Hoffman Falls Wind Project

Case No. 23-00038

900-2.11 Exhibit 10

Geology, Seismology, and Soils

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EXHIBIT 10 GEOLOGY, SEISMOLOGY, AND SOILS

(a) Study of the Geology, Seismology, and Soils Impacts

This Exhibit includes a study of the geologic, seismologic, and soil impacts of the Facility. It includes mapped or otherwise identified existing conditions, an impact analysis, and proposed impact avoidance and mitigation measures.

(1) Existing Slopes Map

The Facility Site is on a localized high area that slopes in all directions, with both forested and agricultural areas. The majority of slopes within the Facility Site range between 1 and 25%,[1] with the greatest proportion of the slopes being between 3 and 10%. The steepest slopes are associated with the collection system and range from 0% to 35%, while slopes associated with wind turbines range from 0% to 15% and slopes associated with access roads (not the slope of the access road itself, but any area within 10 feet of an access road) range from 0% to 25%. Figure 10-1 delineates existing slopes (0-3%, 3-8%, 8-15%, 15-25%, 25-35%, and greater than 35%) in the vicinity of the Facility. This figure was prepared using digital elevation model data provided by the U.S. Geological Survey (USGS) and the New York State GIS Program Office. The data was processed using ESRI ArcGIS® software.

(2) Proposed Site Plan

Civil Design Drawings indicating existing and proposed contours at 2-foot intervals are included in the site plans provided with Exhibit 5. The scale of these drawings is sufficient to show all proposed buildings, structures, paved and vegetative areas, and construction areas, as required by 19 NYCRR 900-2.11(a)(2).

(3) Excavation Techniques to be Employed

Pending the receipt of all required permits, construction is anticipated to start in the fourth quarter of 2025. Facility construction will be performed in several stages. The stages involving excavation are described below. Excavation activities will be primarily associated with grading, trenching, and the installation of the wind turbine foundations. Excavation will be completed using conventional construction equipment, including, but not limited to, bulldozers, track hoes, pan excavators, cable plows, rock saws, rock wheels, and trenchers. In addition, as discussed in Exhibit 10(a)(5)-(7) construction of the Facility may require some blasting. Techniques anticipated to be employed for individual Facility components are described below.

Laydown Yard Construction

The construction laydown yards will be developed by stripping and stockpiling the topsoil and grading and compacting the subsoil. Alternatively, the Applicant is also considering the use of

[1] Slopes of 45 degrees are considered to be 100%; therefore, slopes over 45 degrees are calculated to be over 100%.

cement stabilization at the laydown yards. This would include mixing the subsoil with cement and water. Geotextile fabric and gravel will then be installed to create a level working area.

Public Road Improvements

Improvements to existing public roads, including temporary modifications to establish appropriate turning radii for oversize/overweight (OS/OW) vehicles, will generally require soil stripping and the placement of gravel. A geotextile fabric or grid will be installed beneath the road surface, if necessary, to provide additional support.

Access Road Construction

Wherever feasible, existing driveways, farm lanes, and forest roads will be upgraded for use as Facility access roads to minimize impacts to active agricultural areas, cultural resources, forests, and wetland/stream areas. Where an existing road is unavailable or unsuitable, new gravel surfaced access roads will be constructed. Road construction will involve grubbing of stumps, topsoil stripping, and grading, as necessary. Stripped topsoil will be stockpiled (and segregated from subsoil) along the road corridor for use in site restoration. Following removal of topsoil, subsoil will be graded, compacted, and surfaced with gravel or crushed stone. A geotextile fabric or grid will be installed beneath the road surface, if necessary, to provide additional support. Should the method of utilizing gravel or crushed stone be insufficient to stabilize access roads, the Applicant will work with the construction team to develop alternative options.

Foundation Construction

Once the access roads are complete for a particular group of turbine sites, turbine foundation construction will commence for that group. Based on the design of a foundation for a generic 4- to 6-megawatt wind turbine, it is assumed the foundation will be installed 13.5 feet below the ground surface with 6 inches of grading at the surface to allow for drainage around the foundation and cut/fill balance. Initial activity at each tower site will typically involve clearing and leveling (as needed) based on the site conditions at each tower location. The topsoil and organic material are usually mixed during the excavation process, and thus, will not be reused for structural fill. This material will be placed separately away from the rest of the excavated material to avoid comingling and later used for surface restoration. Topsoil removed during site stripping should be graded into existing site topography and may be used in grading nonstructural fill such as fields, or service areas in which compressibility of the material does not have an impact on structures.

Following topsoil removal, excavators will be used to excavate the foundation hole. Subsoil and rock will be segregated from topsoil and stockpiled for reuse as backfill to the extent possible. Spread footer turbine foundations will be approximately 13.5 feet deep and 75 feet in diameter (see Appendix 5-A). Blasting will likely be required at some turbine foundation sites and will occur in accordance with the Blasting Plan (see Appendix 10-A) and the discussion in Exhibit 10(a)(5).

Electrical Collection System Installation

<u>Underground Electrical Collection Lines</u>

The electrical collection system will be installed using direct burial methods except at road crossings (and certain other locations) where directional boring or open trench techniques will be deployed as agreed to with the local municipalities. Industry standard equipment (e.g., cable plows) will be used. Direct burial will involve the installation of bundled cable directly into a narrow cut or "rip" in the ground. The rip would disturb an area approximately 24 inches wide. Bundled cable would be installed to a minimum depth of 48 inches in all agricultural and non-agricultural areas. Where direct burial is not possible, an open trench will typically be excavated. During open trenching, topsoil and subsoil will be segregated and stockpiled adjacent to the trench for use in site restoration. As utility trenches can provide a conduit for groundwater flow, trenches will be backfilled with material that approximately matches the permeability characteristics of the surrounding soil. If higher permeability fill is used in trenches, consideration will be given to installing seepage collars and/or trench breakers to reduce the likelihood of water migration through the trenches. Depending on soil topology occurring at specific locations of underground cable installation, cable bedding, which typically includes the placement of sand beneath cables, may be required.

At locations where a collection line crosses a stream, wetland, public roadway, or other sensitive feature identified by the Applicant, trenchless technologies (e.g., horizontal directional drilling [HDD] or jack and bore) may be used to avoid impacts. See Exhibit 21(a)(7) for additional information regarding these technologies. See also the Design Drawings (Appendix 5-A) for details regarding where such technologies will be implemented. At these crossings, boring equipment will be staged in boring pits excavated on either side of the road, stream, or wetland, and the collection line(s) will be routed underground between the bore pits. No surface disturbance is required between the bore pits, and all existing vegetation along the streams and within the wetlands (including mature trees) remain in place. The only potential impact associated with directional drilling is a potential surface release, or an "inadvertent return," of drilling fluid. Such inadvertent returns are rare and will be avoided or minimized to the maximum extent practicable when utilizing these technologies. An Inadvertent Return Plan will be submitted as a compliance filing pursuant to §900-10.2(f)(5). Scaled drawings showing typical HDD and/or jack and bore equipment staging layout and design are provided in Appendix 5-A. For more information on locations where HDD and/or jack and bore will be utilized to avoid impacts to streams and wetlands, see Figures 10-2 & 14-2, and Exhibits 13 and 14.

Substation and Switchyard

Substation and point of interconnection (POI) switchyard construction will begin with clearing the site and stockpiling topsoil for later use in site restoration. The site will be graded, and a laydown area for construction equipment, materials, and parking will be prepared. Areas for the retaining wall footing will be excavated and footings will be installed. The retaining wall will be erected while having structural fill brought in to achieve a level area for the substation and switchyard. As the fill is brought into the site area, concrete foundations for major equipment and structural supports will be placed, followed by the installation of various conduits, cable trenches, and grounding grid conductors. The area will then receive aggregate surfacing appropriate for the electrical activity taking place in the area.

(4) Suitability for Construction

On behalf of the Applicant, Westwood Surveying & Engineering (Westwood) conducted a preliminary geotechnical investigation to obtain geotechnical data and provide geotechnical recommendations for the proposed structures within the Facility Site. The results of the investigation are summarized in the Preliminary Geotechnical Investigation Report (see Appendix 10-B). As part of this evaluation, Westwood:

- Investigated subsurface soil and bedrock conditions through sampling and limited geotechnical laboratory testing at three bulk sample sites and eight boring sites.
- Collected and reviewed publicly available data regarding regional geology, soils, surficial and bedrock geology, and tectonic setting and seismology.
- Analyzed the available data to determine the suitability of the site for construction.
- Developed a Preliminary Geotechnical Investigation Report, that discusses:
    - Facility Area Geology
    - Geotechnical Characterization of the Facility Site (e.g., groundwater conditions, bedrock, soil and subsurface soil types)
    - Seismic Site Classification
    - Laboratory Testing
    - Chemical and Engineering Properties
    - Design and Construction Considerations and Recommendations.

Based on Westwood's findings, the Facility Site is generally suitable for the proposed development, and soils within the Facility Site are generally suitable for the proposed foundation systems. The typical stratigraphy of the Facility Site consists of up to 12 inches of topsoil over medium stiff to hard lean clay with variable amounts of sand and gravel overlying medium dense to very dense clayey sand. Underlying the clay and sand is shale bedrock at depths ranging from 5 to 30 feet below ground surface. These soils do not have high shrink/swell potential. Soils encountered on site were found to be generally in a stiff to hard or dense condition and are of low compressibility. The subgrade conditions appear to be suitable for support of the proposed foundations based on an evaluation of bearing capacity and differential settlement. Shallow soils and weathered bedrock encountered on site can be excavated by heavy equipment using conventional excavating and ripping techniques but more competent bedrock below the weathered zone may require very hard ripping or blasting to remove. All excavations will comply with Occupational Safety and Health Administration, local, state, and federal safety regulations. See Exhibit 10(a)(5)-(7) for more details about potential blasting and mitigation measures.

Groundwater was encountered at two of the eight boring locations during the preliminary geotechnical field investigation between the depths of 5 and 10 feet below grade. Gray clay, often indicative of long-term saturation, was also found at a third bore location. Groundwater levels can fluctuate due to seasonal variation, so depth to groundwater should be further recorded during final geotechnical investigations. During the initial investigation visit, piezometers were installed to monitor ground water. When revisited in December of 2023, it was found that the longer-term water level was shallower than the water level encountered during drilling (see Table 3.4 of Appendix 10-B). These levels indicate that there is potential for ground water to accumulate during turbine excavations, though the high clay content of the subgrade soil will generally limit groundwater infiltration. However, standard dewatering practices such as the utilization of sumps and pumps can be used to dewater as needed. Therefore, it is not anticipated that any issues related to groundwater will occur. Additional piezometer measurements will take place in 2024 to gather additional data. See Exhibit 13, Section (a)(3) for an additional discussion of groundwater on site and how water will be managed during construction. The Facility is not proposed to contain any below grade facilities that would require continuous dewatering during operations.

The corrosivity potential of soils at the Facility Site was measured at two boring locations. Samples were obtained from depths ranging from 1 to 5 feet and tested for soluble sulfate, soluble chloride, electrical resistivity, and pH (see Appendix 10-B). Results indicated that sulfate and chloride exposure is considered Class C1, and sulfate exposure is considered low (class S0), and pH ranged from 7.0 to 7.2. Electrical resistivity testing was completed at four locations, indicating a minimum apparent resistivity of 3,720 ohm-centimeters.

The estimated maximum frost penetration depth is 48 inches. To prevent frost heave, all foundations should be constructed at minimum 48 inches below the estimated frost penetration line. Because foundations for the wind turbines, substation, transmission line, and any other ancillary features are anticipated to be constructed at a depth of greater than 48 inches, no mitigation measures are required to protect Facility foundations from frost heave.

In addition to frost heave, shrink and swell potential of the on-site soils was analyzed. The soils observed in the Facility Site consist of medium stiff to hard lean clay with variable amounts of sand and gravel overlying medium dense to very dense clayey sand. Based on laboratory testing, soils found on the Facility Site are anticipated to have minimal shrink/swell potential, except at the bore location near Morrisville Swamp where fat clays were found. At this specific location, infrastructure (HDD Boring) is anticipated to be sufficiently deep (a minimum of 6 feet below ground surface) to minimize the impacts of soil expansion. As a result, specific construction procedures associated with potential expansive clays will not be required for the Facility.

Subsurface hydrologic conditions indicate that de-watering is not expected to be a major concern, as groundwater was only encountered within the depth of the investigation at one location. Based on these conditions, groundwater dewatering is not anticipated in most locations. However, surface water may flow into the excavations following precipitation events and may require periodic removal to facilitate construction.

Locations where HDD is proposed are shown on the Design Drawings (Appendix 5-A). As indicated in the Geotechnical Report, generally, HDD should be feasible in site soil and fractured rock throughout the site through the proper use of current technologies, appropriate equipment, tooling and drilling fluids, and an experienced contractor. Conditions identified such as shallow bedrock, varying bedrock elevation, saturated sands and gravels, and cobbles and boulders will present challenges and limitations to HDD. It is recommended that geotechnical borings be performed at HDD-specific locations during the design phase geotechnical investigation.

The preliminary geotechnical investigation found bedrock to be at a depth of 5 feet or greater throughout the footprint of the proposed Facility. The relatively short bore lengths contemplated for the Project will be specified, as is common practice, for a target depth of cover between 5 and 10 feet and so it is anticipated that the boring will occur within the soils zone of the geological profile. Soil characteristics found in the bore samples, including fine grain sand, silt, and clay, are readily suitable soil conditions for short, small diameter HDD technology. With the relatively short bore lengths planned for the majority of HDD locations within the Facility, drilling fluid pressures can remain low, reducing the probability of inadvertent returns. In addition, the Applicant will prepare a Inadvertent Return Plan to address the unlikely occurrence of inadvertent returns should they occur.

(5) Blasting Plan

Shallow soils and weathered bedrock can be excavated by heavy equipment using conventional excavating and ripping techniques. More competent bedrock below the weathered zone may require very hard ripping or blasting to remove. The level of effort to construct foundations and buried utilities will depend on the depth these elements are to be installed within the weathered and more competent bedrock present. Although mechanical excavation with a pneumatic hammer or large ripper may be possible for some of the bedrock encountered, particularly the upper few feet, based on the results of the geotechnical evaluation, blasting may be required in some areas. In these cases, blasting will likely generate less noise and take less time than conventional excavation techniques. The specific number of sites and location where blasting will occur is currently unknown due to the variation in thickness of soil and weathered rock over bedrock. At the time of construction, the Applicant will determine where blasting may be needed, and the extent required, considering noise impacts, construction schedule and costs, the volume of rock encountered, the hardness of the rock to be removed, required safety precautions, and other factors.

A Blasting Plan (Appendix 10-A) has been prepared that addresses 1) the minimum contractor qualification requirements; 2) notification measures, including procedures and timeframes for notifying host communities and property owners within a one-half mile radius of blasting locations prior to blasting; 3) safe transportation, handling, and storage of blasting materials; 4) use of blasting mats; and 5) identifying and avoiding potential impacts to drinking water wells. This Blasting Plan is intended to provide preliminary guidance and procedures for all the blasting required for the Facility and anticipates that most blasting will be associated with the construction of wind turbine foundations. The footing for a wind turbine takes up approximately 450 cubic yards of volume; therefore, if blasting is required at a turbine location, the maximum amount of rock extracted through blasting per foundation site would be approximately 450 cubic yards.

Prior to blasting at each site, a pre-blast survey will be conducted. The pre-blast survey will inspect the blast area, and adjacent areas (defined as no less than a 500-foot radius from the blast area). The survey will document existing conditions and will include, but not be limited to buildings/structures, water supply wells, utilities (above and below ground). The survey will include written documentation as well as photographic documentation of existing conditions.

(6) Potential Blasting Impacts

Blasting undertaken for the construction of the Facility, in accordance with a properly designed blasting plan, will result in controlled removal of shallow bedrock and minimal impact on existing and above ground structures.

Considering the setbacks the Applicant has incorporated into the design of the Facility (see Exhibit 5(b)), long-term blasting-related impacts are generally not anticipated. In addition, blasting shall be designed and controlled to meet the limits for ground vibration set forth in United States Bureau of Mines Report of Investigation 8507 Figure B-1 (see section 900-15.1(k)(1)(i) of this Part) and air overpressure shall be under the limits set forth in the Conclusion Section in United States Bureau of Mines Report of Investigation 8485 (USBM RI8507 and USBM RI 8485(see section 900-15.1(k)(1)(ii) of this Part) to protect structures from damage. Once blasting is complete, a post-blast survey will be conducted for the same facilities that were documented during the pre-blast survey.

Blasting Impacts to Above-Ground Structures

In designing blasts, the Applicant's blasting contractor will consider locations of residences, seasonal cabins, and other structures within 500 feet of the blast site. Each blast will be designed to limit vibration amplitudes at these locations to be less than limits set to prevent cosmetic damage to plaster walls, which the Society of Explosives Engineers has determined are typically the most vulnerable to blasting. Limits set to prevent damage to plaster walls will ensure no damage occurs to drywall walls, residential structures, or foundations.

Blasting Impacts to Below-Ground Structures

In designing blasts, the blasting contractor will consider locations of below-ground structures and utilities within 500 feet of the blast site. There are no known existing water supply wells located within 500 feet of any wind turbine location, and blasting will be prohibited within 500 feet of all known water supply wells.

With respect to water well impacts, several studies have been carried out to investigate the potential effects of blasting. One study evaluated the performance of 25 test wells drilled at four sites in Ohio, Pennsylvania, and West Virginia, where companies were using blasting to mine coal (Robertson et al., 1980). Test wells, ranging from 80 to 200 feet deep, were drilled 1,000 feet or more from active blasting, and researchers monitored the wells as the blasting progressed to as close as 50 feet from the wells. Blasting caused maximum ground vibration levels at the well sites ranging from 20 millimeters/second (0.84 inches/second) to 138 millimeters/second (5.44 inches/second). Based on monitoring of the well performance during and after the ground vibrations, the study concluded ground level vibrations of 51 millimeters/second (2.0 inches/second) or less are not substantial enough to damage wells. Consistent with this, the Society of Explosives Engineers has concluded that standards that protect plaster walls in houses will also protect below-ground structures, including groundwater wells. See www.explosives.org.

(7) Mitigation Measures for Blasting Impacts

Prior to determining that blasting is necessary, the Applicant will consider several alternative technologies available for excavating rock, including the following:

- Soundless chemical demolition agents (SCDAs): Cementitious powdery substance with quicklime (CaO) as its primary ingredient that expands upon contact with water, resulting in a large expansive pressure when the CaO hydration reaction occurs in a confined condition. By injecting the SCDA into boreholes of a rock mass, the resulting expansive pressure is sufficient to create an effective fracture network in the confined rock mass around the borehole and the rock having been fractured by the SCDA process can then be removed with excavators.
- Rock splitters/pneumatic hammers: Attached to a conventional excavator the drill-like rock splitter is inserted into a pre-drilled borehole and hydraulics of the excavator are used to push the splitter wedge between the splitter feathers to create an outward pressure in the borehole wall that splits the rock. Rock splitters are limited to an effective bench depth of 3.5 feet.
- Rock cutters: Rock-grinding attachments for excavators consisting of fixed-tooth hydraulic rotary drum cutters capable of cutting through hard rock. This equipment is widely used in road construction, underground utility work, tunneling, trenching, mining, and quarrying.

At locations where alternative technologies are not practicable, and blasting is required, blasting impacts to above- and below-ground structures will be avoided and minimized through the appropriate setbacks, the implementation of established Bureau of Mines vibration standards, and through compliance with the Blasting Plan (Appendix 10-B).

(8) Regional Geology, Tectonic Setting, and Seismology

The Facility is located in the central part of Madison County, New York within the Appalachian Highlands physiographic region. The Appalachian region was formed beneath a shallow sea where sedimentary rocks formed over time. The Geologic Map of New York classifies the underlying bedrock as part of the Pleistocene ice age geologic period (Skaneateles Formation, Ludlowville Formation, and Oriskany

Formation) (NYSM/NYSGS, 1970). No known or suspected areas of karst geology, which are characterized by underground drainage systems with sinkholes and caves, are located within the Facility Area. Karst geology generally forms in limestone bedrock, and the dominant bedrock in the Facility Area is mostly sandstone and shale.

The Facility Site is located in a part of New York State considered to have low tectonic activity and the lowest probability of earthquake occurrence. Areas of New York State with higher probabilities of earthquake occurrences are located in the northern (St. Lawrence River Valley), western (Buffalo-Attica regions), and southern (New York City region) portions of the state.

Based on the 2014 New York State Hazard Map (USGS, 2014), the Facility Site is located in an area of low seismic hazard, with a 10% or less chance that an earthquake exceeding magnitude 2.5 on the Richter scale will occur within a 50-year window. The USGS Earthquake Hazards Program does not list any young faults or faults that have had displacement in the Holocene epoch within the vicinity of the Facility Area (USGS, 2018). The New York State Museum (NYSM) has mapped a few topographic linear features as "brittle structures," which include joints and faults, within 25 miles of the Facility Site and several subsurface faults with relative movement within 30 miles of the Facility Site (NYSM, 1977). Likewise, according to the Preliminary Geotechnical Investigation Report, seismicity within the Facility Site is low and liquifiable soils are not present. Therefore, no seismic activity is anticipated within or adjacent to the Facility Site.

(9) Facility Impacts on Regional Geology

The Facility is not anticipated to result in any significant impacts to the regional geology.

Based on subsurface inspections and analyses, the Facility Site is considered suitable for the construction and operation of the Facility and therefore is not anticipated to result in any significant impacts to the regional geology. Only temporary, minor impacts to geology are expected as a result of construction activities. For example, cut and fill may be required where wind turbines, associated structures, and access road sites are not located on completely level terrain; however, the impact to overall topography is anticipated to be minor.

Construction of foundations will be limited to a shallow zone of soil and rock located 0 to 13.5 feet below surface within the foundation footprint. Due to disturbance of only shallow, localized zones of soil and rock stratigraphy, the impacts on regional geology is expected to be minimal. The shale and sandstone bedrock present under the site is not subject to dissolution and formation of caves or karst features, and therefore, measures to mitigate construction risks in karst areas are not required.

Overall, Facility components will be designed, sited, and constructed in a manner that avoids and minimizes temporary or permanent impacts to physiography, geology, and soils, to the extent practicable. Accordingly, when operational, Facility impacts to regional geology will be negligible.

(10) Impacts of Seismic Activity on Facility Operation

Facility operations are considered low risk to impacts from seismic activity, with no young faults or faults that have had displacement in the Holocene epoch identified within the Facility Site. See Section (8) for a discussion of the risk factors related to the anticipated impacts of seismic activity on the Facility.

(11) Soil Types Map

Soil types at the Facility Site were mapped using data from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey (USDA, 2020). See Figure 10-3 for a map delineating soil types within the Facility Site.

(12) Characteristics of Each Soil Type and Suitability for Construction

A wide variety of soil types are documented within the Facility Site according to the Soil Survey Geographic Database (SSURGO) database and NRCS Web Soil Survey (Soil Survey Staff, 2022). According to this publicly available data, 11 primary soil series comprise the majority of the Facility Site. The general characteristics of these soil units are presented in Table 10-1. It is important to note that the SSURGO is the most comprehensive information published by the National Cooperative Soil Survey but not all areas have been field-verified. Therefore, this Exhibit supplements the SSURGO soils data with site-specific soils information gathered during site investigations conducted by the Applicant. These data have been compiled and summarized in Exhibit 10(a)(4) and the Preliminary Geotechnical Investigation Report (Appendix 10-B). These investigations included a site visit to characterize surficial features, an assessment of the Facility Site's general constructability, and a subsurface investigation.

Table 10-1. Soil Series Identified within the Facility Site and their Characteristics.

Soil Series	Main Characteristics
Ontario	• Slope: 0 to 60% • Type of land: cropland, pasture, forest • Land forms: undulating to rolling till plains and drumlins • Texture: loam, silt loam, or sandy clay loam • Drainage: well drained • Depth to bedrock: 40+ inches
Lima	• Slope: 0 to 20% • Type of land: cropland, forest • Land forms: level to moderately steep parts of till plains • Texture: sandy loam, silt loam • Drainage: moderately well drained • Depth to bedrock: 60+ inches
Lansing	• Slope: 0 to 60% • Type of land: cropland, forest • Land forms: level to rolling and steep soils on till plains • Texture: fine sandy loam, silt loam, silty clay loam • Drainage: well drained

Soil Series	Main Characteristics
	• Depth to bedrock: 60+ inches
Honeoye	• Slope: 0 to 65% • Type of land: cropland, forest • Land forms: gently undulating to rolling till plains • Texture: loam, fine sandy loam, silt loam, clay loam • Drainage: well drained • Depth to bedrock: 60+ inches
Conesus	• Slope: 0 to 25% • Type of land: cropland, pasture, forest • Land forms: level to sloping soils on till plains • Texture: loam, silt loam, silty clay loam • Drainage: moderately well drained • Depth to bedrock: 60+ inches
Volusia	• Slope: 0 to 35% • Type of land: pasture, forest, shrubland • Land forms: long uniform slopes, valleys and plateaus • Texture: loam, silt loam • Drainage: somewhat poorly drained • Depth to bedrock: 60+ inches
Mardin	• Slope: 0 to 50% • Type of land: cropland, pasture, shrubland, forest • Land forms: level to very steep with slopes • Texture: silt loam, loam • Drainage: moderately well drained • Depth to bedrock: 60+ inches
Lordstown	• Slope: 0 to 90% • Type of land: forest, pasture, shrubland, cropland • Land forms: level to very steep soils • Texture: loam, silt loam, sandy loam • Drainage: well drained • Depth to bedrock: 20 to 40 inches
Palms	• Slope: 0 to 6% • Type of land: marsh, pasture, cropland • Land forms: closed depressions on plains, moraines, hillside seep areas • Texture: loamy very fine sand, sandy loam, fine sandy loam • Drainage: very poorly drained • Organic Material: 16 to 51 inches
Edwards	• Slope: 0 to 2% • Type of land: brushland, forests, cropland • Land forms: closed depressions on plains and moraines • Texture: marly silt loam, marly silty clay loam • Drainage: very poorly drained • Organic Material: 16 to 51 inches

Soil Series	Main Characteristics
Carlisle	• Slope: 0 to 2% • Type of land: cropland, pasture, forest • Land forms: depressions on plains and moraines • Texture: silt loam and silty clay loam • Drainage: very poorly drainage • Organic Material: 10 inches

Source: SSURGO Database (Soil Survey Staff, 2022).

Suitability and limitations of existing soils and depth to bedrock with respect to construction of the Facility were addressed earlier in this Exhibit and in the Preliminary Geotechnical Investigation Report (see section (a)(4) above and also see Appendix 10-B). The generalized stratigraphy of the Facility Site, as determined from field data (from the ground surface down), consists predominantly of silty glacial till transitioning to weathered rock underlain by more competent sandstone.

(13) Bedrock Analyses and Maps

Figure 10-4 of this Application shows depth to bedrock and depth to the high-water table across the Facility Site relative to Facility components. Representations of bedrock and high-water table depth are derived from both public data (i.e., USDA NRCS SSURGO) and the Applicant's site-specific data (i.e., data from individual borings completed during the geotechnical program). It is important to note that public data may represent mapped bedrock and high-water table depth differently than the site-specific bedrock depth and high-water table depth measured during geotechnical investigations. This is primarily due to a lack of field verification in some areas of the public datasets. The Preliminary Geotechnical Investigation Report (Appendix 10-B) includes maps, figures, and a more detailed discussion of subsurface conditions across the Facility Site. The Design Drawings (Appendix 5-A) and Electrical Design & Substation Plan Drawings (Appendix 5-B) depict the typical foundation depths of the various Facility components.

The typical stratigraphy, as determined from field data, consists of up to 12 inches of topsoil underlain primarily by clayey sand soils which typically transition into shale bedrock at depths ranging from 5 to more than 50 feet below existing grade. Weathered rock is defined as rock in which boring could be advanced by an auger. The shale typically transitioned from highly weathered to fresh, with increasing rock continuity with depth. Vertical profiles from the geotechnical investigation are included in Appendix 10-B.

Based on the results of the borings, bedrock is anticipated to be encountered at relatively shallow depths under many of the turbine locations. The bedrock encountered is anticipated to be structurally suitable for support of foundations for wind turbines and other Facility components. However, turbine locations will undergo additional subsurface investigation prior to construction. See Exhibit 10(a)(5) and (6) and the Preliminary Blasting Plan (Appendix 10-A) for a discussion of blasting anticipated to be conducted as part of Facility construction. Additionally, foundation bases will be placed below the frost penetration depth, which is estimated to be approximately 48 inches across the Facility Site.

(b) Foundation Suitability Evaluation

Based upon the geotechnical conditions within the Facility Site, spread footings and drilled piers are feasible wind turbine, substation, or transmission line structure foundation types (Appendix 10-B). Foundation construction will occur in several stages, which typically include excavation, pouring of concrete mud mat, rebar and bolt cage assembly, outer form setting, casting, and finishing of the concrete, removal of the forms, backfilling and compacting, and site restoration. Excavation and foundation construction will be conducted in a manner that will minimize the size and duration of excavated areas required to install foundations. In addition, foundations will be constructed and inspected in accordance with relevant portions of the New York State Building Code and in conformance with all pre-construction site-specific studies.

(1) Preliminary Engineering Assessment

As previously mentioned, the Preliminary Geotechnical Investigation Report indicates that the Facility Site soils and underlying sedimentary bedrock are generally considered to be structurally suitable to support wind turbine foundations, support buildings, and access roads. However, additional borings will be performed prior to construction to assess localized subsurface conditions at proposed structure locations. Preliminary investigation and testing of the Facility Site found 6 to 30 feet of clay, sand, and gravel over shale bedrock. For these conditions, a spread footing foundation system is suitable (Appendix 10-B). Based on the results of the preliminary geotechnical investigation (Appendix 10-B), none of the investigated wind turbine locations exhibit zones of lower strength material at or below the assumed foundation bearing depth of 9.5 feet. All foundation construction techniques employed will conform to applicable building codes and industry standards.

Based on the characteristics of on-site soils, the risk of frost heave is present at the Facility Site. Foundations for the wind turbines and associated structures will be constructed at a suitable depth below the frost line, assumed approximately 48 inches below ground surface. Therefore, further assessment of frost action was not conducted.

The soils observed in the test borings generally consists of non-plastic silt with varying amounts of sand and gravel. On-site soils should have minimal shrink/swell potential. Therefore, specific construction procedures for potentially expansive clays are not required and further assessment was not conducted.

(2) Pile Driving Assessment

Pile driving is not anticipated to be needed for this Facility. Concrete mat foundations, with or without rock anchors, are suitable for the wind turbine models proposed in this Application.

(3) Mitigation Measures for Pile Driving Impacts

Pile driving will not be needed for this Facility; therefore, this section is not applicable.

(4) Vulnerability to Earthquake and Tsunami Events

As previously indicated in Section (a)(8), the Facility is considered to have minimal vulnerability associated with seismic events based on a review of publicly available data. Nine earthquakes above a magnitude 3.0 have been recorded within 100 miles of the Facility in the past 50 years according to the USGS fault database (USGS, 2023a).

The components of this Facility will be evaluated, designed, and constructed to resist the effects of earthquake motions in accordance with the American Society of Civil Engineers (ASCE) and Section 1613 of the Building Code 2015 of New York State. The Preliminary Geotechnical Investigation Report indicates that the Facility Site is Site Class C, D. Based on soil conditions present in the Facility Site and a lack of faults or seismic activity, the Facility Site is not considered vulnerable to earthquake events. The soils encountered during the subsurface explorations are not susceptible to liquefaction. The Preliminary Geotechnical Investigation Report lists the applicable parameters for design based on the seismic site classification in accordance with ASCE 7-10. Additionally, the Facility is located approximately 4.6 miles from the nearest large water body (Cazenovia Lake). Therefore, vulnerability associated with tsunami events will not be discussed in this Application.

REFERENCES

New York State Museum (NYSM)/New York State Geological Survey (NYSGS). 1970. *Geologic Map of New York – Niagara Sheet*. Available at: http://www.nysm.nysed.gov/common/nysm/files/niagara_bedrock_sheet.jpg (Accessed February 2022).

New York State Museum (NYSM). 1977. *McKendree and Isachsen's Preliminary Brittle Structure Map of New York*. Available at: http://www.nysm.nysed.gov/research-collections/geology/gis (Accessed February 2022).

Robertson, D.A., J.A. Gould, J.A. Straw, and M.A. Dayton. 1980. *Survey of Blasting Effects on Ground Water Supplies in Appalachia* (contract J0285029, Philip R. Berger and Associates, Inc.). Volume I. BuMines OFR, 8, p. 82.

Soil Survey Staff, Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA). 2022. *Web Soil Survey*. Available at: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.html (Accessed February 2022).

United States Geological Survey (USGS). 2014. *Seismic Hazard Map – New York*. Available at: https://www.usgs.gov/media/images/2014-seismic-hazard-map-new-york (Accessed March 2021).

USGS. 2018. *Quaternary Fault and Fold Database for the United States*. Available at: https://www.usgs.gov/programs/earthquake-hazards/faults (Accessed February 2022).

United States Department of the Interior, Office of Surface Mines and Reclamation (1989) *USBM Report RI 8507 – Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting*. Available at: https://www.osmre.gov/resources/blasting/docs/USBM/RI8507BlastingVibration1989.pdf (Accessed February 2022).