saprolite	SP-SC							
08 SS	111	50/4"	15	**Poorly Graded Gravel with Sand (GP)** - gray, moist, very dense, possible residual bedrock or saprolite	GP							
09 SS	83	50/5"	20	**Lean Clay with Gravel (CL)** - gray, moist, hard, possible residual bedrock or saprolite	CL							Piezometer installed to a depth of 20 ft bgs with 5 ft of screen.
10 SS	111	50/4"	25									
11 SS	183	23 50/5"	30	- wet								
12 SS	183	32 50/5"	35									
			40	**BORING TERMINATED AT 34 FT DUE TO AUGER REFUSAL.**								

N VALUE (BLOWS) 0 10 20 30 40 50

Checked By:	Date:	Approved By:	Date:	Firm:
C. Enos	9/20/23	S. Jorgensen	9/22/23	Westwood Professional Services (952) 937-5150 12701 Whitewater Drive, Suite 300 Minnetonka, MN 55343

Westwood

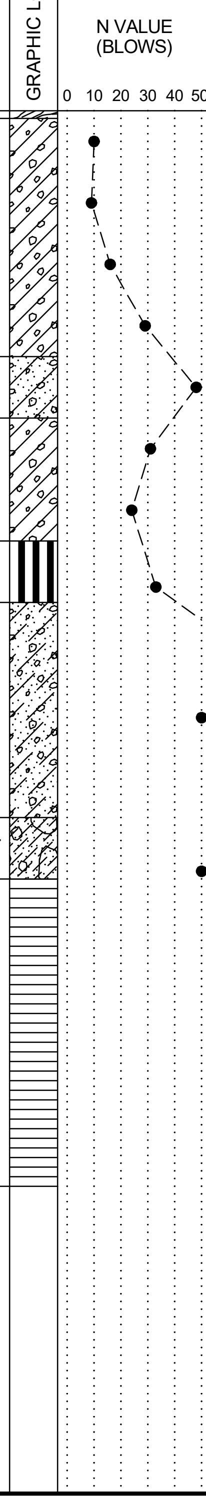
SOIL BORING LOG

BORING NO. B-04

Facility/Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.765588 Long: -76.519675	---	25.0	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	Hollow Stem Auger CME 55	Logger - D. Riedemann Driller - A. Kempisty	7/18/23	7/18/23	11.2

SAMPLE NUMBER AND TYPE	RECOVERY (%) (RQD)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	POCKET PEN (tsf) (* = brittle failure)	COMPRESSIVE STRENGTH (TSF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	P 200 (%)	COMMENTS
01 SS	42	4 4 6		**Topsoil** - 3" thick, dark brown, roots, moderate organics **Gravelly Lean Clay (CL)** - brown, moist, stiff to hard	CL	1.5* 3.5*		16.0			50.5	Coordinates are NAD83 Datum.
02 SS	54	9 6 3				2.0* 1.5*						
03 SS	75	2 6 10	5			3.0* 0.5		14.1	33	14		
04 SS	29	12 14 15				2.25 4.5+						
05 SS	100	12 19 29		**Lean Clay with Gravel (CL)** - grayish brown, moist, hard	CL	4.5+		11.3				
06 SS	100	15 17 14	10	**Gravelly Lean Clay (CL)** - gray, moist, hard	CL	3.75* 4.5+						
07 SS	100	9 11 13				4.5+						
08 SS	75	18 16 17	15	**Silt with Sand and Gravel (ML)** - light gray, moist, hard	ML	4.5+						
				Poorly Graded Sand with Clay and Gravel (SP-SC) - light gray, dry, very dense	SP-SC							
09 SS	17	50/1"	20	- possible residual bedrock or saprolite								Piezometer installed to a depth of 20 ft bgs with 5 ft of screen.
10 SS	67	50/5"	25	**Poorly Graded Gravel with Clay and Sand (GP-GC)** - gray, wet, very dense, likely weathered bedrock	GP-GC							Auger Refusal at 25.
01 RC	100 (22)			**Shale** - gray, moderate rock continuity, hard field hardness, fresh weathering, massive bedding, flakey								
02 RC	100 (55)		30									
			35	**BORING TERMINATED. TARGET DEPTH REACHED**								
			40									



Checked By:	Date:	Approved By:	Date:	Firm:
C. Enos	9/20/23	S. Jorgensen	9/22/23	Westwood Professional Services (952) 937-5150 12701 Whitewater Drive, Suite 300 Minnetonka, MN 55343

Westwood

ROCK CORE PHOTO

BORING NO. B-04

Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.765588° Long: -76.519675°	-	35.0	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	RC - Rock Core	Logger: D. Riedemann Driller: A. Kempisty	7/18/2023	7/18/2023	11.2

Westwood

SOIL BORING LOG

BORING NO. B-05

Facility/Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.734644 Long: -76.514005	---	38.5	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	Hollow Stem Auger CME 55	Logger - D. Riedemann Driller - A. Kempisty	7/21/23	7/21/23	> 18

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	POCKET PEN (tsf) (* = brittle failure)	COMPRESSIVE STRENGTH (TSF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	P 200 (%)	COMMENTS
01 SS	100	4 5 4		**Topsoil** - 4" thick, dark brown, moderate organics		4.25* 2.5*						Coordinates are NAD83 Datum.
02 SS	100	5 3 4		**Lean Clay with Sand and Gravel (CL)** - brown, moist, stiff	CL	2.75 1.0		12.7	29	12		
03 SS	100	2 6 14	5	**Sandy Lean Clay with Gravel (CL)** - grayish brown, moist, very stiff	CL	0.75 4.5+		10.8			51.3	
04 SS	92	44 43 37		**Gravelly Lean Clay with Sand (CL)** - light brown, moist, hard, possible residual bedrock or saprolite	CL	1.5* 4.0*						
05 SS	88	39 31 29		- yellowish brown		3.0* 4.0*						
06 SS	100	38 54 50/5"	10	- gray, possible residual bedrock or saprolite								
07 SS	58	58 50/5"										
08 SS	143	48 50/4"	15	- light gray								
09 SS	194	49 50/1"		- gray								Water added to aid augering. Piezometer installed to a depth of 20 ft bgs with 5 ft of screen.
			20									
10 SS	222	50/4"										
			25									
11 SS	150	50/5"	30	**Poorly Graded Gravel with Clay and Sand (GP-GC)** - gray, wet, very dense, possible residual bedrock or saprolite	GP-GC							
12 SS	133	50/5"	35	**Lean Clay with Gravel (CL)** - gray, moist, medium stiff to hard, possible residual bedrock or saprolite	CL							
13 SS	133	50/5"										
			40	**BORING TERMINATED AT 38.5 FT DUE TO AUGER REFUSAL.**								

Westwood

SOIL BORING LOG

BORING NO. HDD-01

Facility/Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.749311 Long: -76.516405	---	18.7	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	Hollow Stem Auger CME 55	Logger - D. Riedemann Driller - A. Kempisty	7/26/23	7/26/23	17.4

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	POCKET PEN (tsf) (* = brittle failure)	COMPRESSIVE STRENGTH (TSF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	P 200 (%)
01 SS	75	1 3 10	2.0 4.5+					
02 SS	122	6 7 9	2.75 3.75		10.6			
03 SS	100	15 12 14	3.5* 2.0*		11.0			46.3
04 SS	100	15 17 20	2.0* 4.5+					47.9
05 SS	46	19 23 39	3.75* 4.5+					
06 SS	75	24 17 15	3.75* 4.5+					
07 SS	100	5 8 26	4.25* 3.5*					
08 SS	100	20 31 46	4.5+ 4.5+					
09 SS	28	50/2"						
10 SS	14	50/1"						

DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS
0	**Topsoil** - 3" thick, dark brown, roots, moderate organics	
	Lean Clay (CL) - gray, moist, stiff to hard	CL
4	**Clayey Sand with Gravel (SC)** - gray, moist, medium dense to dense	SC
8	**Gravelly Lean Clay with Sand (CL)** - gray, moist, hard	CL
18	**Poorly Graded Gravel with Sand (GP)** - gray, moist, very dense, likely weathered bedrock	GP
	BORING TERMINATED AT 18.7 FT DUE TO AUGER REFUSAL.	

N VALUE (BLOWS): 0 10 20 30 40 50

COMMENTS: Coordinates are NAD83 Datum.

WW_BORING LOG_PP_AGRICOLA WIND_SOIL BORING LOGS.GPJ RMT_CORP.GDT 0042617.01 10/3/23

Checked By:	Date:	Approved By:	Date:	Firm:
C. Enos	9/20/23	S. Jorgensen	9/22/23	Westwood Professional Services (952) 937-5150 12701 Whitewater Drive, Suite 300 Minnetonka, MN 55343

Westwood

SOIL BORING LOG

BORING NO. Sub-1

Facility/Project Name:	Boring Location:	Surface Elev. (ft):	Total Depth (ft bgs):	Borehole Dia. (in):
Agricola Wind Project Cayuga County, New York	Lat: 42.754865 Long: -76.538762	---	40.0	8.0

Drilling Firm:	Drilling Method:	Personnel:	Date Started:	Date Completed:	Water Depth (ft bgs):
Earth Dimensions, Inc.	Hollow Stem Auger CME 55	Logger - D. Riedemann Driller - A. Kempisty	7/20/23	7/20/23	28

USCS	LITHOLOGIC DESCRIPTION
CL	**Topsoil** - 3" thick, dark brown, roots, moderate organics
CL	**Lean Clay (CL)** - brown, moist, very stiff, few sand
CL	- 6" thick gray loose gravel lense **Gravelly Lean Clay with Sand (CL)** - brown, moist, stiff to hard - gray, flakey, possible residual bedrock or saprolite - wet
GP-GC	**Poorly Graded Gravel with Clay and Sand (GP-GC)** - gray, moist, very dense, likely weathered bedrock
CL	**Gravelly Lean Clay with Sand (CL)** - gray, moist, hard, likely weathered bedrock
	BORING TERMINATED AT 38.25 FT DUE TO AUGER REFUSAL.

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	POCKET PEN (tsf) (* = brittle failure)	COMPRESSIVE STRENGTH (TSF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	P 200 (%)	COMMENTS
01 SS	92	5 3 6	4.0 2.0*		24.4	24	8	88.2	Coordinates are NAD83 Datum.
02 SS	25	16 11 11	3.0						
03 SS	25	4 4 13	1.5						
04 SS	100	11 10 15	1.5* 2.0*		15.8				
05 SS	88	11 14 15	3.5 4.5+						
06 SS	167	38 50/4"							
07 SS	148	36 50/4"							
08 SS	95	52 50/2"							
09 SS	83	50/5"							
10 SS	83	50/5"							Piezometer installed to a depth of 20 ft bgs with 5 ft of screen.
11 SS	83	50/5"							Water added to aid drilling.
12 SS	83	50/4"							
13 SS	167	50/4"							Auger Refusal.

DEPTH IN FEET: 5, 10, 15, 20, 25, 30, 35, 40

N VALUE (BLOWS): 0 10 20 30 40 50

GRAPHIC LOG

Checked By:	Date:	Approved By:	Date:	Firm:
C. Enos	9/20/23	S. Jorgensen	9/22/23	Westwood Professional Services (952) 937-5150 12701 Whitewater Drive, Suite 300 Minnetonka, MN 55343

Appendix B

Electrical Resistivity Test Reports

Westwood

Electrical Resistivity Test Results
Wenner 4-Electrode Method
Agricola Wind - Cayuga Co., NY

ER-SUB-01
Location: 42.754824, -76.538748
Description: 71°, sunny, gently sloped, clay, dry **Date:** 7/19/2023

North-South Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	20.7	260	79.3
5.0	1.5	9.54	300	91.4
10.0	3.0	5.30	333	102
20.0	6.1	3.06	385	117
30	9.1	2.30	434	132
50	15.2	1.66	522	159
100	30.5	1.09	685	209
200	61	0.74	930	283

East-West Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	20.0	251	76.6
5.0	1.5	10.00	314	95.8
10.0	3.0	5.32	334	102
20.0	6.1	3.12	392	120
30	9.1	2.31	435	133
50	15.2	1.70	534	163
100	30.5	1.05	660	201
200	61	0.64	804	245

ER-03
Location: 42.774256, -76.550392
Description: 82°, hazy, gently sloped, clay, dry **Date:** 7/17/2023

North-South Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	20.30	122	37.2
5.0	1.5	8.25	259	79.0
10.0	3.0	6.37	400	122
20.0	6.1	4.79	602	183
30	9.1	4.10	773	236
50	15.2	3.17	996	304
100	30.5	1.93	1210	370

East-West Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	21.5	270	82.3
5.0	1.5	8.34	262	79.9
10.0	3.0	5.98	376	115
20.0	6.1	4.89	614	187
30	9.1	4.22	795	242
50	15.2	3.19	1000	305
100	30.5	1.85	1160	354

ER-09
Location: 42.730674, -76.534703
Description: 76°F, overcast, gently sloped, clay, moist **Date:** 7/24/2023

North-South Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	25.7	323	98.4
5.0	1.5	9.72	305	93.1
10.0	3.0	5.46	343	105
20.0	6.1	3.52	442	135
30	9.1	2.77	522	159
50	15.2	1.97	619	189
100	30.5	1.25	785	239

East-West Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	25.4	319	97.3
5.0	1.5	9.28	292	88.9
10.0	3.0	5.71	359	109
20.0	6.1	3.50	440	134
30	9.1	2.72	513	156
50	15.2	1.97	619	189
100	30.5	1.28	804	245

Westwood

Electrical Resistivity Test Results
Wenner 4-Electrode Method
Agricola Wind - Cayuga Co., NY

ER-20
Location: 42.765401, -76.519475
Description: 74°, hazy, gently sloped, clay, dry
Date: 7/18/2023

North-South Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	34.70	436	133
5.0	1.5	10.10	317	96.7
10.0	3.0	5.14	323	98.4
20.0	6.1	3.12	392	120
30	9.1	2.44	460	140
50	15.2	1.86	584	178
100	30.5	1.27	798	243

East-West Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	37.40	470	143
5.0	1.5	10.10	317	96.7
10.0	3.0	5.27	331	101
20.0	6.1	3.15	396	121
30	9.1	2.49	469	143
50	15.2	1.86	584	178
100	30.5	1.31	823	251

ER-22
Location: 42.733975, -76.513984
Description: 77°, sunny, gently sloped, clay, dry
Date: 7/19/2023

North-South Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	17.20	122	37.2
5.0	1.5	6.95	218	66.6
10.0	3.0	4.25	267	81.4
20.0	6.1	2.76	347	106
30	9.1	2.24	422	129
50	15.2	1.63	512	156
100	30.5	1.02	641	195

East-West Transect

ELECTRODE SPACING		MEASURED RESISTANCE	APPARENT RESISTIVITY	
(feet)	(meters)	(ohms)	(ohm-feet)	(ohm-meters)
2.0	0.6	19.8	249	75.8
5.0	1.5	7.03	221	67.3
10.0	3.0	4.19	263	80.2
20.0	6.1	2.86	359	110
30	9.1	2.24	422	129
50	15.2	1.65	518	158
100	30.5	1.06	666	203

Appendix C

Laboratory Testing Reports

Water Content Test Summary (ASTM:D2216)

Project:	Agricola	Job:	14533
Client	Westwood Surveying & Engineering	Date:	8/17/2023

Sample Information & Classification

Boring #	HDD-01	HDD-01	Sub-01	B-01	B-01	B-01	B-02	B-03
Sample #	SS-02	SS-04	SS-03	SS-02	SS-03	SS-04	SS-02	SS-02
Depth (ft)	2-4	6-8	4-6	2-4	4-6	6-8	2-4	2-4
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand and a little gravel (CL)	Clayey Sand w/gravel (SC)	Lean Clay w/sand (CL)	Sandy Lean Clay w/gravel (CL)	Sandy Lean Clay w/gravel (CL)	Silty Clayey Sand w/gravel (SC-SM)	Lean Clay w/sand and a little gravel (CL)	Lean Clay w/sand (CL)
Water Content (%)	10.6	11.0	15.8	9.0	8.2	8.3	12.4	15.7

Sample Information & Classification

Boring #	B-03	B-04	B-04	B-05	B-05			
Sample #	SS-05	S-02	SS-04	SS-02	SS-03			
Depth (ft)	8-10	2-4	6-8	2-4	4-6			
Type	Bag	Bag	Bag	Bag	Bag			
Material Classification	Silty Clay w/sand and gravel (CL-ML)	Clayey Gravel w/sand (GC)	Lean Clay w/sand and gravel (CL)	Lean Clay w/sand and gravel (CL)	Sandy Lean Clay w/gravel (CL)			
Water Content (%)	7.0	14.1	11.3	12.7	10.8			

Sample Information & Classification

Boring #								
Sample #								
Depth (ft)								
Type								
Material Classification								
Water Content (%)								

Sample Information & Classification

Boring #								
Sample #								
Depth (ft)								
Type								
Material Classification								
Water Content (%)								

Laboratory Test Summary

Project:	Agricola	Job:	14533
Client:	Westwood Surveying & Engineering	Date:	8/17/2023

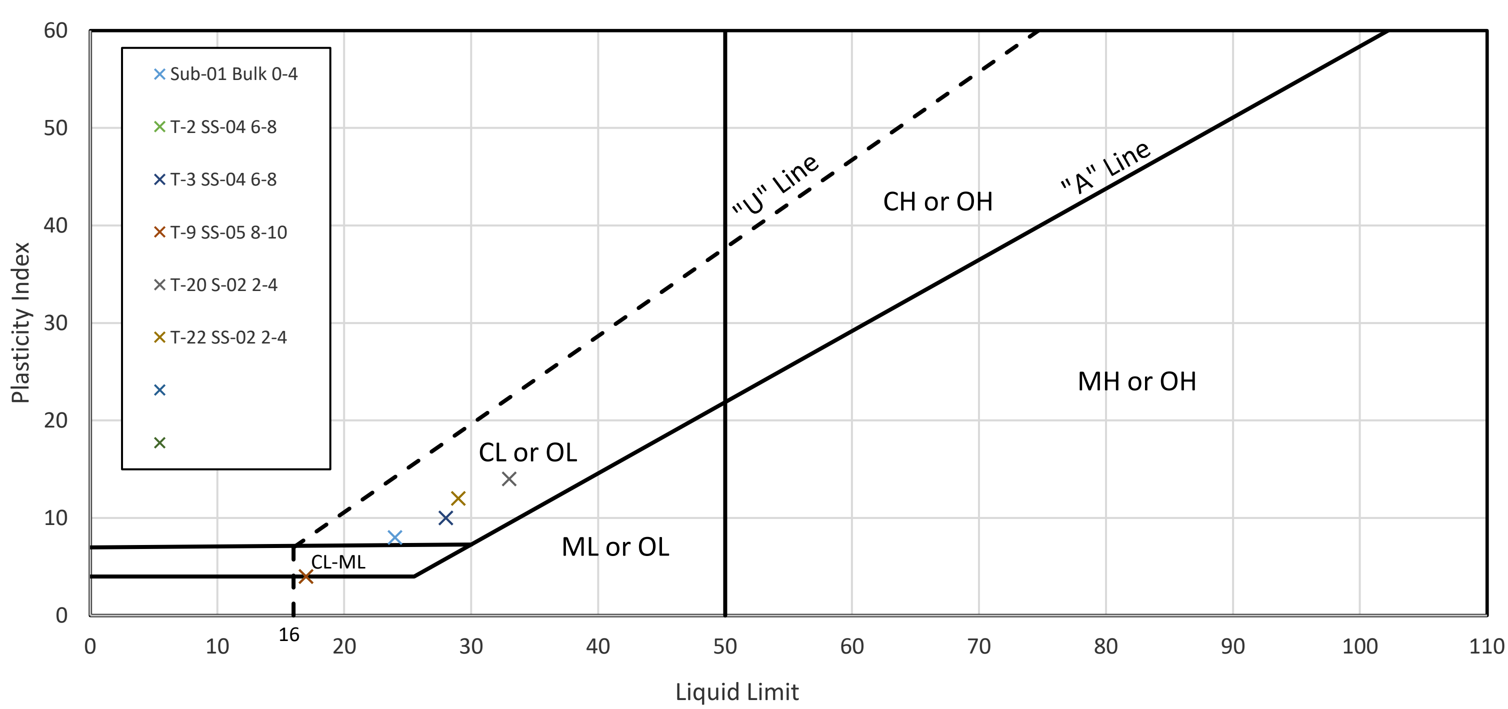
Sample Information & Classification

Boring #	Sub-01	B-01	B-03	B-03	B-04	B-05		
Sample #	Bulk	SS-04	SS-04	SS-05	S-02	SS-02		
Depth (ft)	0-4	6-8	6-8	8-10	2-4	2-4		
Sample Type	Bulk	Bag	TWT	Bag	Bag	Bag		
Material Classification	Clayey Sand w/a little gravel (SC)	Silty Clayey Sand w/gravel (SC-SM)	Clayey Sand w/gravel (SC)	Silty Clay w/sand and gravel (CL-ML)	Clayey Gravel w/sand (GC)	Lean Clay w/sand and gravel (CL)		

Atterberg Limits (ASTM:D4318)

Liquid Limit	24	17	28	17	33	29		
Plastic Limit	16	13	18	13	19	17		
Plasticity Index	8	4	10	4	14	12		

Plasticity Chart (ASTM:D2487)



9530 James Ave South

SOIL ENGINEERING TESTING, INC.

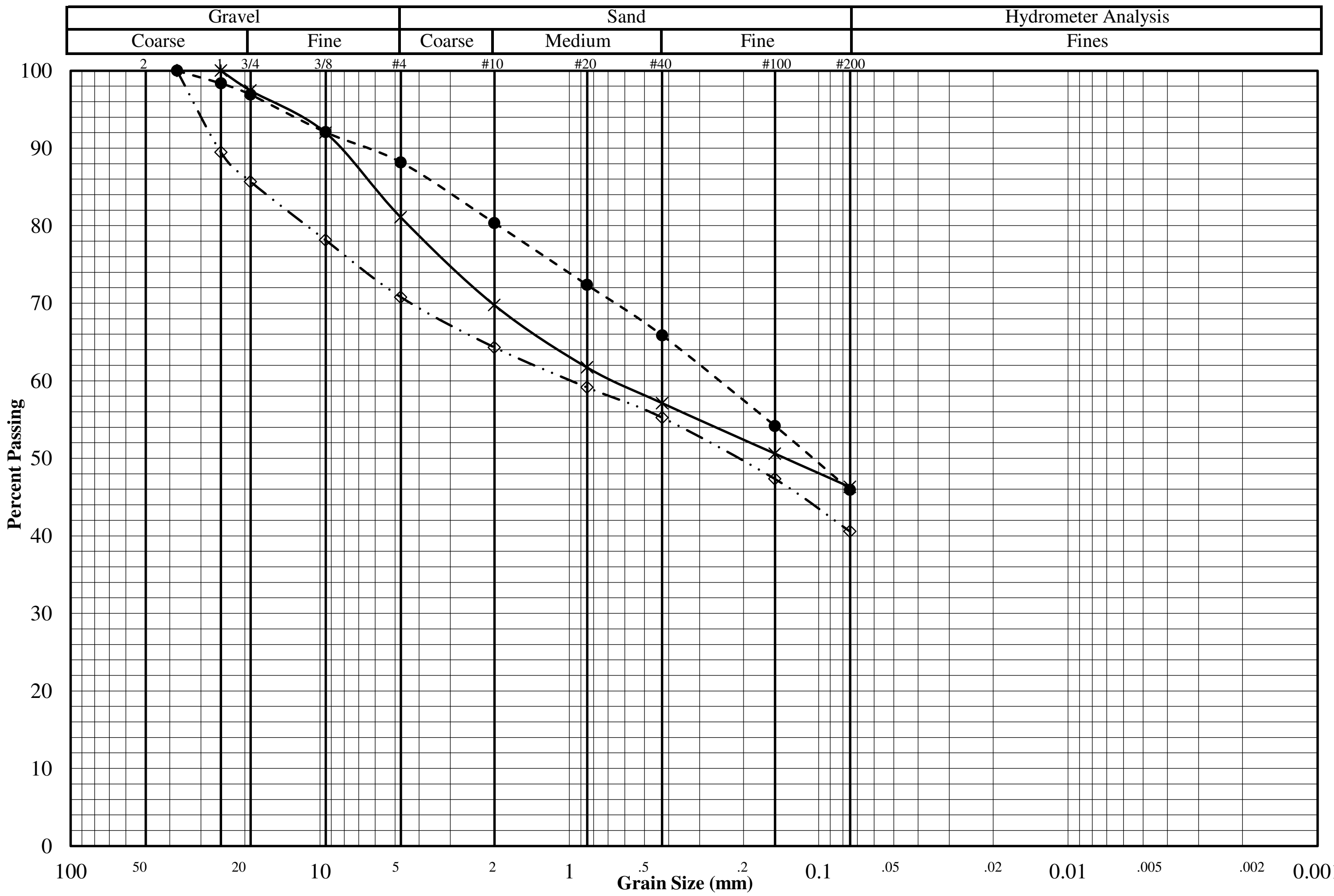
Bloomington, MN 55431

Grain Size Distribution ASTM D422-16

Job No. : **14533**

Project:	Agricola	Test Date:	8/8/23
Reported To:	Westwood Surveying & Engineering	Report Date:	8/15/23

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	HDD-01	SS-03	4-6	Bag	Clayey Sand w/gravel (SC)
●	Sub-01		0-4	Bulk	Clayey Sand w/a little gravel (SC)
◇	B-01	SS-04	6-8	Bag	Silty Clayey Sand w/gravel (SC-SM)



Additional Results	*	●	◇
Liquid Limit		24	17
Plastic Limit		16	13
Plasticity Index ASTM:D4318		8	4
Water Content ASTM:D2216			8.3
Dry Density (pcf) ASTM:D7263			
Specific Gravity ASTM:D854			
Porosity			
Organic Content ASTM:D2974			
pH ASTM:D4972 Method B		7.8	

Percent Passing

	*	●	◇
Mass (g)	624.8	24403.0	477.1
2"			
1.5"		100.0	100.0
1"	100.0	98.4	89.5
3/4"	97.4	96.9	85.7
3/8"	92.0	92.1	78.1
#4	81.1	88.2	70.8
#10	69.8	80.4	64.3
#20	61.7	72.4	59.1
#40	57.1	65.9	55.3
#100	50.6	54.2	47.4
#200	46.3	45.9	40.6

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

(* = assumed)

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

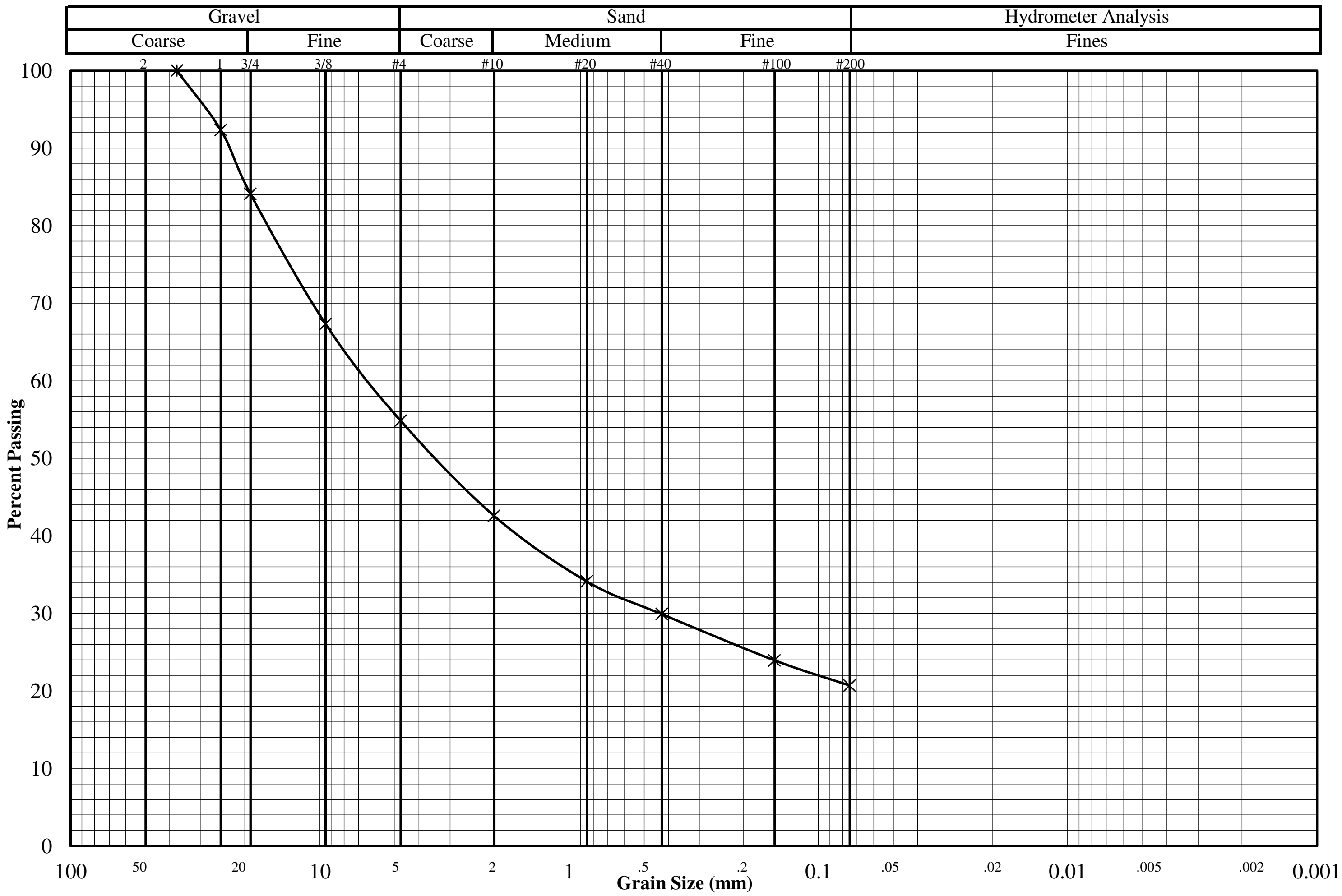
Bloomington, MN 55431

Grain Size Distribution ASTM D422-16

Job No. : **14533**

Project:	Agricola	Test Date:	8/8/23
Reported To:	Westwood Surveying & Engineering	Report Date:	8/15/23

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	B-04	S-02	2-4	Bag	Clayey Gravel w/sand (GC)
●					
◇					



Additional Results	*	●	◇
Liquid Limit	33		
Plastic Limit	19		
Plasticity Index ASTM:D4318	14		
Water Content ASTM:D2216	14.1		
Dry Density (pcf) ASTM:D7263			
Specific Gravity ASTM:D854			
Porosity			
Organic Content ASTM:D2974			
pH ASTM:D4972 Method B			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	392.7		
2"			
1.5"	100.0		
1"	92.4		
3/4"	84.1		
3/8"	67.3		
#4	54.8		
#10	42.6		
#20	34.1		
#40	29.9		
#100	24.0		
#200	20.7		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

pH Testing Summary Sheet (ASTM:D4972)

Project: **Agricola** Job: **14533**
Client: **Westwood Surveying & Engineering** Date: **8/28/2023**

Boring / Location	Sample	Sample Type	Depth (ft)	pH	Visual Classification
Sub-01		**Bulk**	**0-4**	**7.8**	**Clayey Sand w/a little gravel (SC)**
TH-01		**Bulk**	**0-4**	**7.6**	**Sandy Lean Clay w/a little gravel (CL)**
B-04		**Bulk**	**0-4**	**7.3**	**Sandy Lean Clay w/gravel (CL)**

Soil Resistivity Results

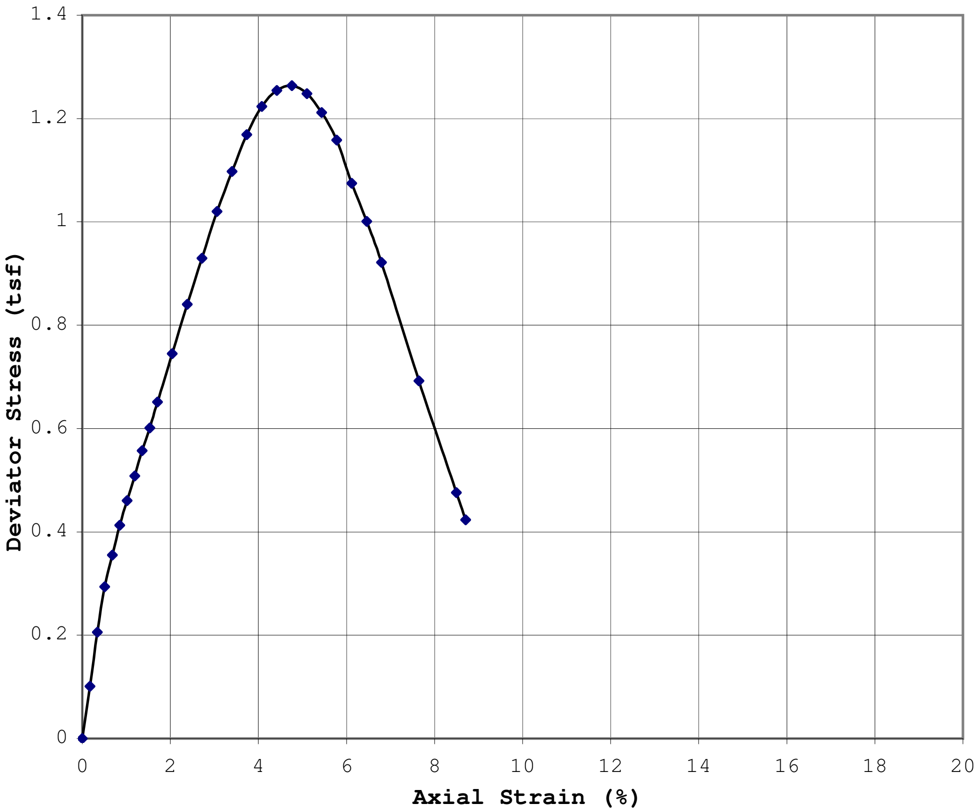
(ASTM G57 - Laboratory Soil Box)

Project:	**Agricola**				**Job #:**	**14533**
Client:	**Westwood Surveying & Engineering**				**Date:**	**8/17/23**
Sample Information & Classification						
Boring	TH-01	B-04	Sub-01			
Sample						
Depth (ft)	0-4	0-4	0-4			
Sample Type	Bulk	Bulk	Bulk			
Soil Classification	Sandy Lean Clay w/a little gravel (CL)	Sandy Lean Clay w/gravel (CL)	Clayey Sand w/a little gravel (SC)			
Water Content & Density (As Received)						
Water Content (%)	24.0	15.4	12.2			
Dry Density (PCF)	95.4	116.3	114.8			
Water Content & Density (Saturated)						
Water Content (%)	**27.7**	**18.3**	**18.0**			
Dry Density (PCF)	**92.7**	**111.3**	**114.0**			
Resistivity (ohm-cm) (ASTM G57)						
As Received Moisture Content Resistivity (ohm-cm)	**4,220**	**3,980**	**7,940**			
Saturated Condition Resistivity (ohm-cm)	**3,990**	**3,900**	**6,370**			

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Agricola | Job: 14533
Client: Westwood Surveying & Engineering | Date: 8/9/23
Remarks:



Boring: B-02 Depth: 6-8
Sample #: ST-04

Soil Type: Clayey Sand w/gravel (SC)

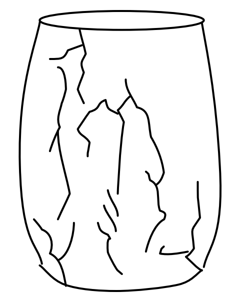
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.86 Ht. (in) 5.89
Height to Diameter Ratio: 2.1

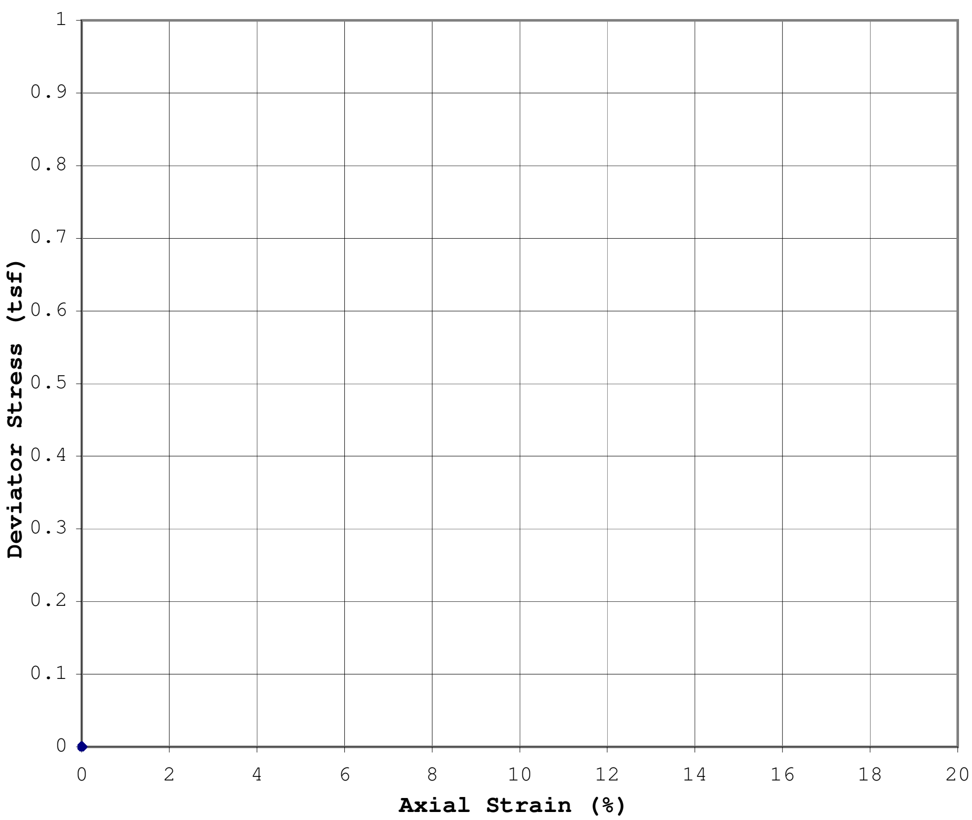
Unconfined Comp. Strength: **1.26** **tsf**
Strain at Failure (%): **4.8**

W.C. (%): 10.4
Yd (pcf): 125.5

LL: 28
PL: 18
PI: 10

Sketch of Specimen After Failure





Boring: Depth:
Sample #:

Soil Type:

Strain Rate (in/min):
Sample Type:

Dia. (in): Ht. (in):
Height to Diameter Ratio:

Unconfined Comp. Strength: **tsf**
Strain at Failure (%):

W.C. (%):
Yd (pcf):

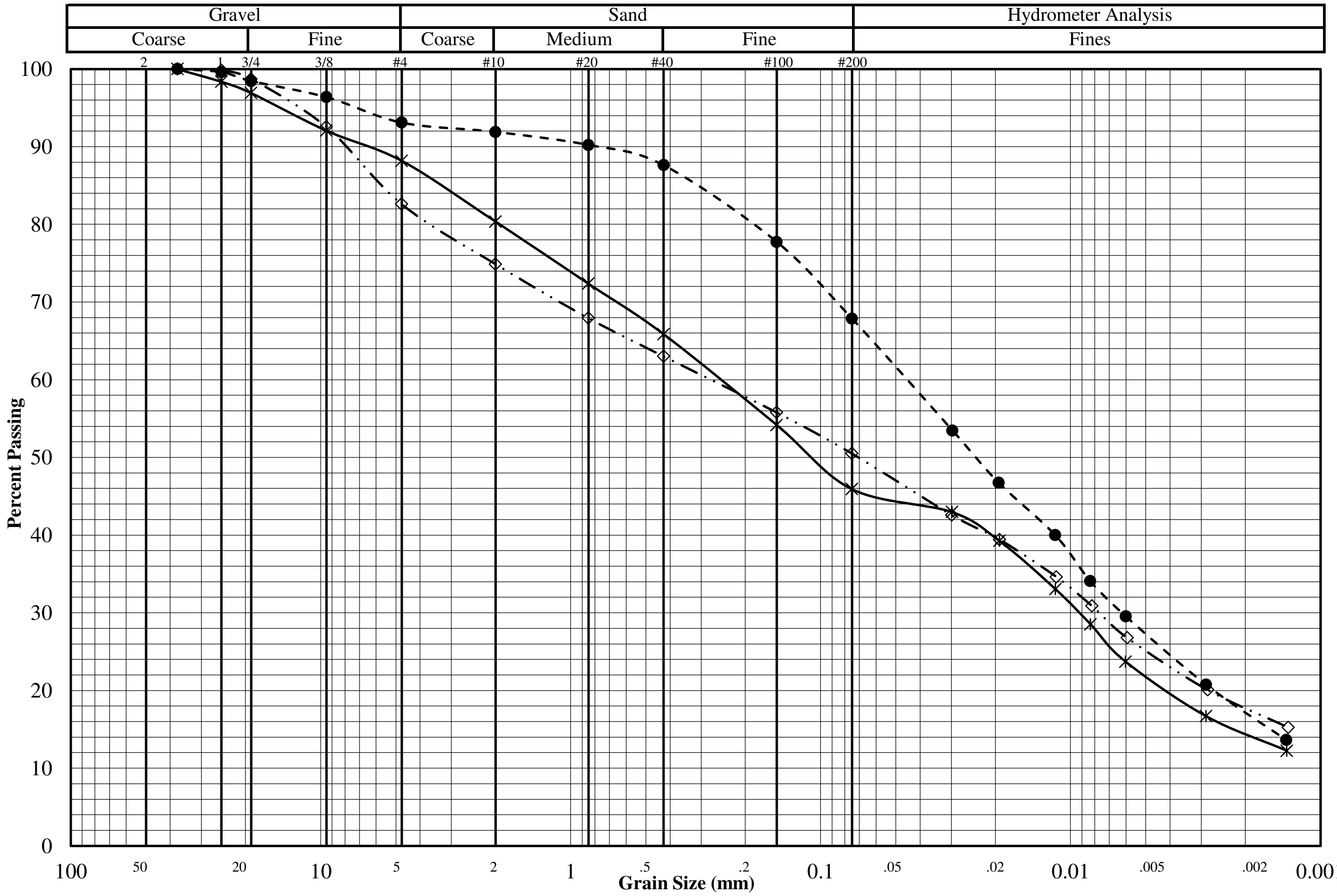
Sketch of Specimen After Failure

9530 James Ave South
SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55431

Grain Size Distribution ASTM D422-16

Job No. :	14533
Project: Agricola	Test Date: 8/22/23
Reported To: Westwood Surveying & Engineering	Report Date: 8/28/23

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Sub-01		0-4	Bulk	Clayey Sand w/a little gravel (SC)
●	TH-01		0-4	Bulk	Sandy Lean Clay w/a little gravel (CL)
◇	B-04		0-4	Bulk	Sandy Lean Clay w/gravel (CL)



Additional Results	*	●	◇
Liquid Limit	24		
Plastic Limit	16		
Plasticity Index ASTM:D4318	8		
Water Content ASTM:D2216			
Dry Density (pcf) ASTM:D7263			
Specific Gravity ASTM:D854	2.68*	2.68*	2.68*
Porosity			
Organic Content ASTM:D2974			
pH ASTM:D4972 Method B			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	24403.0	22757.0	18480.0
2"			
1.5"	100.0	100.0	100.0
1"	98.4	99.6	99.8
3/4"	96.9	98.5	98.7
3/8"	92.1	96.4	92.6
#4	88.2	93.1	82.6
#10	80.4	91.9	74.9
#20	72.4	90.2	67.9
#40	65.9	87.6	63.0
#100	54.2	77.7	55.8
#200	45.9	67.9	50.5

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

Grain Size Distribution ASTM D422-16

Job No. : **14533**

Project:	Agricola	Test Date:	8/22/23
Reported To:	Westwood Surveying & Engineering	Report Date:	8/28/23

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	Sub-01		0-4	Bulk	Clayey Sand w/a little gravel (SC)
Spec 2	TH-01		0-4	Bulk	Sandy Lean Clay w/a little gravel (CL)
Spec 3	B-04		0-4	Bulk	Sandy Lean Clay w/gravel (CL)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"	100.0	1.5"	100.0	1.5"	100.0
1"	98.4	1"	99.6	1"	99.8
3/4"	96.9	3/4"	98.5	3/4"	98.7
3/8"	92.1	3/8"	96.4	3/8"	92.6
#4	88.2	#4	93.1	#4	82.6
#10	80.4	#10	91.9	#10	74.9
#20	72.4	#20	90.2	#20	67.9
#40	65.9	#40	87.6	#40	63.0
#100	54.2	#100	77.7	#100	55.8
#200	45.9	#200	67.9	#200	50.5

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.030	43.0	0.030	53.5	0.030	42.6
0.019	39.3	0.019	46.7	0.019	39.4
0.012	33.1	0.012	40.0	0.011	34.6
0.008	28.5	0.008	34.1	0.008	30.9
0.006	23.7	0.006	29.6	0.006	26.8
0.003	16.7	0.003	20.8	0.003	20.1
0.001	12.3	0.001	13.6	0.001	15.2

Remarks

Specimen 1	Specimen 2	Specimen 3

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Moisture Density Curve ASTM: D698, Method B

Project: **Agricola** Date: **8/28/23**

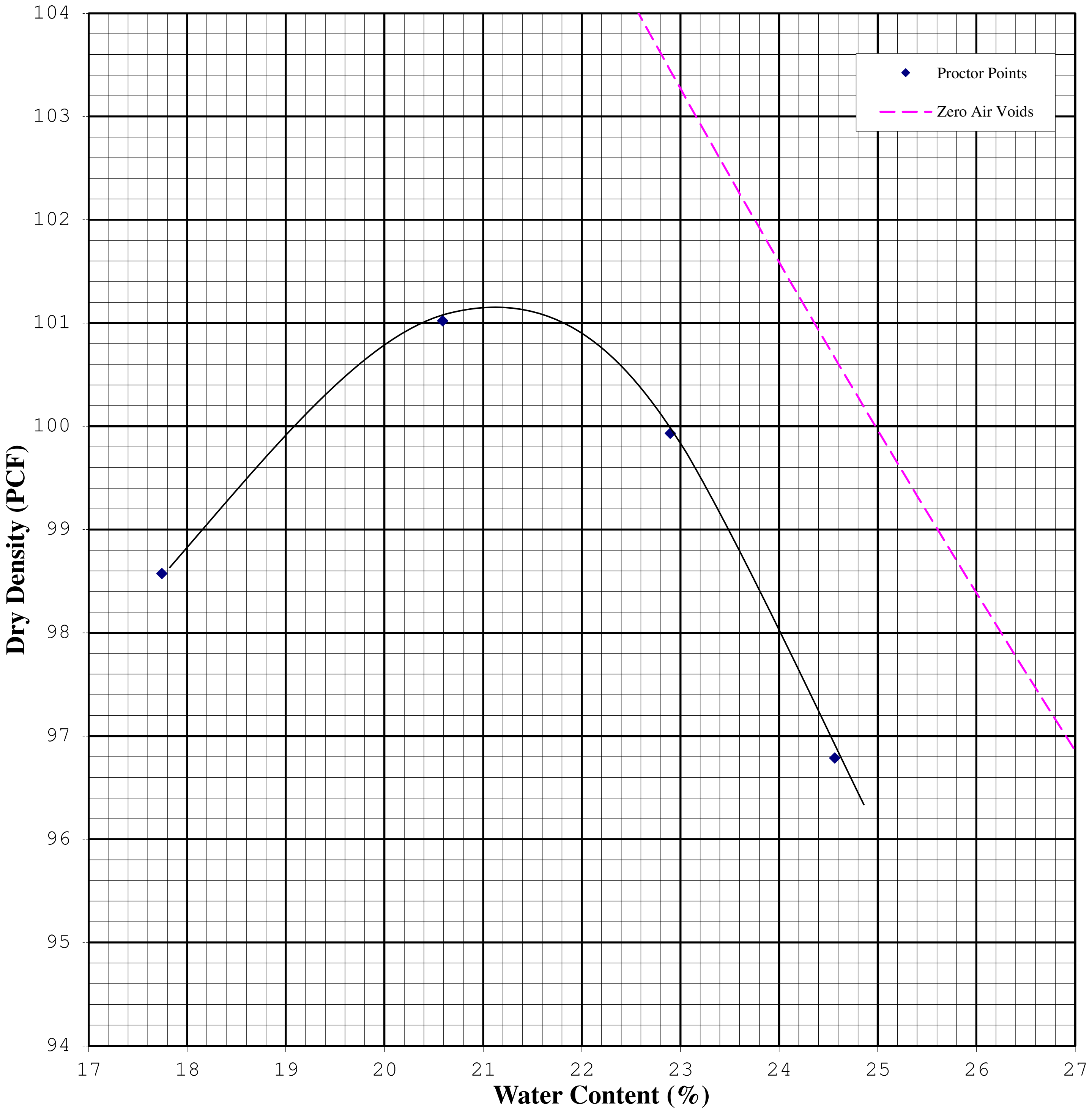
Client: **Westwood Surveying & Engineering** Job No. **14533**

Boring No. **TH-01** Sample: Depth(ft): **0-4** Location:

Soil Type: **Sandy Lean Clay w/a little gravel (CL)**

As Received W.C. (%): **24.6** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **101.1** Opt. Water Content (%): **21.1**



9530 James Ave South SOIL ENGINEERING TESTING, INC. Bloomington, MN 55431

SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Agricola** | Date: **8/28/23**

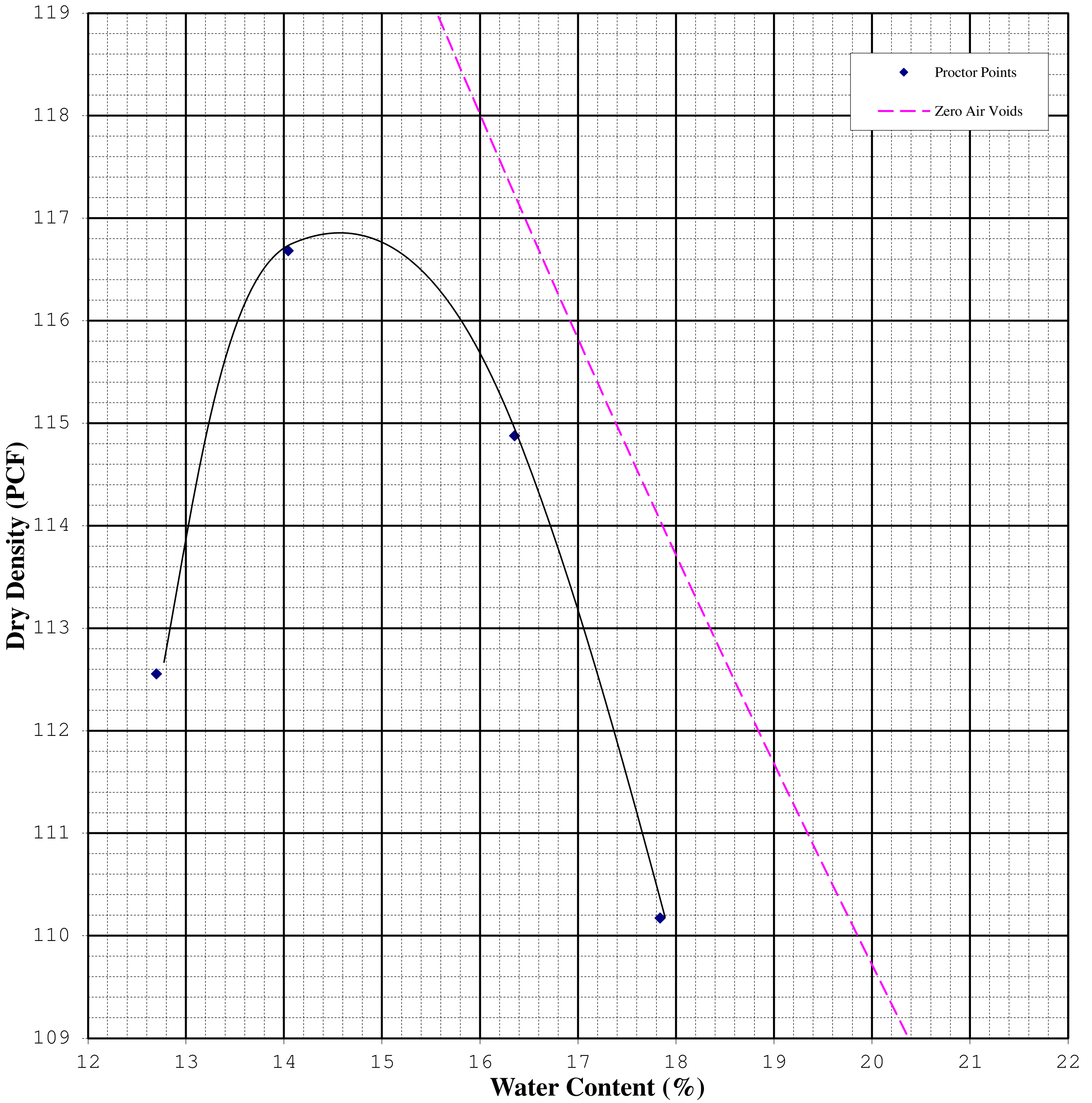
Client: **Westwood Surveying & Engineering** | Job No. **14533**

Boring No.: **B-04** Sample: Depth(ft): **0-4** Location:

Soil Type: **Sandy Lean Clay w/gravel (CL)**

As Received W.C. (%): **16.1** LL: PL: PI: Specific Gravity: **2.71** *Assumed

Maximum Dry Density (pcf): **116.8** Opt. Water Content (%): **14.6**



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SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Agricola** Date: **8/17/23**

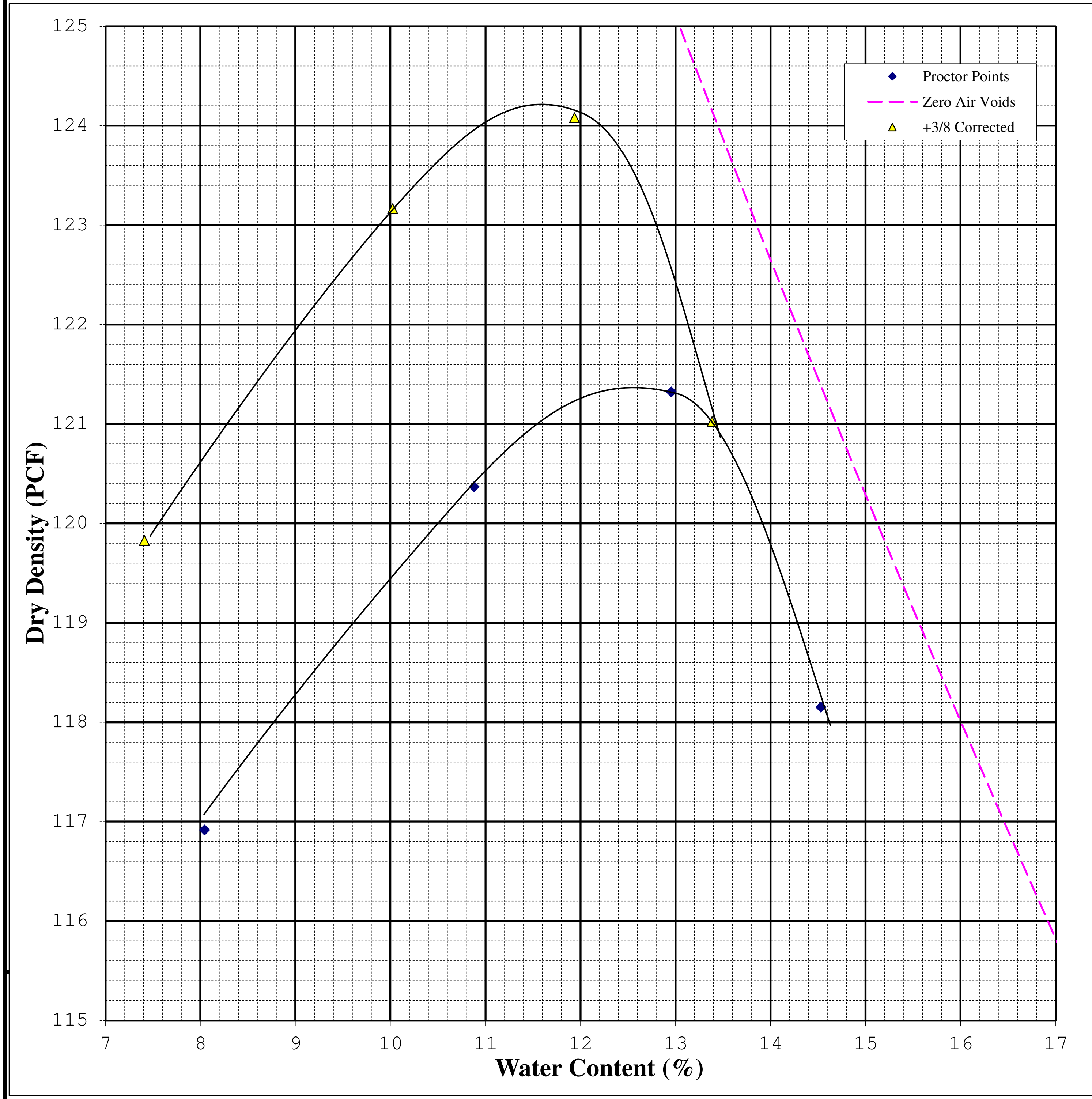
Client: **Westwood Surveying & Engineering** Job No. **14533**

Boring No. **Sub-01** Sample: Depth(ft): **0-4** Location:

Soil Type: **Clayey Sand w/a little gravel (SC)**

As Received W.C. (%): **12.1** LL: **24** PL: **16** PI: **8** Specific Gravity: **2.71** *Assumed

Maximum Dry Density (pcf): ◆ **121.4** △ **124.2** Opt. Water Content (%): ◆ **12.6** △ **11.6**



Thermal Resistivity Report ASTM D:5334

Project: **Agricola** Job #: **14533**

Client: **Westwood Surveying & Engineering** Date: **8/21/23**

Boring	Specimen Type	Depth (ft)	Type	Classification	Proctor Values: Maximum Dry Density (PCF)	Proctor Values: Optimum Moisture (%)	Initial Conditions: Dry Density (PCF)	Initial Conditions: WC (%)	Initial Conditions: Thermal Resistivity (ºC-cm/W)	Dry: Thermal Resistivity (ºC-cm/W)
TH-01	**Reconstituted**	**0-4**	**Bulk**	**Sandy Lean Clay w/a little gravel (CL)**	**101.1**	**21.1%**	**91.2**	**24.4%**	**70**	**211**
B-04	**Reconstituted**	**0-4**	**Bulk**	**Sandy Lean Clay w/gravel (CL)**	**116.8**	**14.5%**	**105.3**	**16.0%**	**64**	**188**
Sub-01	**Reconstituted**	**0-4**	**Bulk**	**Clayey Sand w/a little gravel (SC)**	**121.4**	**12.6%**	**109.4**	**12.0%**	**60**	**174**

Specimens reconstituted to approximately 90% of maximum standard proctor density near the as received moisture content.

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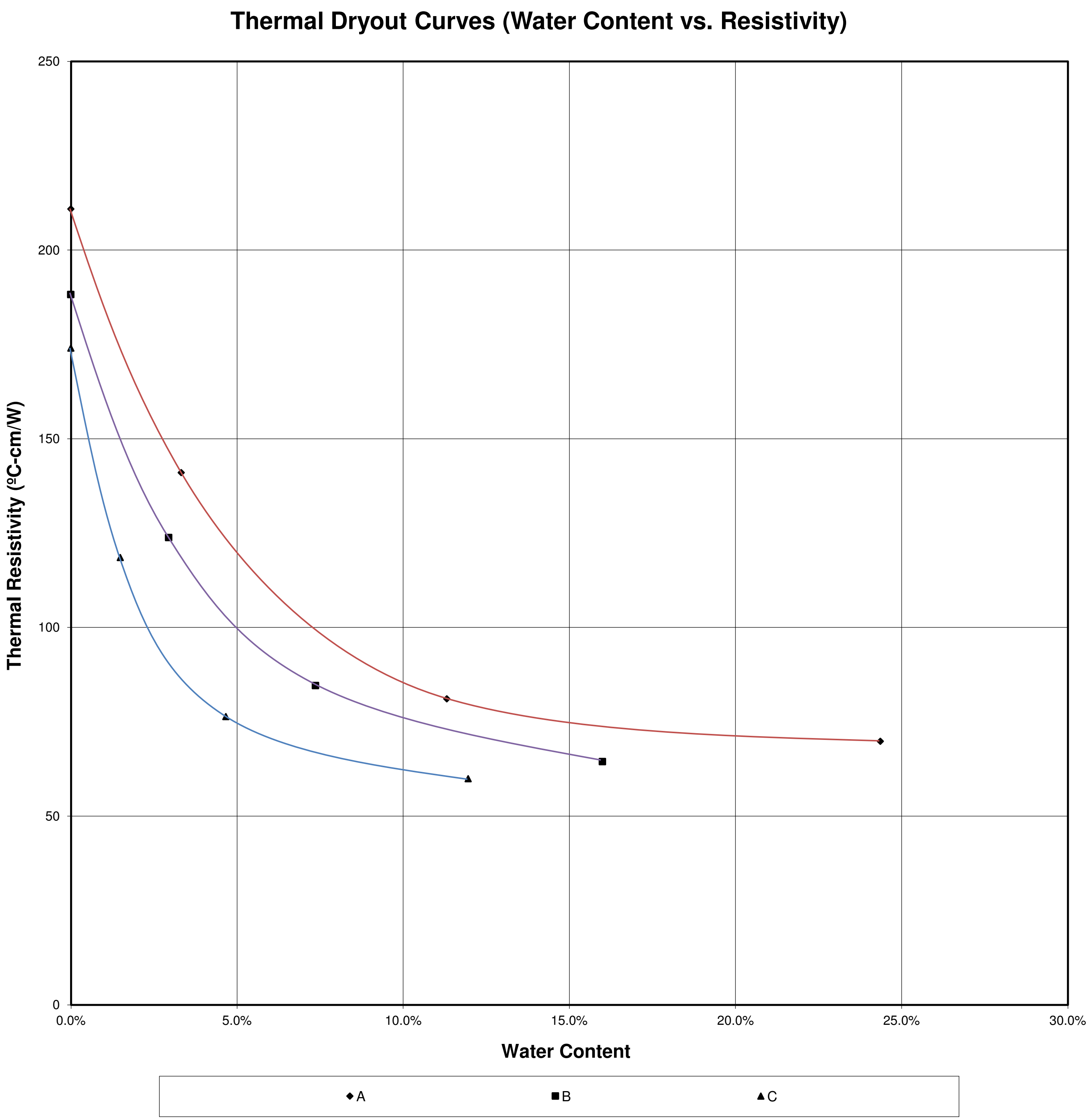
Thermal Resistivity Report ASTM D:5334

Project:	Agricola	Job:	14533
Client:	Westwood Surveying & Engineering	Date:	8/21/23

	Boring	Depth (ft)
Specimen A:	TH-01	0-4
Specimen B:	B-04	0-4
Specimen C:	Sub-01	0-4



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Bloomington, MN 55431

http://www.soilengineeringtesting.com

RMB
Environmental Laboratories, Inc.
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Detroit Lakes
22796 County Highway 6
Detroit Lakes, MN 56501
218-846-1465

Hibbing
1111 7th Ave. E.
Hibbing, MN 55746
218-440-2043

August 27, 2023
Laboratory Report

Soil Engineering Testing, Inc
Tyler Sandoz
9530 James Ave S
Bloomington, MN 55431

RE: Agricola
Work Order :B010166

Enclosed are the results of analyses for samples received by the laboratory on 08/09/2023 12:00. If you have any questions concerning this report, please feel free to reach out to customer service at 888-200-5770 or the contacts listed below:

Chad Hadler	Senior Project Manager	Chad.Hadler@rmbel.com	(952) 456-8470
Justin Tweedale	Senior Project Manager	Justin.Tweedale@rmbel.com	(218) 849-8747
Kathleen Mitchell	Quality Assurance Director	Kathleen.Mitchell@rmbel.info	(785) 493-1633
Robert Borash	President | CEO	Robert.Borash@rmbel.info	(218) 849-6420

Report approved by:

Kathleen A. Mitchell

Kathleen Mitchell
Senior Quality Assurance Director
kathleen.mitchell@rmbel.com

The results in this report apply only to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Detroit Lakes (DL) Certification / Accreditation Numbers: EPA Lab ID MN00918 • Minnesota Department of Health 027-005-336 • North Dakota Department of Environmental Quality R-187
Bloomington (BL) Certification / Accreditation Numbers: EPA Lab ID MN01091 • Minnesota Department of Health 027-053-475 • North Dakota Department of Environmental Quality R-231
Hibbing (HB) Certification / Accreditation Numbers: EPA Lab ID MN01082 • Minnesota Department of Health 027-137-480 • North Dakota Department of Environmental Quality R-228

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Hibbing, MN 55746
218-440-2043

Report Date: August 27,2023

Soil Engineering Testing, Inc
9530 James Ave S
Bloomington MN, 55431

Project: Agricola
Project Number: 14533

Date/Time Received
8/9/2023 12:00:00PM

ANALYTICAL REPORT FOR SAMPLES

Laboratory ID	Sample Name	Matrix	Date/Time Sampled
B010166-01	TH-01	Solid	08/09/2023 11:00
B010166-02	B-04	Solid	08/09/2023 11:00
B010166-03	Sub-01	Solid	08/09/2023 11:00

Additional information:

All samples will be retained for 30 days from date sampled, unless otherwise requested.
Record retention policy is 5 years unless otherwise agreed to in writing.
All calculations are performed using the raw data results.

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Laboratory Results

August 27, 2023

Lab Number	Analyte	Sample Name	Result	Units	Sample RL	DF	Analysis Method	Analyzed	Batch	Analyte Qualifiers	Facility
Chemistry Parameters											
B010166-01	Chloride	TH-01	**< 5.0**	mg/Kg wet	5.0	1	EPA 9056A	08/26/23 18:01	BG06291		DL
B010166-01	Sulfate as SO4	TH-01	**13.4**	mg/Kg wet	5.0	1	EPA 9056A	08/26/23 18:01	BG06291		DL
B010166-02	Chloride	B-04	**5.9**	mg/Kg wet	5.0	1	EPA 9056A	08/26/23 18:19	BG06291		DL
B010166-02	Sulfate as SO4	B-04	**37.0**	mg/Kg wet	5.0	1	EPA 9056A	08/26/23 18:19	BG06291		DL
B010166-03	Chloride	Sub-01	**5.8**	mg/Kg wet	5.0	1	EPA 9056A	08/26/23 18:37	BG06291		DL
B010166-03	Sulfate as SO4	Sub-01	**16.7**	mg/Kg wet	5.0	1	EPA 9056A	08/26/23 18:37	BG06291		DL

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Chemistry Parameters - Quality Control

Analyte	Result	Units	Qualifiers	Sample RL	DF	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BG06291 - EPA 9056A											
Blank (BG06291-BLK1)											
Prepared: 08/15/2023 Analyzed: 08/25/2023											
Chloride	< 5.0	mg/Kg wet		5.0	1						
Sulfate as SO4	< 5.0	mg/Kg wet		5.0	1						
Blank (BG06291-BLK2)											
Prepared: 08/15/2023 Analyzed: 08/26/2023											
Chloride	< 5.0	mg/Kg wet		5.0	1						
Sulfate as SO4	< 5.0	mg/Kg wet		5.0	1						
Blank (BG06291-BLK3)											
Prepared: 08/15/2023 Analyzed: 08/26/2023											
Chloride	< 5.0	mg/Kg wet		5.0	1						
Sulfate as SO4	< 5.0	mg/Kg wet		5.0	1						
Blank (BG06291-BLK4)											
Prepared: 08/15/2023 Analyzed: 08/26/2023											
Chloride	< 5.0	mg/Kg wet		5.0	1						
Sulfate as SO4	< 5.0	mg/Kg wet		5.0	1						
Blank (BG06291-BLK5)											
Prepared: 08/15/2023 Analyzed: 08/27/2023											
Chloride	< 5.0	mg/Kg wet		5.0	1						
Sulfate as SO4	< 5.0	mg/Kg wet		5.0	1						
LCS (BG06291-BS1)											
Prepared: 08/15/2023 Analyzed: 08/25/2023											
Chloride	241	mg/Kg wet		5.0	1	250		97	90-110		
Sulfate as SO4	245	mg/Kg wet		5.0	1	250		98	90-110		
LCS (BG06291-BS2)											
Prepared: 08/15/2023 Analyzed: 08/26/2023											
Chloride	240	mg/Kg wet		5.0	1	250		96	90-110		
Sulfate as SO4	242	mg/Kg wet		5.0	1	250		97	90-110		
LCS (BG06291-BS3)											
Prepared: 08/15/2023 Analyzed: 08/26/2023											
Chloride	240	mg/Kg wet		5.0	1	250		96	90-110		
Sulfate as SO4	240	mg/Kg wet		5.0	1	250		96	90-110		

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Chemistry Parameters - Quality Control

Analyte	Result	Units	Qualifiers	Sample RL	DF	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BG06291 - EPA 9056A											
LCS (BG06291-BS4)											
Prepared: 08/15/2023 Analyzed: 08/26/2023											
Chloride	242	mg/Kg wet		5.0	1	250		97	90-110		
Sulfate as SO4	243	mg/Kg wet		5.0	1	250		97	90-110		
LCS (BG06291-BS5)											
Prepared: 08/15/2023 Analyzed: 08/27/2023											
Chloride	244	mg/Kg wet		5.0	1	250		98	90-110		
Sulfate as SO4	244	mg/Kg wet		5.0	1	250		98	90-110		

Qualifiers and Definitions

Item	Definition
RL	Reporting Limit (Corrected for dilution factor when applicable due to sample preparation variation.)
MDL	Method Detection Limit (Corrected for sample preparation variation.)
DF	Dilution Factor
DL	Indicates test performed by RMB Environmental Laboratories - Detroit Lakes

RMB Environmental Laboratories, Inc.

Bloomington, MN | Detroit Lakes, MN | Hibbing, MN
1.888.200.5770 | rmbel@rmbel.info | www.rmbel.info

CHAIN OF CUSTODY RECORD

Page [ ] of [ ]

Electronic version available at http://www.rmbel.info/lab/chains-of-custody/

Client: Soil Engineering Testing, Inc.	Phone #:	Fax #:
Project Name: AGRICOLA	Project Task Code:	PO/WO #: 14533
Sampler: (print name)	Sampler Phone #	
Report to: Tyler Sandoz	Bill to: Tyler Sandoz	
Report to Email: tsandoz@soilengineeringtesting.com	Bill to Email: tsandoz@soilengineeringtesting.com	

☐ "EQUIS" EDD Lab Format - MPCA Data Submittal

Analyses Requested

B010166

Lab Code	Station ID/Sample Description	Date	Time	# of Bottles	Sample Method	Start Depth	End Depth	Sample Type	Matrix	Sulfate	Chloride	Redox	Sulfide	Sample Comments: (Equipment Type, Filtration, AIS, Preservation)
01	T-17	8/9/23	11:00	1	SW-SOIL	0'	4'	Sample	Soil-Sub	X	X			
02	T-20	↓	↓	↓	↓	0'	4'	↓	↓	X	X			
03	SUB-01	↓	↓	↓	↓	0'	4'	↓	↓	X	X			

TS (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, I hereby authorize RMB Environmental Laboratories to process the samples as received.

_______ (Initials) In the event that samples are received by the lab at a temperature greater than 6 ° C, please contact client at phone # ____________ before processing samples.

Relinquished by: (client signature)	Date	Time	Relinquished by Lab: (signature)	Date	Time
[signature]	8/9/23	12:00			
Received by Lab: (signature)	**Date**	**Time**	**Received by Lab: (signature)**	**Date**	**Time**
[signature]	080923	1200			

☒ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain:
☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: 23.5 ° C
☒ Samples received same day as collection BL LTG: 01
Comments: Chlorine: No Yes NA

☐ DOES meet proper sample storage and transportation guidelines
☐ Does NOT meet proper sample storage and transportation guidelines
Explain:
☐ Rcvd on ice ☐ Rcvd at room temp Rcvd Temp: ____ ° C
☐ Samples received same day as collection LTG:
Comments:

BILLING
Shipping / Courier:
Mileage:
Field Staff:
Equipment:
Other:

SHIPPING TO LAB
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☒ Hand Delivery
☐ Courier
☐ RMB Courier

INTERLAB SHIPPING
☐ Speedee
☐ UPS
☐ USPS
☐ FedEx
☐ Courier
☐ RMB Courier

CMW 08/14/23

Appendix D

MFAD Input Design Parameters

Westwood

MFAD Input Design Parameters
Agricola Wind Project

Boring ID	Depth to Groundwater (ft)	Depth (ft)	Model	Total Unit Weight (pcf)	Modulus of Deformation (ksi)	Friction Angle (deg)	Undrained Shear Strength or Rock Cohesion (ksf)	Rock / Concrete Bond Strengh (ksf)	Allowable Skin Friction (ksf)(1)	Allowable End Bearing (ksf)(1)
Substation	28	0 - 2	Ignore due to moisture change/scour.							
		2 - 6	Soil	120	0.90	-	1.50	-	0.20	3.0
		6 - 10	Soil	120	1.20	-	2.00	-	0.25	4.0
		10 - 33	Soil[2]	130	2.40	-	4.00	-	0.10	8.0
		33 - 40	Soil[2]	135	10	40	-	-	0.10	20.0

Notes:

(1) A safety factor of 2.0 has been applied for skin friction and 3.0 for compressive end bearing.

(2) Some possible residual/highly weathered rock was modeled as soil due to a high degree of weathering/fractures, thick soil seams/infilling, or potential boulder.

(3) If the foundation is bearing on rock, only end bearing is to be used for axial design.

(4) If the foundation design embedment depth relies on bearing in competent bedrock, the foundation should be socketed a minimum of 1.0 times the foundation diameter into competent rock. Shallower rock sockets may be acceptable if the design does not rely on the rock strength for axial or lateral support. Soil and rock conditions, along with MFAD capacity and deflection values, should be considered when determining embedment into rock.