EAST POINT ENERGY CENTER

Case No. 17-F-0599

1001.21 Exhibit 21

Geology, Seismology, and Soils

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Exhibit 21: Geology, Seismology, and Soils

This Exhibit will track the requirements of proposed Stipulation 21, dated August 20, 2019, and therefore, the requirements of 16 NYCRR § 1001.21. This Exhibit contains a comprehensive summary of the geology, seismology, and soil character impacts resulting from proposed construction of the East Point Energy Center. Within this Exhibit is an identification and mapping of existing geological and surficial soil conditions, an impact analysis and definition of constraints resulting from these geological conditions, and a discussion on potential impact avoidance and mitigation measures.

Conclusions made within this Exhibit are based on the findings of a geotechnical engineering report performed by Terracon Consultants, Inc. (Terracon) completed on August 22, 2019. A total of 18 borings and four test-pits were completed at the Project Area during the geotechnical exploration. A summary of the borings completed to date is presented in the following table.

Table 21-1. Summary of Test Borings during Preliminary Site Survey

Test Boring No.	Depth of Boring (feet)	Date Completed
B-1	21.0	5-15-2019
B-2	20.5	5-15-2019
B-3	3.4	5-16-2019
B-4	16.5	5-16-2019
B-5	7.1	5-16-2019
B-6	9.5	5-17-2019
B-7	21.5	5-16-2019
B-8	21.5	5-24-2019
B-9	9.0	5-23-2019

Table 21-1. Summary of Test Borings during Preliminary Site Survey

Test Boring No.	Depth of Boring (feet)	Date Completed
B-10	11.5	5-20-2019
B-11	21.5	5-17-2019
B-12	16.5	5-20-2019
B-13	13.0	5-22-2019
B-14	6.4	5-22-2019
B-15	21.5	5-22-2019
B-16	15.4	5-22-2019
SS-1	5.2	5-24-2019
SS-2	5.4	5-24-2019
TP-1	11.5	5-15-2019
TP-2	7.0	5-15-2019
TP-3	11.5	5-15-2019
TP-4	5.5	5-15-2019

21(a) Existing Slopes Map

Figure 21-1 utilizes the United States Geologic Survey (USGS) National Elevation Dataset and ESRI ArcGIS software to demarcate predetermined existing slope ranges (0-3%, 3-8%, 8-15%, 15-25%, 25-35%, 35% and over) on and within a mapped drainage area which have the potential to be influenced by the Project. Slopes within this area range from 0-3% to >35%, with 85% of the Project Area occurring on slopes less than 15%. Table 21-2 below presents the percent coverage that each slope range encompasses within the influenced drainage area.

Table 21-2. Percent Coverage of Slope Ranges within Drainage Area

Percent Slope Ranges (%)	Percent Area (%)
0 – 3	14.3
3 – 8	39.0
8 – 15	31.8
15 – 25	12.7
25 – 35	1.9
> 35	0.3
Total	**100.0**

Earth moving and general soil disturbance will increase the potential for wind/water erosion and sedimentation into surface waters and downstream areas. Implementing the erosion and sediment control measures as outlined in the Stormwater Pollution Prevention Plan (SWPPP) will minimize impacts to steep slopes and highly erodible soils that may occur in the event of extreme rainfall or other events that could potentially lead to severe erosion and downstream water quality issues. The Preliminary SWPPP for this Project is included as Appendix 23-3 and will be updated and submitted to the Secretary of the Department of Public Service Staff for approval before construction. In addition, impacts to soil will be further minimized by the following means, as necessary:

- Prior to commencing construction activities, erosion control devices will be installed between the work areas and downslope areas to reduce the risk of soil erosion and sedimentation. Erosion control devices will be monitored continuously throughout construction and restoration for function and effectiveness.
- During construction activities, hay bales, silt fence and other appropriate erosion control measures will be placed as needed around disturbed areas and stockpiled soils.
- Public road ditches and other locations where Project-related runoff is concentrated will be armored with rip-rap to dissipate the energy of flowing water and to hold the soil in place.

- Following construction, all temporarily disturbed areas will be stabilized and stored in accordance with approved plans.

21(b) Slope Impact Avoidance

Fewer than 15% of the Project Area has slopes steeper than 15%. Project components will be sited to avoid steep slopes; therefore, impacts are not expected. Where avoidance is not feasible, site grading will be performed as indicated in the Grading & Drainage Plans presented in Appendix 11-1. No solar arrays are proposed on slopes exceeding 12%. Erosion and sediment control measures are described in greater detail within the Preliminary SWPPP provided as Appendix 23-3 in Exhibit 23 and are also depicted on the Erosion & Sediment Controls Plans presented in Appendix 11-1.

21(c) Proposed Site Plan

A proposed preliminary site plan was prepared and is included within the Preliminary Design Drawings presented in Appendix 11-1. The site plan shows existing and proposed contours at two-foot intervals for the Project Area and on-site interconnections. The site plan also identifies locations of proposed operation and maintenance components, solar panel locations, access roads, electrical collection line routes, and interconnections to existing utility infrastructure.

21(d) Preliminary Calculation of Cut and Fill

A preliminary calculation was performed utilizing existing and proposed three-dimensional surfaces generated from two-foot contour data to estimate the quantity of cut and fill necessary for Project construction. The cut and fill volumes stated below are differences calculated between the existing ground conditions, based off of contemporary and Project-specific Light Detection and Ranging (LiDAR) data, and the presumed ground surface character which will be left as a direct result of Project development. Specifically, earthwork quantity calculations were prepared using AutoCAD Civil 3-D software. An existing conditions surface was created based on two-foot contours generated from a LiDAR survey of the Project Area. From that data set, a proposed conditions surface was created from the Project grading plan. Differences between these two surface designs indicated the amount of material which will be excavated for construction. These calculations do not take into account the collection line trenching operation as part of the equation. It is presumed that collection line trenching would return soils to near existing conditions with the backfilling of the trench after collection line placement, negating any net change in the soil strata (similar to how it has been done on operational solar farms across New York State). The calculated difference between the existing and proposed grades indicates that an estimated volume of approximately 76,253 cubic yards of topsoil and 139,018 cubic yards of subsoil will be excavated. All topsoil excavated and a total of 139,834 cubic yards of subsoil will be placed. This results in a net earthwork balance of approximately 816 cubic yards of material needed for the construction of the proposed solar arrays and associated Project infrastructure. This total does not account for the approximately 16,175 cubic yards of crushed stone needed for access road and substation construction.

It should be noted that the calculation of cut and fill assumed that depths greater than 78 inches were to be considered as indicating bedrock per the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) lower limit of soil survey presented in Keys to Soil Taxonomy (NRCS 2014). However, in reference to Figure 21-3, actual depth to bedrock is greater than 78 inches throughout the majority of the Project Area. No excavations are expected to reach or exceed 78 inches.

It is anticipated that no materials will be exported from the Project Area and any excess materials from on-site excavations will be used as fill throughout the Project Area, with the exception of gravel for the access roads, which will consist of imported fill material. It should be noted, however, that the initial design is likely conservative and overstates the amount of cut that will actually be necessary during construction of the Project, as the access roads and substations will in fact be constructed in both cut and fill conditions.

Invasive Species Management and Control Plan

In order to identify the presence of invasive species in spoil material and prevent the spread of invasive species by the transportation of materials to and from the Project Area, an Invasive Species Management and Control Plan (ISMCP) has been developed and is provided in Appendix 22-6. The primary purpose of the ISMCP is to control the spread or introduction of invasive species in the excavated materials and avoid spreading and/or transporting invasive species by vectors (mechanisms of species transfer) directly correlated to the construction and operation of the Project. The ISMCP will be appended to the Project construction contract, requiring the BOP Contractor to implement the control measures outlined within the ISMCP. The principal construction-related control measures contained within the ISMCP are to prevent introduction and spread of all New York listed invasive species. No fill material will be transported offsite from the

Project Area. This action will minimize the potential for introduction and/or transport of invasive species to uncolonized regions.

Management actions will be grouped into four main categories including: material inspection, targeted species treatment and removal, sanitation, and restoration. Within each category, specific actions or combinations thereof can be taken depending on characteristics of a particular species and its density within the target area. Monitoring for invasive species will be conducted throughout the duration of the Project to ensure that the ISMCP is implemented appropriately and that the goals outlined therein are being met. Of note, it should be stated that invasive species identified on site prior to construction are likely to spread even in the absence of further human intervention. It is therefore necessary to distinguish between natural movement of invasive species and anthropogenic movement caused by Project related construction activities. The ISCP will propose a goal of a zero-net increase in the number of invasive species present and their distribution in the Project Area is based on actions related specifically to Project construction and operation.

Post construction monitoring will be conducted for a minimum of five years following completion of Project-related activities on site. This is to ensure that ISMCP goals are met, as germination and spread of invasive species can continue long after construction activities have concluded. Failure to meet the goals of the ISMCP will result in revision of the control plan and extension of the post construction monitoring phase for a period of two years from implementation of the revised plan.

21(e) Description and Preliminary Calculation of Imported Fill, Gravel, Asphalt, and Surface Treatment Material

The existing site topography was derived from LiDAR survey data of the Project Area. Proposed topography/final grade was developed based on the design criteria and constraints required for the anticipated delivery of Project components and construction of the Project facility. As stated previously, a preliminary calculation was performed utilizing existing and proposed three-dimensional surfaces generated from two-foot contour data to estimate the quantity of cut and fill necessary for Project construction.

The fill material will be used for several purposes including subgrade material for access roads and substations, and grading for laydown areas. Based on the calculation of cut and fill, the material excavated from the site will be utilized for fill for solar array sites. Importing additional graded fill material will be required for the construction of permanent access roads, and the substation yards. It is anticipated that approximately 16,175 cubic yards of gravel fill will be required for construction of the Project Area. Gravel fill will be imported from off-site. Excess material from excavations will be distributed across disturbed areas and blended into existing topography to return each area to its pre-construction condition to the maximum extent practicable, or as described in the site grading plan, provided in Appendix 11-1.

Imported structural fill (e.g. gravel) should contain no particles larger than 3 inches and less than 10 percent, by weight, of material finer than a No. 200 mesh sieve. The imported materials should be free of recycled concrete, asphalt, bricks, glass, and pyritic shale rock. Additional laboratory testing will be required to determine if the on-site soils are suitable for use as structural fill on site.

Additional fill materials of surface material and concrete (used for footings and foundations) will also constitute as fill for the Project. The quantity of gravel and surface treatment materials was estimated based on the preliminary site plan. The estimated quantity of each imported material is presented in the following Table 21-3.

Table 21-3. Estimated Quantity of Imported Material

Imported Material	Quantity (yd^3)
Gravel	16,175
Surface Material	816
Concrete	2,700
TOTAL	25,158

At this time, it is assumed that large off-road dump trucks with an approximate capacity of 22 cubic yards will be the primary truck used to transport materials throughout the site. As such, it is presumed that approximately 735 truckloads would be required to transport imported gravel fill material into the Project Area throughout the duration of construction. Additionally, 97 truckloads of surface material will also be brought into the Project Area utilizing these truck types. Concrete truck designs which are presumed to be utilized for this Project will carry approximately 8 cubic yards and weigh 70,000 lbs. With the estimated requirement of 2,700 cubic yards of concrete pavement for this Project, an additional 338 concrete truckloads will also be necessary to transport concrete fill materials on-site throughout the duration of construction.

As mentioned above, it should be noted that the initial design is likely conservative and overstates the amount of cut and fill that will actually be necessary during construction of the Project.

21(f) Description and Preliminary Calculation of Cut Material of Spoil to be Removed

Based on the preliminary cut and fill calculation performed in Section 21(d), it is not expected that any on-site material will be removed during construction. There will be an excess of approximately 6,737 cubic yards topsoil stripped from ground surfaces in areas where fill will be placed. This material will be temporarily stockpiled and controlled through Erosion & Sediment Control (E&SC) guidelines along the construction corridors and incorporated in the site restoration where applicable, described in further detail on grading and drainage plans provided in Appendix 11-1. During restoration of the Project, all excess topsoil materials will be re-graded to approximate pre-construction conditions in order for the site character and drainage areas to be returned to existing conditions to the maximum extent practicable.

21(g) Construction Methodology and Excavation Types

The proposed start date in the construction of the Project is currently in mid- to late- 2020. Project excavation and construction will be performed in several stages and will include the main elements and activities described below.

Location and Extent of Horizontal Directional Drilling (HDD) Methods

In select locations, the Applicant is proposing to utilize trenchless excavation techniques, otherwise known as horizontal directional drilling (HDD), to route 34.5 kV collection circuits under obstacles including roads (Beech Road, Empie Road and U.S. Route 20) and state-protected streams and wetlands. Approximately 1,285 feet of collector line will be installed via HDD. The HDD method was chosen because it has proven to be a safe and efficient method of crossing roads, railroads, streams, wetlands, and other environmentally sensitive areas with minimal surface impact. The Applicant is currently locating and designing all specific target HDD locations, (see preliminary site plans in Appendix 11-1 for proposed locations). Other areas may also be included where topographical or environmental constraints dictate that HDD installation methodology is the best construction practice.

Inadvertent Return Plan for Horizontal Directional Drilling (HDD)

The HDD process involves the use of water and bentonite (a naturally occurring clay) slurry as a coolant and lubricant for the advancing drill head. The slurry also helps to stabilize the bore and aids in the removal of cuttings during the drilling process. Bentonite is nontoxic; however, if released into waterbodies, has the potential to adversely impact fish, fish eggs, aquatic plants, and benthic invertebrates. Therefore, to protect these natural resources, the Applicant has prepared an Inadvertent Return Plan which outlines operational procedures and responsibilities for the prevention, containment, and cleanup of inadvertent releases associated with the HDD process. The objective of this Plan is to:

1. Minimize the potential for an inadvertent release of drilling fluids associated with HDD activities;
2. Provide for the timely detection of inadvertent returns;
3. Protect environmentally sensitive areas (streams, wetlands) while responding to an inadvertent release;
4. Ensure an organized, timely and “minimum-impact” response in the event of an inadvertent return and release of drilling fluids; and, ensure that all appropriate notifications are made immediately.

A detailed Inadvertent Return Plan was created for the Project and is included in Appendix 21-3 of this Application. Details within the Plan indicate:

- Site personnel responsibilities;
- Effective training regimes for handling an inadvertent return;
- Measures to prevent inadvertent releases;
- Equipment and containment materials which will be utilized in the event of an inadvertent return;
- An outline on effective responses to an inadvertent release;
- A list of parties to be notified at the unlikely event of an inadvertent return;
- Details outlining an effective clean up and restoration strategy;
- Steps on construction restart and avoidance of future inadvertent returns; and
- Effective documentation of the incident.

Although HDD has proven to be a safe and reliable method of crossing surface features with very minimal impact, the potential still exists for inadvertent releases of drilling fluid to the surface, which can have a detrimental impact on the environment. These releases typically occur as a result of seeps which can form when pressure in the drill hole exceeds the capability of the overburden to contain it, or when fluids find a preexisting fault in the overburden. The likelihood of these situations occurring can be minimized by taking into consideration the soil type and bedrock composition. Bore depth will be determined based on these site-specific factors; however, a minimum depth of 25 feet in sound soils is typically sufficient to prevent an inadvertent release.

Refer to Appendix 21-3 for the Inadvertent Return Plan for this Project.

Construction Phases

Pre-Construction Survey and Environmental Monitoring

Prior to the commencement of Project related construction, an overall site survey will be performed in order to effectively locate and demarcate the exact location of Project components and routes. This will facilitate assembly strategy and construction efficiency. An Environmental Monitor will be implemented during the construction phase of the Project to oversee all construction and restoration activities in order to ensure compliance with all applicable environmental conditions and permit guidelines. Prior to the start of construction at specific sites, the Environmental Monitor, with support of construction management personnel, will conduct site reviews in locations to be impacted, or potentially impacted, by associated construction activities. Pre-construction site review will direct attention to previously identified sensitive resources to avoid (e.g., wetlands and waterbodies, archaeological, or agricultural resources), as well as the limits of clearing, location of drainage features (e.g., culverts, ditches), location of agricultural tile lines, and layout of sedimentation and erosion control measures. Work area limits will be defined by flagging, staking, and/or fencing prior to construction.

The pre-construction walk over will also aid in the identification of any specific landowner preferences and concerns. The placement of erosion and sediment control features will also be located during this site review in order to mitigate potential impacts to sensitive sites and also uphold erosion and sediment control Sate-wide initiatives. The pre-construction site review will serve as a critical means of identifying any required changes in the construction of the Project in a timely manner in order to avoid future delays to project construction timeframes.

Site Clearing and Preparation

After the initial site review, Project-related construction will be initiated by clearing brush and woody vegetation within the limit of disturbance (LOD) established for the solar arrays, access roads, electrical collection line routes, and other supporting infrastructure (collection substation, switchyard, laydown yard, etc.). Vegetation cleared within this LOD will be removed, organized, and disposed on site and outside any indicated sensitive sites (see Appendix 11-1). The definitive clearing impacts which will occur as a result of the Project will be based on final engineering design. For more information on clearing impacts, including their description and quantification, please refer to Exhibit 22 of this Application.

Laydown Yard Construction

All laydown yard areas were selected for ease of accessibility, strategic location in the construction work flow, relatively flat ground surface, occurrence outside of sensitive resources (wetlands, waterbodies, cultural areas etc.), and containing limited shrubby or woody vegetation in order to reduce impacts to natural vegetation areas. Most sites are situated within agricultural areas or within old fields left fallow.

Laydown yards will be developed by stripping and stockpiling the topsoil (stockpiles will be stabilized per the SWPPP) and grading the subsoil (as necessary). Geotextile fabric and gravel fill will then be put in place to create level working areas for the staging of temporary construction trailers, equipment and materials. Laydown areas will also be utilized for contractor parking.

Upon completion of the construction phase of the Project, any gravel fill will be removed, and topsoil stock piles will be utilized to return laydown areas to existing grades and conditions. For any laydown yards staged in active agricultural areas, subsoils will be “ripped” to reduce compaction caused by construction of the Project. Active agricultural lands will be restored in accordance with the New York State Department of Agriculture & Markets Guidelines for Agricultural Mitigation for Solar Energy Projects (Revision 4/19/2018), or that which is most current at the time of Project construction, to the maximum extent practicable.

Access Road Construction

Access roads will be constructed to provide access from existing roadways for the Project. The new gravel access roads will be constructed to reach the proposed solar array location safely and effectively. Road widths will be approximately 16 feet of gravel for array access roads (with a total vehicle clearance width of at least 20 feet), and 20 feet of gravel for substation/switchyard access roads.

Road construction will initially involve the stripping of topsoil and grubbing of stumps, as necessary, after removal of vegetation. All topsoil will be segregated from subsoil and stockpiled (windrowed) along the access road corridor for use in site restoration and soil surface grading. Following removal of topsoil, exposed subsoils will be graded to specifications outlined in the site design, compacted for constructability, and surfaced with gravel or crushed stone for intended use as an established Project access road. Geotextile fabric or grid may be installed beneath the road surface where needed in order to provide additional stability support to the access road. Details regarding access road construction are discussed in Exhibits 11 and 12 of this Application.

If necessary, dewatering of excavations may occur in order to keep the excavations free of standing water and permit safe and constructible environment. Dewatering methods will involve pumping the water to a predetermined well-vegetated discharge point, away from wetlands, waterbodies, and other sensitive resources. Discharge of water will include measures/devices to slow water velocities and trap any suspended sediment (sediment bags). All dewatering activities will also be conducted in accordance with the final Project SWPPP and in accordance with the SPDES General Permit for Stormwater Discharges from Construction Activities in effect at the time of construction. The use of temporary pump-around techniques or coffer dams will be used during the installation of all access road waterbody crossings. Appropriate sediment and erosion control measures will be installed and maintained according to the final Project SWPPP, which will be finalized during final engineering and prior to construction. In order to facilitate effective draining and surface water management within the access road, culverts, timber mats and/or water bars will also be utilized where necessary.

Solar Array Racking System Construction

The construction of solar array racking systems (the supporting structures on which the solar modules will be mounted) will occur after associated access roads to the predefined array site have been completed or are substantially in place. Upon access to the predetermined array location, strictly adhering to guidance from the site grading plan, the grading and leveling of the array site location will occur. In keeping with conventional topsoil preservation methods, topsoil will be stripped from the excavation area as in the access road construction operation. Topsoil will be stockpiled and stabilized in accordance with SWPPP guidelines for future use in site restoration efforts.

During excavation, subsoil and bedrock will also be segregated and stockpiled for reuse as backfill and in access road development. As stated previously, stockpiled soils will be located outside of sensitive resource areas and will be stabilized in accordance with the final Project SWPPP. Though none is proposed, where blasting is deemed necessary, all blasting operations will adhere to applicable New York State statutes and regulations governing the use of explosives, see section (h) below for more information on the Project Blasting Plan.

Depending on site soil characteristics, racking foundations will be installed by one of three methods. First, the post of the racking system may be driven directly into the soil. This is the primary method of post installation proposed. Second, a ground screw type post will be installed directly into the soil. Third, in cases of high ledge or bedrock, a post hole will be drilled into the rock to an appropriate depth, the post will be installed, and the post hole will be grouted. See detail sheet C-104 of the preliminary design plans. Based on the finding of the preliminary geotechnical investigations, soils are conducive to the installation of pile-drive foundations. Some areas are likely to encounter refusal above the required embedment depth, and therefore post-holes should be drilled, and foundations reinforced as described above.

34.5 kV Electrical Collection Line Construction

The construction of 34.5 kV collection circuits between solar arrays will involve multiple methods including direct burial and open trench construction methods utilizing equipment such as a rock saw, cable plow, rock wheel and/or trencher. Direct burial methods involve the installation of a bundle of electric and fiber optic cable directly into a narrow trench in the ground. Where direct burial is not possible due to site specific constraints, an open trench will be utilized. Open trench operations involve the excavation, segregation, and stockpiling of topsoil and subsoil adjacent to the cutting of an open trench. Cable bundles are laid at the base of the trench and the trench is backfilled with suitable fill material and any additional spoils are spread out to match existing grades.

Trench breakers will be put into place as necessary along trench lines in order to prevent erosion caused by the lateral movement of runoff of soil strata in the open trench. These breakers will be located within the trench on steep slopes (based on field conditions) above agricultural, cultural, or wetland/waterbody areas to avoid erosion, sediment build up, and the deposition of sediment into any of the predetermined sensitive resources in the Project Area.

Following installation of the 34.5 kV collection line route, the contractor will utilize strategically positioned topsoil and subsoil piles to return disturbed areas to pre-construction grades. Installation of buried electrical lines would typically require a width of up to 20 feet of vegetation clearing for this Project. However, in areas where buried electrical lines have been routed collinear with proposed access roads, there will be no additional vegetation or soil disturbance beyond what is expected for the predetermined access road construction. All cleared areas along the buried electrical line routes will be restored through seeding and mulching and areas outside of the Facility fence line will be allowed to regenerate naturally. As previously noted, HDD will also be employed in select areas in order to navigate collection line around, and prevent damage to, existing roadways and sensitive natural resources including wetlands and roadways. For more information on HDD drilling see the subsection on *Inadvertent Return in Horizontal Directional Drilling (HDD)* below and also the Inadvertent Return Plan located in Appendix 21-3.

Solar Array Delivery

The solar array segments and racking will be delivered to the designated construction locations through use of large big-rigs utilizing flatbeds and dry vans (for hardware) and offloaded by crane equipment. No excavation of soil strata or disturbance of bedrock is proposed to occur during this stage of the construction.

Collection Substation and Switchyard Construction

Much like the clearing of laydown areas, substation and switchyard construction will commence with clearing of any woody or shrubby vegetation within the substation footprint. After clearing, the topsoil will be stripped and stockpiled for later use in site restoration. Exposed subsoil will then be graded to specifications outlined in the Project grading plan and foundation areas will be excavated using standard excavation equipment. Construction staging areas for equipment and materials will also be graded and created. Structures will be supported with deep foundations. At this stage, foundations will be embedded or drilled, after which installation of electrical infrastructure (structural steel skeleton, conduits, cables, bus conductors, insulators, switches, circuit breakers, transformers, control buildings, etc.) will occur.

During substation and switchyard site finalization, gravel fill/crushed stone will be spread throughout the substation and switchyard surface and a perimeter of chain link fence will be erected for security and safety precautions. Finally, the high voltage link-ups will be connected and tested for charge and integrity through electrical control systems in the control houses on-site. Restoration of the adjacent areas impacted by construction back to existing conditions in direct vicinity to the substation and switchyard will be completed using stockpiled topsoil, and the appropriate seed and mulch.

Blasting Operations

As stated previously, this Project involves excavation of soil for the installation of foundations for the placement of solar arrays and substation facilities. The excavation consists of drilling holes of various sizes and depths for the installation of foundations to support steel structures. Based upon the geotechnical investigation conducted at the Project Area, blasting is not anticipated. However, there is a possibility that the sub-soil may consist of weathered rock or solid bedrock.

If rock or bedrock is encountered during excavation, the construction crews will extract and excavate it using a backhoe or other appropriate equipment. However, if the bedrock cannot be extracted with a backhoe, other means may be used for excavation (e.g. pneumatic jacking and/or hydraulic fracturing). Consequently, no blasting will be required if the above procedures are used for the excavation. However, if the rock cannot be excavated using above equipment it may be necessary to use a blasting method to remove bedrock/rock laden foundation sites. In such cases a blasting plan shall be used. See 21(h) below for more details on the Project blasting plan.

Subsurface Drain Tile Repair Impact and Repair

The Applicant is committed to minimize impacts to agricultural operations and will work with landowners/farm operators to address unanticipated post-construction impacts. The Applicant will work with affected landowners/farmers regarding potential drainage issues on their properties and will utilize trench breakers in areas of moderate to steep slopes on active agricultural land if deemed prudent (based on field conditions) to ensure that the deposition of impacted or stockpiled soils do not occur over agricultural lands.

Existing drain tiles will be identified and located before construction as much as is reasonably possible based primarily on consultation the landowner. During and after construction operations, any existing drain tiles within the area of disturbance will be checked for damage, and damaged drain tiles will be repaired as specified in landowner lease agreements and will be performed by qualified drain-tile specialists. The Applicant will coordinate with the landowner to continue to monitor drain tiles post-construction to ensure repairs are properly functioning.

Temporary Cut or Fill Storage Areas

In the initial siting and design process, the strategic placement and design of these components was undergone with the direct strategy of minimizing the amount of areas which require cut and fill operations to occur. As stated previously, the construction and placement of Project infrastructure will require cut or fill to achieve the final grades within the Project Area. A multitude of scenarios would potentially require areas of cut and/or fill including access roads constructed on a side slope, grading areas of the arrays to slopes of 12 percent or less, grading out work areas which are naturally undulatory or crowned, and access roads traversing an existing grade that exceeds the maximum design slope. It is anticipated that approximately 6,737 cubic yards will be fill derived from excavated materials with the exception of gravel for the access roads.

Following the solar array manufacturer’s recommendations, array foundations founded on soil will be constructed no less than 5 to 7 feet below the finished grade. Permanent access roads will be constructed using 12 inches of crushed gravel over native sub-soils which will be stock-piled for this said use. Where necessary, the native soils will be reinforced with geo-synthetic fabric.

Proper methods for segregating stockpiled and spoil material will be implemented. All excavated soils will be reused in close proximity to where it was unearthed to the maximum extent possible. This technique will aide in reducing the proliferation of non-native flora to uncolonized areas within Project.

21(h) Delineation of Temporary Cut or Fill Storage Areas

Excavation and grading plans, including design and location of temporary storage of topsoil and subsoil structures, are provided as Appendix 11-1 to this application. Excess fill materials will be stockpiled and stored for use onsite. Several storage options may be employed to stockpile topsoil materials as determined appropriate for on-site conditions during the construction phase including but not limited to silt fencing and straw bale barriers. Concrete waste may be stored in a constructed concrete wash area sited away from wetlands and wetland buffers.

21(i) Characteristics and Suitability of Material Excavated for Construction

Terracon, an engineering services company, conducted a desktop geotechnical study to evaluate the subsurface conditions within the Project Area. This study consisted of a literature review of publicly available data as well as recommendations established on this information. This study was supplemented with a preliminary geotechnical investigation that included the performance of test borings at 18 locations across the Project Area.

Based on the findings of these studies, the subsurface materials that would be encountered within the Project Area are suitable for construction of the proposed structures. Four test pits were excavated to approximate depths of between 5.5 and 11.5 feet. Laboratory corrosion series testing, and thermal resistivity dry-out curves were performed on four site samples. Infiltration testing was performed at two locations during the preliminary geotechnical investigation. Results are as follows:

Table 21-4. Results of Laboratory Corrosion Testing (Reproduced from Preliminary Geotechnical Engineering Report, Appendix 21-1)

Boring	Depth	Sulfides (ppm)	Chlorides (ppm)
TP-1	11.5’	Nil	30
TP-2	7’	Nil	35
TP-3	11.5’	Nil	32
TP-4	5.5’	Nil	23

In general, a chloride concentration greater than 500 parts per million (ppm), or a sulfate concentration greater than 2,000 ppm is considered to be indicative of a corrosive environment for most structures. Based on the test results it appears that a corrosive environment does not exist, and standard Type I/II cement may be utilized on this Project.

Frost depth in the Project Area is 48 inches. The foundations for new site structures will bear below this depth to prevent frost heave.

Organic-laden soil was only encountered at the ground surface during the preliminary investigation. The depth of organic material in the topsoil was no more than approximately 12 inches. This material will be stripped during earthwork so that new structures do no bear on organic-laden soil.

The preliminary geotechnical investigation findings suggest that the three primary strata to be encountered at boring locations are:

- Stratum 1 – Silty and Sandy Silt, with varying amounts of gravel, cobbles, and possible boulders
- Stratum 2 – Weathered rock, shale and limestone
- Stratum 3 – Bedrock (limestone and shale)

Stratum 1 – Silty and sandy silt soil was encountered at the ground surface at some locations and extended to depths of up to 21.5 feet (the maximum depth investigated). This stratum was primarily composed of loose to very dense silty sand with gravel. Standard Penetration Testing "N" values in this stratum ranged between zero and greater than 50 blows per foot.

Stratum 2 – Weathered rock from glacial till was typically encountered from the 3.5 feet below the surface to depths of up to 21 feet and consisted of very dense shale and limestone. Standard Penetration Testing "N" values in this stratum typically required more than 50 blows per foot.

Stratum 3 – Bedrock was encountered at the maximum depth investigated, 21.5 feet. This stratum consisted of bedrock comprised of limestone and shale. The bedrock was weak to soft and close to very close fractured. At locations where augers could penetrate into this stratum the Standard Penetration Testing "N" values typically exceeded 50 blow per foot.

21(j) Preliminary Plan for Blasting Operations

Blasting and/or rock excavation techniques are not anticipated within the Project area based on the geotechnical investigation and proposed excavation depths, however a preliminary blasting plan has been prepared in the event that blasting is determined to be required. The Preliminary Blasting Plan is provided as Appendix 21-2.

It is anticipated that the contractor for this Project can excavate with relatively little difficulty using a rock saw, cable trencher or plow. Where bedrock is encountered, it is anticipated to be rippable due to its content, and thus will be excavated using large excavators, rock rippers, or chipping hammers. The method or combination of methods required will specifically be tailored to the structural integrity, depth, and robustness of rock/bedrock encountered.

In the event that a unique situation requiring blasting arises, the Preliminary Blasting Plan provided as Appendix 21-2, including procedures timeframes for notifying municipal officials and property owners (or persons residing at the location if different) within one-half mile radius of the blasting site of these activities, as well as an assessment of potential blasting impacts, and a blasting impact mitigation measures plan will be used. However, it should be stated that the blasting contractor shall be responsible for generating an overall Contractor Blasting Plan, if required, and also a written site-specific blasting plan if there are differences in selected blasting sites including the subsoil and bedrock conditions. This specification shall also be used for pre-blast surveys, notifications, use of explosives, security, monitoring, and documentation.

21(k) Assessment of Potential Impacts from Blasting

Impacts to bedrock could be anticipated as a result of blasting operations, which may be required in limited areas during construction of the Project. The bedrock encountered in the preliminary geotechnical survey consisted of limestone and shale. Stratums were sampled by coring. The recovered bedrock core was typically weathered weak to soft rock. Blasting and/or rock excavation techniques are not anticipated based on bedrock within the Project Area, therefore no impacts are expected. A Preliminary Blasting Plan has been provided in Appendix 21-2. Impacts to existing above- and below-ground structures were not assessed as blasting will not be required as part of the construction of the Project.

21(l) Identification and Evaluation of Reasonable Mitigation Measures Regarding Blasting Impacts

The utilization of blasting techniques is not anticipated for this Project, therefore impacts requiring mitigation are not expected. Should blasting be required, to minimize impacts, blasting will 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 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 RI 8507 and USBM RI 8485). Mitigation measures will include alternative technologies and/or location of structures in order to negate the need for blasting. Where reasonable alternative measure cannot be employed, blast mats and backfill will be utilized to control any excessive rock movement when blasting in close proximity to identified structures. Additionally, the Applicant will outline a plan for securing compensation for damages that may occur due to blasting, if applicable.

21(m) Regional Geology, Tectonic Setting, and Seismology

In addition to the Preliminary Geotechnical Engineering Report in Appendix 21-1, several existing published sources were used to better understand regional geology, tectonic setting and seismology within the Project Area. The sources include the Soil Survey of Schoharie County (USDA, 2019), statewide bedrock geology mapping (NYS Museum/NYS Geological Survey, 1999a), New York State surficial geology mapping (NYS Museum/NYS Geological Survey, 1999b), 2014 New York State Hazard Map (USGS, 2014b), and USGS Earthquake Hazards Program (USGS, 2015).

The Project Area is located within the east central part of New York State in the glaciated portion of the Allegheny Plateau physiographic section of the Appalachian Plateau physiographic province. Major topographic and geologic features in this area were formed during the last glacial advance and retreat, which ended approximately 12,000 years ago. The Project is located just south of the most recent glacial maximum advance.

Numerous “through” valleys and troughs are found in this province (NYSDOT Geotechnical Design Manual, 2013). Some contain large lakes, such as the Finger Lakes, others only small ponds or streams. The valley walls found within this province are rather steep, forming escarpments along the northern boundary of the plateau. The Project Area is a hilly highland area with few scattered wetlands. Elevations within the Project Area range approximately between 1,200 feet and 1,600 feet according to the USGS web topographic maps.

The northern portion of the Project Area is underlain by Onondaga limestone of the Middle Devonian age, Schoharie Limestone of the Lower Devonian age, and Cobleskill Limestone of the Upper Silurian age. The Southern portion of the site is underlain by shale bedrock of the Hamilton Group of the Middle Devonian age. The bedrock is approximately 200-300 feet below the ground surface in upland areas, forming a hard, resistant cap. The thick sedimentary rock is believed to have been severely eroded, lying in horizontal layers which create a flat-topped appearance. The transition to bedrock from the overlying glacial till is uniform in the Project Area. Surficial geology is comprised of the Lorraine, Trenton and Black River Groups and can be classified as glacial till. These units were formed in the upper Ordovician and are composed of predominantly shale, mudstone, and sandstone rock types. Most of the rock types consist of soft fragments which pose no obstacles to excavation.

Publicly available mapping indicates that karst topography is present within the majority of the Project Area and throughout the Schoharie Valley. The USGS delineates a narrow band of carbonate rocks with karst potential which extend across the state from Buffalo to Albany. These areas are directly underlain by carbonate bedrock, sometimes covered by a thin layer of sediments. This underlying geology creates the potential for sinkholes, caves, or other karst features at varying densities. Land subsidence, or sink holes, are more commonly observed in karst formed by soluble or evaporated rock. Carbonate rock, consistent with that found within the Project area is less soluble and such features take more time to form. The limestone geology in this area is susceptible to the development of sinkholes. A review of available aerial photography, observations made on site, as well as discussions with the manager of the property indicates the presence of potential sinkholes within the limits of the proposed development. Specifically, near Boring B-4 potential sinkholes and limestone bedrock outcroppings were encountered. The loose soils directly on top of rock encountered in boring B-4 is typical of Karst geology and indicates the potential for additional sinkholes to develop in the vicinity. Collapses are relatively rare, with the most recent occurrence in New York State reported over 20 years ago (NY Division of Homeland Security and Emergency [DHSES] 2014).

Construction activities will minimize excavations in karst-prone areas where excavations may result in subsurface erosion. Subsurface erosion resultant from excavation in karst-prone areas is typical of soils comprised of fine particles. Geotechnical investigations found that throughout most of the Project Area, soils consist of coarse particles, which are less susceptible to erosion and infiltration. Given the geology within the Project area, sinkhole mitigation will be a consideration for structures proposed in the vicinity of boring B-4, and excavation in this area will be avoided to the maximum extent practicable. As noted above, sinkholes found in this region generally having shallow sloping sides caused by dissolving carbonate rock and collapses of are relatively rare. Where sinkhole activity is discovered, the area will be excavated to expose the throat of the sinkhole and sealed with concrete. This sealed area may then be backfilled using on-site materials. For sinkholes with deeper overburden, less effective alternative methods may be necessary, including the installation of a plug consisting of geotextile fabric over an excavated area as determined by a geotechnical engineer, followed by layers of gravel in decreasing size, capped with another layer of geotextile fabric. Blasting is not anticipated or proposed and therefore blasting impacts to karst features were not assessed.

Groundwater aquifers are located in the glacial outwash in the valley areas in the vicinity of the Project area. Upland areas typically do not have a true water table above a depth of approximately

70 to 80 feet. However upland areas are subject to perched groundwater conditions during wetter periods as infiltrating water becomes trapped within the soil above undisturbed clayey glacial till and bedrock. Figure 21-3 also depicts the anticipated depth to seasonal high-water table (SHWT). Depth to SHWT is shown as ranging from the surface to more than 50 inches below the ground surface. With conditions being so variable across the site, it is not readily known if the proposed facilities will encounter groundwater in the area. Groundwater was encountered in six of the borings and test pits at the time of exploration at depths ranging between about 5.5 to 15 feet below existing grades. However, as indicated, this could vary seasonally.

There are no known oil and natural gas wells located in the vicinity of the Project Area (NYSDEC, 2014).

According to USGS Seismic Hazards database, the Project Area is located in an area of relatively low seismic activity with a 2% probability of a magnitude 5.0 earthquake occurring in the next 50 years of peak acceleration exceeding 10% to 14% of the force of gravity (Figure 21-4). This indicates relative low probability for seismic activity and bedrock shift in the vicinity of the Project area. In addition, the USGS Earthquake Hazards Program does not list any faults within the vicinity of the Project Area.

Based upon correlations with Standard Penetration Testing "N" values obtained during the preliminary geotechnical investigation and New York State Building Code guidelines available, for the portions of the site within the loose silt area, the Seismic Site Classification is D. For the balance of the site that is outside of the loose silt area, the Seismic Site Classification is C. Based upon the composition and relative density of the site soils, their liquefaction should not occur in response to earthquake motions.

21(n) Facility Construction and Operation Impacts to Regional Geology

A Preliminary Geotechnical Engineering Report has been completed and is included as Appendix 21-1. In general, the conditions encountered are favorable for the Project. The available information suggests that the solar array posts will be underlain by loose silt, glacial till, weathered shale and limestone, and potential bedrock. It is therefore anticipated that the arrays can utilize driven piles and the collection/switchyard equipment use shallow and deep foundations where

proposed. The glacial till, transition zone rock, and bedrock typically provides high bearing strength and good short-term excavation stability.

Based on the subsurface conditions encountered during the investigation performed to date, it appears that the primary geotechnical issues will be:

- Shallow and possible premature refusal due to shallow bedrock, cobbles, and boulders;
- Excavation of the glacial till, transition zone rock, and potential bedrock (limited);
- Possible deterioration of the glacial till and transition zone rock upon excavation and exposure to the elements and construction traffic.

The glacial till, transition zone rock, and bedrock will provide high bearing strength and good short-term excavation stability if left undisturbed. However, the strength of the glacial till and transition zone strata will deteriorate if they are allowed to saturate or if they are disturbed by over-excavation. The stability of slopes and excavations in these strata will also decrease over time. Typically, permanent slopes in the glacial till are graded no more steeply than 33% (18.4 degrees) unless they are reinforced.

Given the nature of construction associated with Project development, minimal adverse impacts to regional geology and soils are expected during the construction phase, and little to no temporary or permanent impacts are expected once the facility is operational. Project Facilities have been designed and sited to avoid or minimize impacts to geology, topography and soils within the Project Area.

21(o) Seismic Activity Impacts on Project Location and Operation

The USGS Earthquake Hazards Program does not list any faults within the vicinity of the Project Area. Soils within the Project Area are looser and typically are classified as Site Class C or D, which are appropriate for shallow foundations are do not indicate risk of collapse during seismic activity. In addition, the USGS Earthquake Hazard Program does not identify any young faults within the vicinity of the Project Area. Therefore, the impact due to seismic activity is considered to be negligible. Also, the design of current solar array technology allows for operational control and emergency shut off in case of an emergency such as a significant seismic event.

21(p) Soils Types Map

Figure 21-2 delineates soil types within the Project Area utilizing the USDA NRCS Web Soil Survey application. A detailed discussion of each soil type is provided in Section 21(q), below.

21(q) Soil Type Characteristics and Suitability for Construction

Information regarding on-site soils was obtained from on-site investigations conducted by Terracon, and from existing published sources, including The Soil Survey of Schoharie County, New York (USDA, 1969), USDA Web Soil Survey (2019), and Soil Survey Geographic (SSURGO, 2019).

The Soil Survey of Schoharie County, New York (USDA, 1969) and the USDA Web Soil Survey indicates that all proposed facilities and solar arrays are sited within two soil associations. The Darien-Nunda association occurs on drumlin-like hills and ground moraines overlaying calcareous glacial till. These soils are deep, medium-to-low lime soils which are moderately well-drained and medium-to-fine-textured. Minor soils, which comprise approximately 20% of the association are highly organic and drainage is poor. The Honeoye-Farmington association contain well-drained soils of varying depth. The Honeoye soils are deeper and medium-textured, whereas the Farmington soils are much shallower, often less than 20 inches to limestone bedrock. The major soils comprise approximately 40% each of the association.

Sinkholes, caves and cracks in the bedrock are common in this formation, particularly along the northern boundary. Percent organic material ranges among mapped soil units from 0.64 to 2.20%. Depth to a restrictive layer across all soil series is greater than 200 centimeters, with the exception of the Farmington series which is restricted by lithic bedrock at 50 centimeters. Land uses across both associations are well suited to agricultural production in support of dairy farming (e.g. pasture, hay, corn and oats). There are nine soil series within the Project Area, of which there are 24 individual soil map units. Three of the soil units are designated as *Prime Farmland if Drained*, six are designated as *Farmland of Statewide Importance*, and two are designated *All Areas are Prime Farmland*. The remaining units are not prime farmland. Each soil series and unit is described in detail below:

Alluvial land (Al) consists of 40 percent fluvaquents and similar soils, 35 udifluvents and similar soils, and 25 percent minor components. Alluvial land is found on floodplains.

Darien series consists of very deep, somewhat poorly drained soils formed in Wisconsinan age till on till plains, drumlins, and moraines. The potential for surface runoff is low to very high with moderately slow permeability in the subsoil and slow permeability in the substratum. Permeability is moderately slow in the subsoil and slow in the substratum. Darien soils are nearly level to steep with slopes ranging from 0 to 25 percent. The typical soil profile of this series is 0 to 72 inches thick, consisting of very dark grayish brown silt loam about nine inches thick with olive brown and gray clay loam and channery silty clay loam extending to a depth of 72 inches.

DaB is Darien channery silt loam, 2 to 8 percent slopes. This soil consists of 75 percent Darien and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Darien soils are found on hills, till plains, and drumlinoid ridges. This map unit is listed as a hydric soil, with a depth to water table of 9 inches.

DdB is Darien silt loam, gently undulating, 2 to 8 percent slopes. This soil consists of 75 percent Darien and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Darien soils are found on hills, till plains, and drumlinoid ridges. This map unit is listed as a hydric soil and is considered Prime Farmland if drained. Depth to water table is 9 inches.

DdD is Darien silt loam, undulating, 15 to 25 percent slopes. This soil consists of 75 percent Darien and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Darien soils are found on hills, till plains, and drumlinoid ridges. This map unit is listed as a hydric soil, with a depth to water table of 9 inches.

DeB is Darien silt loam, 2 to 8 percent slopes. This soil consists of 75 percent Darien and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Darien soils are found on hills, till plains, and drumlinoid ridges. This map unit is listed as a hydric soil and is considered Prime Farmland if drained. Depth to water table is 9 inches.

DuC3 is Darien silt loam, undulating, 8 to 15 percent slopes, eroded. This soil consists of 75 percent Darien and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Darien soils are found on hills, till plains, and drumlinoid ridges. This map unit is listed as a hydric soil, with a depth to water table of 7 inches.

Farmington series consists of shallow, well drained and somewhat excessively drained soils formed in till. The potential for surface runoff is high or very high with moderately high or high hydraulic conductivity. The internal drainage of the soil is medium primarily because of joints and cracks in the underlying rock. Farmington soils are nearly level to very steep with slopes ranging from 0 to 70 percent. The typical soil profile of this series is dark grayish brown silt loam about eight inches thick with brown and yellow-brown loam and limestone bedrock extending to a depth of 18 inches.

FaB is Farmington very rocky silt loam, 0 to 10 percent slopes. This soil consists of 75 percent Farmington and similar soils and 25 percent minor components, with a typical profile 0 to 24 inches thick. Farmington soils are found on benches, ridges, and till plains. This map unit is not listed as a hydric soil and the depth to water table is greater than 79 inches.

FaF is Farmington very rocky silt loam, 10 to 70 percent slopes. This soil consists of 75 percent Farmington and similar soils and 25 percent minor components, with a typical profile 0 to 24 inches thick. Farmington soils are found on benches, ridges, and till plains. This map unit is not listed as a hydric soil, as none of its components are hydric soils. Depth to water table is greater than 79 inches

Honeoye series consists of very deep, well drained soils formed in loamy till. They are nearly level to very steep soils on till plains, hills, ridges, and drumlins. The potential for surface runoff is very low to high. Honeoye soils are dominantly on gently undulating to rolling till plains. In some places they are on dissected side slopes of the upland plateau and in other areas they are on the top and upper side slopes of drumlins and convex ridges. Slope ranges from 0 to 65 percent. The typical soil profile of this series is dark grayish brown silt loam about 13 inches thick with brown loam extending to a depth of 30 inches and dark grayish brown gravelly loam to a depth of 72 inches.

HfB is Honeoye-Farmington complex, 2 to 10 percent slopes. This soil consists of 50 percent Honeoye and similar soils, 30 percent Farmington and similar soils, and 20 percent minor components, with a typical profile 0 to 79 inches thick. Honeoye soils are found on till plains, drumlins, and ridges. Farmington soils are found on till plains, drumlins, and hills. This map unit is not listed as a hydric soil, as none of its components are hydric soils. This unit is classified as Prime Farmland. Depth to water table is greater than 79 inches.

HfC is Honeoye-Farmington complex, 10 to 20 percent slopes. This soil consists of 50 percent Honeoye and similar soils, 30 percent Farmington and similar soils, and 20 percent minor components, with a typical profile 0 to 79 inches thick. Honeoye soils are found on till plains, drumlins, and ridges. Farmington soils are found on till plains, drumlins, and hills. This map unit is not listed as a hydric soil, as none of its components are hydric soils. Depth to water table is greater than 79 inches.

Illion Series consists of deep or very deep, poorly drained soils formed in till and are present in upland till plains. The potential for surface runoff is very low to very high with moderate or moderately slow permeability above the subsoil and slow or very slow permeability in the subsoil and substratum. Ilion soils are nearly level or gently sloping with slopes ranging from zero to eight percent. The typical soil profile of this series is very dark gray silt loam about nine inches thick with grayish brown silty clay loam and channery silt loam extending to a depth of 60 inches. Soils in this series are classified as Farmland of Statewide Importance within the Project area.

IaB is Ilion and Appleton soils, 3 to 8 percent slopes. This soil consists of 40 percent Ilion and similar soils, 35 percent Appleton and similar soils, and 25 minor components, with a typical profile 0 to 60 inches thick. Ilion soils are found in depressions. Appleton soils are found on drumlins, ridges, and till plains. This map unit is listed as a hydric soil and the water table occurs approximately at the soil surface.

IlA is Ilion and Lyons, silt loams, 0 to 3 percent slopes. This soil consists of 40 percent Ilion and similar soils, 35 percent Lyons and similar soils, and 25 percent minor components, with a typical profile 0 to 60 inches thick. Ilion soils are found on depressions. Appleton soils are found on drumlins, ridges, and till plains. Lyons soils are found in depressions. This map unit is listed as a hydric soil and the water table occurs approximately at the soil surface.

IlC is Ilion and Lyons, silt loams, 3 to 15 percent slopes. This soil consists of 40 percent Ilion and similar soils, 35 percent Lyons and similar soils, and 25 percent minor components. Ilion soils are found on depressions. Appleton soils are found on drumlins, ridges, and till plains. Lyons soils are found in depressions. This map unit is listed as a hydric soil and the water table occurs approximately at the soil surface.

Lakemont Series consists of deep, fine-textured poorly drained or very poorly drained, high-lime soils. The soils formed in reddish-brown, calcareous, silt and clayey-lake deposits. The potential for surface runoff is negligible to very high. Permeability is moderately slow in the surface and very slow in the subsoil sand substratum. Lakemont soils are on nearly level parts and slight depressions of lake plains. Slope ranges from 0 to 3 percent. Depth to bedrock is greater than 40 inches and in most areas is greater than 60 inches. The typical profile has a layer of very dark gray to black silty clay loam eight inches thick and gray silty clay to 17 inches. From 17 to 26 inches, the silty clay becomes more pinkish with masses of iron accumulation. From 26 to 60 inches, the soils of the Lakemont series consist of dark reddish gray to brown silty clay loam.

LdB is Lakemont and Madalin silty clay loams, 2 to 6 percent slopes. This soil consists of 40 percent Lakemont, 35 percent Madalin and 25 percent minor components, with a typical profile 0 to 60 inches thick. The major soils in this unit are typically found in depressions and on toeslopes. This map unit is listed as a hydric soil. This unit is classified as Farmland of Statewide Importance.

Madalin Series consists of very deep, poorly drained soils on lake plains and depressions in the uplands formed in water-deposited materials. The potential for surface runoff is negligible to very high, with moderately low or moderately high hydraulic conductivity on the surface and moderately low to low hydraulic conductivity in the subsoil and substratum. Madalin soils are relatively flat with slopes ranging typically from 0 to 3 percent. The typical soil profile of this series is very dark grey silt loam about 20 centimeters thick with grayish brown stratified silt to clay subsoils extending to a depth of 132 centimeters.

Ma is Madalin silt loam, over till. This soil consists of 75 percent Madalin, till substratum, and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Madalin soils are found on depressions. This map unit is listed as a hydric soil and the water table occurs approximately at the soil surface. This unit is classified as Farmland of Statewide Importance.

Mohawk Series consists of very deep, well drained soils formed in till with a high component of shale. These soils are present on glaciated upland summits through upper toeslopes. The potential for surface runoff is medium to high, with moderately high to high hydraulic conductivity in the surface layer and moderately low to moderately high hydraulic conductivity in the substratum. Mohawk soils are relatively flat to steep, with slopes typically ranging from three to 30 percent. The typical soil profile of this series is very dark grayish brown silt loam about eight inches thick with brown to dark grayish brown silt loam extending to a depth of 72 inches.

MhC is Mohawk and Honeoye soils, 10 to 20 percent slopes. This soil consists of 40 percent Mohawk and similar soils, 35 percent Honeoye and similar soils, and 25 percent minor components, with a typical profile 0 to 60 inches thick. Mohawk soils are found on hills and drumlinoid ridges. Honeoye soils are found on till plains, drumlins, and ridges. This map unit is not listed as a hydric soil, as none of its components are hydric soils. Depth to water table is greater than 79 inches.

MhC3 is Mohawk and Honeoye soils, 10 to 20 percent slopes, eroded. This soil consists of 40 percent Mohawk and similar soils, 35 percent Honeoye and similar soils, and 25 percent minor components, with a typical profile 0 to 60 inches thick. Mohawk soils are found on hills and drumlinoid ridges. Honeoye soils are found on till plains, drumlins, and ridges. This map unit is not listed as a hydric soil, as none of its components are hydric soils. Depth to water table is greater than 79 inches.

MhD is Mohawk and Honeoye soils, 20 to 30 percent slopes. This soil consists of 40 percent Mohawk and similar soils, 35 percent Honeoye and similar soils, and 25 percent minor components, with a typical profile 0 to 60 inches thick. Mohawk soils are found on hills and drumlinoid ridges. Honeoye soils are found on till plains, drumlins, and ridges. This map unit is not listed as a hydric soil, as none of its components are hydric soils. Depth to water table is greater than 79 inches.

MlB is Mohawk and Lima soils, 2 to 10 percent slopes. This soil consists of 40 percent Mohawk and similar soils, 35 percent Lima and similar soils, and 25 percent minor components, with a typical profile 0 to 60 inches thick. Mohawk soils are found on hills and drumlinoid ridges. Lima soils are found on drumlins, ridges, and till plains. This map unit is listed as a hydric soil and is classified as Prime Farmland. Depth to water table is greater approximately 20 inches.

MlB3 is Mohawk and Lima soils, 2 to 10 percent slopes, eroded. This soil consists of 40 percent Mohawk and similar soils, 35 percent Lima and similar soils, and 25 percent minor components, with a typical profile 0 to 60 inches thick. Mohawk soils are found on hills and drumlinoid ridges. Lima soils are found on drumlins, ridges, and till plains. This map unit is listed as a hydric soil. Depth to water table is greater approximately 20 inches.

Nunda Series consists of very deep and deep, moderately well drained soils formed in silty mantles that overlie till derived from clayey shale on upland till plains. The potential for surface runoff is low to high, with moderate permeability in the surface and upper subsoils, moderately slow permeability in the lower subsoils, and slow or very slow permeability in the substratum. Nunda soils are gently sloping to steep soils located on glaciated uplands. The slope of Nunda soils typically ranges from zero 35 percent. The typical soil profile of this series is dark grayish brown silt loam about nine inches thick with brown to gray silt loam and channery silty clay loam subsoils extending to a depth of 72 inches.

NdB is Nunda channery silt loam, 3 to 10 percent slopes. This soil consists of 75 percent Nunda and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Nunda soils are found on hills, till plains, and drumlinoid ridges. This map unit is not listed as a hydric soil, as none of its components are hydric soils. This unit is classified as Farmland of Statewide Importance. Depth to water table is greater approximately 16 inches.

NdC is Nunda channery silt loam, 10 to 20 percent slopes. This soil consists of 75 percent Nunda and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Nunda soils are found on hills, till plains, and drumlinoid ridges. This map unit is not listed as a hydric soil, as none of its components are hydric soils.

NdC3 is Nunda channery silt loam, 10 to 20 percent slopes, eroded. This soil consists of 75 percent Nunda and similar soils and 25 percent minor components, with a typical profile 0 to 60 inches thick. Nunda soils are found on hills, till plains, and drumlinoid ridges. This map unit is not listed as a hydric soil, as none of its components are hydric soils. Depth to water table is greater approximately 16 inches.

Tunkhannock Series consists of very deep, well to somewhat excessively drained soils formed in water-sorted glacial material derived from reddish sandstone, siltstone, and shale. The potential for surface runoff is low to very high. Permeability is moderately rapid in the solum and rapid in the substratum. Tunkhannock soils are nearly level to very steep soils on glacial outwash terraces, kames, and valley trains. Slope ranges from 0 to 60 percent. The typical soil profile of this series is brown to pale brown gravelly loam about 16 inches thick with reddish brown extremely gravelly sandy loam and stratified loamy fine sand series extending to a depth of 72 inches.

ThC is Tunkhannock and Chenango gravelly silt loams, 5 to 15 percent simple slopes. This soil consists of 45 percent Tunkhannock and similar soils, 35 percent Chenango and similar soils, and 20 percent minor components, with a typical profile 0 to 60 inches thick.

Tunkhannock soils are found on valley trains and terraces. This map unit is not listed as a hydric soil, as none of its components are hydric soils.

Table 21-5. Summary of Soil Types

Map Unit Symbol	Map Unit Name	Slope (%)	Acres within Project Area
Al	Alluvial land	0 to 3	24.7
DaB	Darien channery silt loam	2 to 8	5.3
DdB	Darien silt loam, gently undulating	2 to 8	10.1
DdD	Darien silt loam, undulating	15 to 25	30.0
DeB	Darien silt loam	2 to 8	139.3
DuC3	Darien silt loam, undulating, eroded	8 to 15	38.8
FaB	Farmington very rocky silt loam	0 to 10	4.0
FaF	Farmington very rocky silt loam	10 to 70	4.2
HfB	Honeoye-Farmington complex	2 to 10	431.1
HfC	Honeoye-Farmington complex	10 to 20	77.7
IaB	Ilion and Appleton soils	3 to 8	32.2
IlA	Ilion and Lyons soils	0 to 3	0.3
IlC	Ilion and Lyons silt loams	3 to 15	27.6
LdB	Lakemont and Madalin silty clay loams	2 to 6	5.6
Ma	Madalin silt loam, over till	0 to 2	34.8

Table 21-5. Summary of Soil Types

Map Unit Symbol	Map Unit Name	Slope (%)	Acres within Project Area
MhC	Mohawk and Honeoye soils	10 to 20	23.7
MhC3	Mohawk and Honeoye soils, eroded	10 to 20	98.0
MhD	Mohawk and Honeoye soils	20 to 30	46.1
MIB	Mohawk and Lima soils	2 to 10	148.2
MIB3	Mohawk and Lima silt loams, eroded	2 to 10	20.1
NdB	Nunda channery silt loam	3 to 10	7.4
NdC	Nunda channery silt loam	10 to 20	50.1
NdC3	Nunda channery silt loam, eroded	10 to 20	65.1
ThC	Tunkhannock and Chenango gravelly silt loams	5 to 15	2.9

Soil drainage among mapped soil units is predominantly classified as moderately well to well drained, and approximately 22 percent of soils are classified as somewhat poorly to poorly drained. For additional information about agricultural resources within the Project Area, including designated Agricultural District lands, see Exhibit 4 and Exhibit 22.

The primary impact to the physical features of the Project Area will be the disturbance of soils during construction. Based on the assumptions outlined in Table 22-2, disturbance to soils from all anticipated construction activities will total approximately 401.8 acres. Of this total, only approximately 288.3 acres will be converted to access roads, array racking systems, structures, and etc., while the remaining will be restored and stabilized following completion of construction. The area of disturbance calculations presented above assume that significant soil disturbance will occur in all areas in which construction occurs. Actual disturbance will include overlap of some components will be highly variable based on the specific construction activity, the construction techniques employed, and soil/weather conditions at the time of construction.

Earth moving and general soil disturbance will increase the potential for wind/water erosion and sedimentation into surface waters. Soils within the Project Area exhibit low permeability and limited depth to bedrock and are rated as most to somewhat limited infiltration capacity. Implementing the erosion and sediment control measures outlined in the Preliminary SWPPP will minimize impacts to steep slopes and highly erodible soils that may occur in the event of extreme rainfall or other event that could potentially lead to severe erosion and downstream water quality issues. In addition, impacts to soils will be further minimized by the following means:

- Public road ditches and other locations where Project-related runoff is concentrated will be armored with rip- rap to dissipate the energy of flowing water and to hold the soils in place.
- Prior to commencing construction activities, erosion control devices will be installed between the work areas and downslope areas, to reduce the risk of soil erosion and siltation. Erosion control devices will be monitored continuously throughout construction and restoration for function and effectiveness.
- During construction activities, hay bales, silt fence, or other appropriate erosion control measures will be placed as needed around disturbed areas and stockpiled soils.
- Following construction, all temporarily disturbed areas will be stabilized and restored in accordance with approved plans.

Impacts to soil resources will be minimized by adherence to best management practices that are designed to avoid or control erosion and sedimentation and stabilize disturbed areas. In addition, erosion and sedimentation impacts during construction will be minimized by the implementation the erosion and sedimentation control plan developed as part of the SPDES General Permit for the Facility. Erosion and sediment control measures shall be constructed and implemented in accordance with a preliminary SWPPP (see Appendix 23-3). All excavations will comply with local, state, and federal regulations.

Construction excavations may encounter areas of perched groundwater if construction occurs during a time when a seasonally high water table may be present. In addition, construction during rainy periods may see an increase in perched groundwater due to the low hydraulic conductivity and soil permeability within the Project Area. Temporary de-watering may be required during the construction if perched water, groundwater or seepage is encountered. Open sump pumping method is the most common method of dewatering and is anticipated to be sufficient based on relatively low permeability soils anticipated at the site. As stated previously, the water will be discharged properly to an area identified within the SWPPP. Dewatering methods will involve pumping the water to a predetermined well-vegetated discharge point, away from wetlands, waterbodies, and other sensitive resources. Discharge of water will include measures/devices to slow water velocities and trap any suspended sediment.

21(r) Bedrock and Underlying Bedrock Maps, Figures, and Analyses

Figure 21-3 shows the bedrock geology and depth to high water table within the Project Area. Depth to bedrock is mapped at greater than 78 inches over much of the Project Area. Depth to water table ranges from at ground surface to greater than 6 feet (Figure 21-3).

Maps, figures, and analyses on depth to bedrock, underlying bedrock types, vertical profiles of soil, bedrock, water table, seasonal high groundwater roadways to be constructed, and all off-site interconnections required to serve the Project are provided in the Preliminary Geotechnical Investigation Report, provided as Appendix 21-1. Additionally, Appendix 21-1 provides an evaluation of the potential impacts due to Project construction and operation, including any on-site water disposal systems. These analyses were based on information obtained from publicly available maps, scientific literature, a review of technical studies conducted on and in the vicinity of the Facility, and on-site field observations, test pits and/or borings as available.

21(s) Evaluation of Suitable Building and Equipment Foundations

Foundation construction for Project Components within the collection substation and switchyard occurs in several stages, which typically includes 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.

Some equipment may be supported on shallow foundations, while other structures may be supported on deep foundations consisting of drilled shafts, direct embed poles or rock anchors. Transmission line structures are anticipated to be constructed as poles on drilled shafts or as direct embed poles. Based on the subsurface conditions encountered in the soil borings and test pits, the proposed collection substation and switchyard will be constructed at locations where glacial till soils are underlain by shallow bedrock and not planned near the noted loose silts.

Settlement potential of shallow foundations was analyzed using soil compressibility properties derived from the SPT borings drilled in the planned collection substation and switchyard location and assumed structural loads. Estimated total settlements will be less than one inch provided column loads are less than 150 kips and the applied bearing pressure of small isolated slabs or mats is less than about 3,000 psf. Shallow foundation systems for support of lightly-loaded buildings and equipment pads will be acceptable provided these maximum loads are not exceeded.

Proposed collection substation and switchyard structures may also be supported as direct embed poles or poles supported on drilled shaft foundations designed using the soil properties presented in this report. Drilled shafts can be constructed as straight shafts at least 24 inches in diameter. Settlement of drilled shaft foundations using design properties, as presented in the geotechnical analyses, is expected to be less than 0.5 inch. All building structure foundations should bear on suitable natural soil, or on properly compacted structural fill. Compaction recommendations for structural fill are provided in the preliminary geotechnical investigation (Appendix 21-1)

(1) Preliminary Engineering Assessment

The available information suggests that foundations will be underlain by glacial till and bedrock. Solar array racking will be installed by one of three methods. First, the post may be driven directly into the soil. This is the primary method of installation. Second, a ground screw type post will be installed directly into the soil. Third, in cases of high ledge or bedrock, a post hole will be drilled into the rock to an appropriate depth, the post will be installed, and the post hole will be grouted. See preliminary design plans included in Appendix 11-1.

Design frost depth is four feet in the Project Area, and foundations must bear below this depth to prevent movement due to frost heave. Additionally, the manufacturer specifications indicate that standard embedment is 5 to 7 feet is required to support racking and panels.

The glacial till typically provides high bearing strength and good short-term excavation stability if it is left undisturbed. The glacial till contains a significant percentage of silt and sand and loses strength rapidly if saturated and subjected to dynamic loading such as that imparted by construction equipment. Due to the potential for a variable rock surface, there is the potential for foundations to be partially founded on bedrock, natural soils and/or compacted structural fill. If a mixed bearing grade condition exists, where the bearing surface transitions from bedrock to soil, the rock will be undercut at least twelve inches over a length extending back at least ten feet from the transition to soil. The undercut will be backfilled with compacted imported structural fill.

Assuming the foundation excavations are properly managed during construction, an allowable bearing pressure of 5,000 pounds per square foot is appropriate for shallow foundations bearing on undisturbed glacial till. An allowable bearing pressure of 12,000 pounds per square foot is estimated for foundations bearing on Stratum 2-Transition Zone Rock (weathered shale/limestone) materials. An allowable bearing pressure of 20,000 (shale) to 50,000 (limestone) pounds per square foot is estimated for foundations bearing on Stratum 3 – Bedrock.

(2) Post Installation Impact Assessment

Traditional pile driving is not proposed for Project installation. It is anticipated that the posts for the panel racking system will be installed with end bearing either in the glacial till soils or directly on weathered rock or rock. Based on manufacture specifications approximately 450 posts/MW will be required for a total of 22,500 posts. Posts are galvanized steel and load-carrying capacity will vary based on post dimensions and installation methods. Installation is typically completed using an excavator equipped with a vibratory driving attachment or drilling, setting, and backfilling posts. It is anticipated that the posts can be installed in 95 days utilizing 4 post installation crews working 10 hours per day.

Based on soil types throughout the Project Area, the posts are anticipated to be driven with a vibratory hammer. Helical posts (i.e. pile screws), if utilized, will be installed with a minimum 4,100ft/lb of torque. If refusal is encountered during installation, the posts will be installed into pre-drilled holes and filled with grout.

The primary impacts from post installation operations are noise and vibration. The equipment used in post installation is not expected to generate any off-site noise impacts (see Exhibit 19).

(3) Pile Driving Mitigation

In order to minimize impacts associate with noise, post installation activities will be designed to minimize impacts to nearby residences and existing structures. Post installation will be restricted to within the hours of 8:00 am to 6:00 pm on Monday through Friday and will not occur on state or federal holidays.

(4) Vibrational Impacts

All post installation operations which occur adjacent to residences, buildings, structures, utilities or other facilities will be undergone with specific planning and insight from industry professionals, contractors, inspectors, and the Applicant, with full consideration for all forces and conditions involved and with the safety as the top priority. To the extent practicable, facilities have been sited to avoid existing structures. Based on air-borne induced vibration modeling conducted by Epsilon Associates Inc. no receptors were found to experience sound levels equal to or greater than 65 dB at 16, 31.5, or 63 Hz. This analysis is further discussed in Exhibit 19 and provided in Appendix 19-1.

Post installation for a solar facility is smaller scale compared to pile driving for heavy infrastructure (i.e. building foundations or bridges). Typically, posts are driven into the ground using hydraulic ram machinery, which is about the size of a small tractor or forklift and have much less vibrational impacts than equipment utilized for heavy infrastructure. Additionally, many posts in the array will require pre-drilling holes which will minimize the use of the hammer to install the posts. As such, no vibrational impacts are anticipated. The closest distance to a structure where post installation is proposed is over 190 feet and is well over several hundred feet in most locations.

21(t) Evaluation of Earthquake and Tsunami Event Vulnerability at the Project Area

The Project Area is located in an area of relatively low seismic activity. The USGS Seismic Hazards database indicates a 2 percent chance of an earthquake occurring in the next 50 years of peak acceleration exceeding 10 to 14 percent of the force of gravity in the Project Area. The site has a dense soil cover and will not provide significant amplification of seismic waves. Geophysical surveys are part of the overall scope of services but were not authorized for this phase of the investigation and no site-specific shear wave velocity data is available. The Project Area appears to have minimal vulnerability associated with seismic events based on review of publicly available data. The findings were provided in Section 21(o) above. Therefore, further analysis was not conducted.

The nearest large body of water, Lake Ontario, is over 100 miles from the Project area, therefore vulnerability to tsunami events is not applicable to the Project.

21(u) Corrosion and Degradation Potential

Some soil units found within the Project Area are considered to be acidic. However, based upon site-specific soil testing, it was determined that a corrosive environment does not exist, and standard Type I/II cement may be utilized on this Project (see Appendix 21-3).

21(v) Evaluation of Risk to Foundations and Underground Cables from Frost and Soil Shrink/Swell

According to soil maps for the Project area, mapped soil units indicate moderate to high risk for frost action. Frost heaves exert pressure on underground structures resultant from intermittent freezing and thawing of the soil. The additional pressure causes soils to lift, which may result in displacement of underground structures (e.g. foundations, cables, etc.) which are constructed above the frost line. Frost depth in New York State averages 36 to 48 inches. In accordance with the NYS Building Code, and Land Use Code of the Town of Sharon, concrete slab foundations footings, and posts will be constructed to a minimum depth of 48 inches and adhere to all American Society for Civil Engineers (ASCE) 32 standards.

Existing soils are proposed for re-use as structural and/or compacted fill. The soil observed in the test borings generally consists of non-plastic silt with varying amounts of sand and gravel. Accordingly, soils found on-site should have minimal shrink/swell potential. As a result, specific construction procedures associated with potential expansive clays will not be required for the Project.

References

NRCS. USDA. (2014). Keys to Soil Taxonomy (Twelfth Edition). Available at: https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1252094&ext=pdf

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