WATKINS GLEN SOLAR ENERGY CENTER

Case No. 17-F-0595

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 Stipulation 21, dated February 21, 2020, and therefore, the requirements of 16 New York Codes, Rules and Regulations (NYCRR) § 1001.21. This Exhibit contains a comprehensive summary of the geology, seismology, and soil impacts resulting from proposed construction of the Watkins Glen Solar Energy Center. This Exhibit provides identification and mapping of existing geological and surficial soil conditions, an impact analysis, definition of constraints resulting from these geological conditions, and discusses potential impact avoidance and mitigation measures.

Conclusions made within this Exhibit are based on the findings of a geotechnical investigation performed by Terracon Consultants, Inc. (Terracon), conducted during October 2019. A total of 13 borings and 5 test-pits were completed at the Project Area during the geotechnical exploration, as further detailed in the Geotechnical Engineering Report provided as Appendix 21-1. A summary of the borings completed to date is presented in Table 21-1.

Table 21-1. Summary of Test Borings During Project Area Survey

Test Boring No.	Depth of Bore/Test Pit (feet)	Date Completed
WG-1	14.5	10/8/2019
WG-2	20.0	10/8/2019
WG-3	20	10/8/2019
WG-4	18.5	10/8/2019
WG-5	20.0	10/8/2019
WG-6	20.0	10/8/2019
WG-7	15.5	10/7/2019
WG-8	20.0	10/8/2019
WG-9	20.0	10/9/2019
WG-10	20.0	10/7/2019
WG-11	20.0	10/8/2019
WGSS-1	28.5	10/8/2019
WGSS-2	30.5	10/8/2019
WTP-1	10.0	10/24/2019
WTP-2	3.5	10/24/2019
WTP-3	4.0	10/24/2019
WTP-4	6.0	10/24/2019
WTP-5	10.0	10/24/2019

21(a) Existing Slopes Map

Slope data from the United States Geologic Survey (USGS) National Elevation Dataset was analyzed and mapped using Environmental Systems Research Institute (ESRI) ArcGIS software, to delineate existing slopes (0–3%, 3–8%, 8–15%, 15–25%, 25–35%, and 35% and over) on and within a mapped drainage area which may be influenced by Project development and associated interconnections. This data is visually represented on Figure 21-1. Slopes within the Project Area range from 0–3% to 15–25%, with 99.9% 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 Project Area.

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

Slope Range (%)	Percent within Drainage Area (%)
0 – 3	67.5%
3 – 8	31.9%
8 – 15	0.6%
15 – 25	<0.1%
25 – 35	0.0%
> 35	0.0%
Total	**100%**

21(b) Slope Impact Avoidance

Less than 0.1% of the Project Area exceeds 15% grade and is too steep for panel installation. Project Components will be sited to avoid steep slopes; therefore, impacts are not expected. No solar arrays will be installed on slopes exceeding 12%. Grading may be necessary on fewer than 5 acres, which have slopes exceeding 12%. Any required grading will be performed as indicated on the Preliminary Design Drawings presented in Appendix 11-1. Earth moving and general soil disturbance associated with Project construction activities may increase the potential for wind/water erosion and sedimentation into surface waters and downstream areas.

Further, impacts to steep slopes and highly erodible soils may occur due to extreme rainfall or other natural events, which could lead to severe erosion and downstream water quality issues. Implementing the erosion and sediment control measures as outlined in the Stormwater Pollution Prevention Plan (SWPPP) will minimize these impacts. The SWPPP for this Project is included as Appendix 23-3 and will be updated and submitted to the Secretary 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, straw 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 riprap to dissipate the energy of flowing water and to hold the soil in place.
- Following construction, all temporarily disturbed areas will be stabilized in accordance with approved plans.

Erosion and sediment control measures are described in greater detail within the SWPPP provided as Appendix 23-3 and are depicted in the Preliminary Design Drawings presented in Appendix 11-1.

21(c) Proposed Site Plan

A proposed preliminary Site Plan was prepared and included within the Preliminary Design Drawings presented in Appendix 11-1. The Site Plan shows existing and proposed contours at 1-foot intervals for the Project Area and the location of on-site interconnection facilities. The Site Plan also identifies locations of all proposed infrastructure including all construction areas, solar panel locations, access roads, paved and vegetative surfaces, electrical collection line routes, and interconnections to existing utility infrastructure. No buildings are proposed. Two underground pipelines, Columbia Pipeline and Empire Pipeline, owned by TransCanada and National Fuel respectively, transect the Project Area north to south, west of Baker Hill Road. Excavations, blasting (if determined necessary), and other ground disturbances, as applicable, have been designed to comply with encroachment guidelines provided by the owners of the existing infrastructure, insofar as guidelines are consistent with applicable federal, state, and local requirements. These guidelines are provided in Exhibit 12 as Appendices 12-4 and 12-5. Disturbance within the existing pipelines' respective rights-of-way (ROWs) is not anticipated for Project construction or operation with the exception of an improvement to an existing farm road that presently crosses both ROWs. Refer to sheet C.304 of the site plan drawings included in

Appendix 11-1 for additional details. Refer to Exhibit 12 for a discussion concerning consistency with the pipeline owner guidelines for improvement of the farm road.

21(d) Preliminary Calculations of Cut and Fill

A preliminary calculation was performed utilizing existing and proposed 3D surfaces generated from 1-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 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 3D software. An existing conditions surface was created based on 1-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. Calculations are provided for topsoil, sub-soil, and rock layers separately based on information provided in the Schuyler County Soil Survey and Geotechnical Engineering Report.

These calculations do not account for the collection line trenching operations 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 was done on operational solar farms across New York State). Approximately 170,904 cubic yards of material will be excavated from the Project Area. Approximately 159,706 cubic yards of fill will be required for the proposed construction. This results in a net earthwork balance of approximately 11,198 cubic yards of cut material remaining. Excess cut material will be incorporated across the Project Area to the maximum extent practicable, resulting in a net earthwork balance of approximately 0 cubic yards of fill material needed for the construction of the proposed solar arrays and associated Project infrastructure. Approximately 17,800 cubic yards of topsoil will be excavated and used as fill for grading. The remaining excavated topsoil will be replaced to restore the original site grading, to the maximum extent practicable. Approximately 5,277 cubic yards of crushed stone is needed for access road, substation, and switchyard construction. Section 21(e) details the quantity of fill material to be imported into the Project Area for construction of the access roads, structural bases for foundations, and compacted fill for burial of electric lines.

It should be noted that the calculation of cut and fill assumed that depths of greater than 78 inches were to be considered as indicating bedrock per the United States Department of Agriculture (USDA) Natural Resource 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 throughout the Project Area is approximately 5.6 feet (67.2 inches). Excavations are not expected to reach or exceed the depth to bedrock.

It is anticipated that no material 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 substation will in fact be constructed in both cut-and-fill conditions.

Invasive Species Management and Control Plan

The Applicant has developed an Invasive Species Management and Control Plan (ISMCP) to outline best practices and control measures for identifying the presence of invasive species in spoil material and for preventing the introduction and spread of invasive species within or outside the Project Area. The ISMCP is provided in Appendix 22-7. 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 linked to the construction and operation of the Project. The ISMCP will be appended to the Project construction contract, requiring the Contractor to implement the control measures outlined within the ISMCP. The principal construction-related control measure will include prohibiting fill material from being transported off site from the Project Area. This action will minimize the potential for introduction and/or transport of invasive species identified within the Project Area 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 will be implemented based on best science regarding treatment and control options for a 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. Identification resources will be made available to Project staff and contractors to facilitate early identification of invasive species. A list of invasive species identified within the Project Area based on previously conducted field surveys is provided in Appendix 22-7. Of note, it should be stated that invasive species identified at the Project Area 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 ISMCP will propose a goal of a zero-net increase in the number of invasive species present and their distribution in the Project Area resulting from actions directly attributable to Project construction and operation (i.e., significant distances between existing and novel populations such as could not occur through natural dispersal mechanisms).

Post-construction monitoring will be conducted bi-annually during a minimum of a 5-year period following completion of Project-related activities on site. This monitoring 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 time in accordance with the Certificate Conditions of the Project.

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

The existing site topography is 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. As stated previously, a preliminary calculation was performed utilizing existing and proposed 3D surfaces generated from 1-foot contour data to estimate the quantity of cut and fill necessary for Project construction.

Fill material will be required for several purposes including subgrade material for access roads and burial of electrical lines, structural bases for electrical equipment foundations, and site grading to achieve necessary construction grades. Based on the calculation of cut and fill, the material excavated from the site will be utilized for fill for the Project Area. Approximately 5,277 cubic yards of crushed stone/gravel fill material imported from off-site will be required for the construction of permanent access roads, the substation, and the switchyard. Additionally, 1,900 cubic yards of concrete imported from off site will be required for fence posts, and sub-foundations. 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 Preliminary Design Drawings, provided in Appendix 11-1.

Imported structural fill (e.g., gravel) should contain no particles larger than 6 inches and less than 20%, by weight, of material finer than a No. 200 mesh sieve. Non-frost susceptible (NFS) fill should contain less than 5% material finer than a No. 200 mesh sieve. The imported materials should be free of organic matter and debris including 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. Crushed stone imported as fill should be uniform, consisting of ¾-inch angular particles wrapped in geotextile fabric.

Additionally, imported 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 Table 21-3.

Table 21-3. Estimated Quantity of Imported Material

Imported Material	Quantity (yd^3)
Gravel	5,277
Surface Material	0
Concrete Pavement	1,900
TOTAL	**7,177**

At this time, it is assumed that off-road dump trucks with an approximate capacity of 22 cubic yards will be the primary truck used to transport materials throughout the Project Area. As such, it is presumed that approximately 240 truckloads would be required to transport imported gravel fill material into the Project Area throughout the duration of construction. The cement trucks presumed to be utilized for this Project have a capacity of approximately 8 cubic yards and weigh 70,000 pounds (lbs.). An estimated 1,900 cubic yards of concrete will be required for this Project and an additional 238 cement truckloads will also be necessary to transport concrete fill materials on site.

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

Based on the preliminary cut-and-fill calculations performed in Section 21(d), it is not expected that any on-site material will be removed from the Project Area during construction. Stripped topsoil will be replaced in kind, to the maximum extent practicable. This material will be temporarily stockpiled and contained by erosion and sediment controls along the construction corridors and incorporated in the site restoration where applicable, as described in further detail on the Preliminary Design Drawings provided in Appendix 11-1.

During restoration of the Project, all excess topsoil materials will be regraded to approximate pre-construction conditions for the site character and drainage areas to be returned to existing conditions to the maximum extent practicable.

As stated in Section 21(e), imported structural fill (e.g., gravel) should contain no particles larger than 6 inches and less than 20%, by weight, of material finer than a No. 200 mesh sieve. The imported materials should be free of organic matter and debris including 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.

21(g) Construction Methodology and Excavation Techniques

The proposed start date for the construction of the Project is currently early 2022. Project excavation and construction will be performed in several stages and will include the main elements and activities described below. Excavations will be designed and conducted with consideration of the Encroachment Guidelines provided by owners of the Columbia and Empire pipelines that transect the Project Area.

Location and Extent of Horizontal Directional Drilling Methods

The Applicant is proposing to utilize trenchless excavation techniques, otherwise known as horizontal directional drilling (HDD), on the Project to route 34.5-kilovolt (kV) collection circuits under site features including two existing gas lines and one stream. The HDD method was chosen because it has proven to be a safe and efficient method of crossing roads, pipelines, railroads, streams, wetlands, and other environmentally sensitive areas with minimal surface impact. The Applicant is currently locating and designing all specific target HDD locations. Refer to the Preliminary Design Drawings in Appendix 11-1 for proposed HDD locations and a typical HDD equipment layout diagram. Other areas may also be included, as identified in a Compliance Filing, where topographical or environmental constraints dictate that HDD installation methodology is the best construction practice. Refer to Exhibit 12 Construction for additional details on the proposed pipeline crossings.

Inadvertent Return Plan for 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 (e.g., streams, wetlands) while responding to an inadvertent release; and
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 21-2 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 cleanup 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 should be determined based on these site-specific factors; however, a minimum depth of 25 feet in sound soils should be sufficient to prevent an inadvertent release.

The proposed HDD for the Project has a moderate risk of inadvertent release based on the existing site soils and bedrock features. The chance for inadvertent return increases when unfavorable drilling stratum are experienced such as glacial till, highly fractured rock, non-cohesive alluvial material, or cobbles. The soil stratum at the Project Area, as discussed in further detail in Section 21(i) below, is composed of silt, sand, and gravel mixtures with occasional rock fragments, weathered shale, and competent shale bedrock. The surficial and native soils layers are satisfactory for performing HDD operations. The shale bedrock is moderately fractured with close fracture spacing, which may result in difficulties when conducting drilling operations. Geotechnical investigations indicated the depth to bedrock adjacent to the proposed HDD locations ranges from approximately 3 feet to upwards of 20 feet deep. The HDD bore depths will remain in the silt, sand, and gravel layers to the maximum extent practicable. Inadvertent return is not anticipated as a result of HDD operations and precautions will be taken to reduce the possibility of a release. Geotechnical factors will be significantly considered when finalizing the HDD bore locations and design to reduce the possibility of an inadvertent return event during HDD operations.

Refer to Appendix 21-2 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 to effectively locate and demarcate the exact location of Project Components and routes. This survey will facilitate assembly strategy and construction efficiency. An agricultural and Environmental Monitor (EM) will be designated during the construction phase of the Project to oversee all construction and restoration activities to ensure compliance with all applicable certificate conditions and other permit requirements. Prior to the start of construction at specific sites, the EM, with the 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 existing underground pipelines, location of agricultural tile lines, and layout of erosion and sediment 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, as applicable. The placement of erosion and sediment control features will also be located during this site review to mitigate potential impacts to sensitive sites and also uphold erosion and sediment control state-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 to avoid future delays to Project construction timeframes.

Activities proposed in proximity to existing gas pipelines will not result in disturbance to or crossing of existing resources and are in compliance with encroachment guidelines. A representative from one or both companies may be retained to ensure activities are permissible and aligned with established requirements.

Site Clearing and Preparation

After the pre-construction site review by the EM and construction personnel, wherein the limits of disturbance (LOD) and construction workspaces are established and sensitive resources are identified, Project-related construction will be initiated by clearing brush and woody vegetation within the 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 the LOD will be removed, organized, and disposed on site and outside any indicated sensitive sites (see Appendix 11-1). The definitive clearing impacts that 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, refer to Exhibit 22 of this Application.

Topsoil, forest mat, and otherwise unsuitable or disturbed materials will be stripped and/or removed prior to placing fill. Stripped materials consisting of vegetation and organic materials will primarily be used to revegetate landscaped areas or exposed slopes after completing grading operations. Soils that are suitable for reuse as fill will be temporarily stockpiled on site, and later distributed throughout the Project Area to return disturbed areas to existing grades. Additional stripped materials containing vegetation or organic matter may be used to revegetate landscaped areas or exposed slopes following construction and grading. Structural fill placed over exposed pre-existing pipelines, if applicable, will adhere to the specifications provided by the pipeline owners, as they are consistent with recommendations in the Geotechnical Engineering Report (Appendix 21-1) and in compliance with state and local requirements (see Appendices 12-4 and 12-5).

Laydown Yard Construction

Laydown yard areas were selected for ease of accessibility, strategic location in the construction work flow, relatively flat ground surface, occurrence outside sensitive resources (wetlands, waterbodies, cultural areas, etc.), and containing limited shrubby or woody vegetation to reduce impacts to natural vegetation areas. A majority of the laydown yard areas 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, the gravel fill and geotextile fabric will be removed, and topsoil stockpiles will be utilized to return laydown areas to existing grades and conditions. Subsoils at laydown yards staged in active agricultural areas 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 and Markets (NYSDAM *Guidelines for Solar Energy Projects – Construction Mitigation for Agricultural Lands Revision 10/18/2019*, 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 12 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 the 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 to provide additional stability support to the access road. Details regarding access road construction are discussed in Exhibit 11 of this Application.

If necessary, dewatering of excavations may occur to keep the excavations free of standing water and permit a safe and constructible environment. Dewatering methods will involve pumping the water to a dewatering facility located in a predetermined, well-vegetated area away from wetlands, waterbodies, and other sensitive resources. Dewatering facilities will include measures/devices to slow water velocities and trap suspended sediment (e.g., geotextile filter bags). All dewatering activities will also be conducted in accordance with the final Project SWPPP and in accordance with the State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity 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. To facilitate effective draining and surface water management within the access road, culverts and/or water bars will also be utilized where necessary. The access roads will be sloped where appropriate to direct water toward the edge of the road and/or downgradient to minimize the potential for ponding on or adjacent to the access roads.

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 sites 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 for access road development. As stated previously, stockpiled soils will be located outside sensitive resource areas and will be stabilized in accordance with the final Project SWPPP. Though none are proposed, if blasting is deemed necessary, all blasting operations will adhere to applicable New York State statutes and regulations governing the use of explosives. See Section 21(j) below for more information on the Project Blasting Plan. The Project Blasting Plan will incorporate guidelines and requirements for blasting operations within specified distances of the two underground pipelines located within the Project Area as outlined in the documents included in Appendices 12-4 and 12-5.

Depending on site soil characteristics, racking posts will be installed by one of three methods. First, the post 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. Refer to the Preliminary Design Drawings for additional racking information. Based on the findings of the geotechnical investigation, soils may not be conductive to the installation of pile-driven 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.

The Applicant will provide advance notification of any excavation that occurs within the ROW for existing pipelines located within the Project Area (25 feet of the Columbia Pipeline, 50 feet of the Empire Pipeline), as required by the owners of these existing structures. For excavations which require vibrating equipment, plans and procedures will be submitted to owners of the pipeline for review and approval prior to initiating activity. The use of other heavy equipment is not permitted within 25 feet of existing pipelines, and therefore the Applicant will utilize small backhoes or hand-digging for excavation and construction within these areas. Refer to Exhibit 12 Construction for more details regarding the existing pipelines that traverse the Project Area.

34.5-kV Electrical Collection Line Construction

The construction of the 34.5-kV collection circuits between solar arrays will involve multiple methods including direct burial, open trench methods utilizing equipment such as a rock saw, cable plow, rock wheel, and/or trencher, and HDD. The location of underground cables will be in part dictated by the location of existing underground pipelines located within the Project Area. Minimum distances between existing pipelines and the newly constructed collection line will be maintained as outlined in the Encroachment Guidelines provided in Appendices 12-4 and 12-5. Construction methodology within the ROW of existing pipelines will follow the specifications provided by pipeline owners.

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 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, areas 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 the Facility fence line will be allowed to regenerate naturally. As previously noted, HDD will also be employed in select areas to navigate the collection line around while preventing damage to existing pipelines and sensitive natural resources. For more information on HDD drilling, refer to the subsection on *Inadvertent Return for HDD* above and the Inadvertent Return Plan located in Appendix 21-2.

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 a combination of shallow and deep foundations. At this stage, the shallow mat/slab foundations will be poured, and deep foundations will be embedded or drilled. After the foundations have set, installation of electrical infrastructure (structural steel skeleton, conduits, cables, bus conductors, insulators, switches, circuit breakers, transformers, control house, 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 house 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 excavating soil for the installation of foundations for the placement of 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 Section 21(j) below for more details on the Project Blasting Plan.

Subsurface Drain Tile Repair Impact and Repair/Replacement

The Applicant is committed to minimizing impacts to agricultural operations and will work with landowners/farm operators to address unanticipated post-construction impacts. The Applicant will work with the affected landowner 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 (base 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 with 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 or replaced 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 that require cut-and-fill operations to occur. As stated previously, the construction and placement of Project infrastructure will require minor 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% or less, grading out work areas that are naturally undulatory or crowned, and access roads traversing an existing grade that exceeds the maximum design slope. It is anticipated that approximately 159,706 cubic yards will be fill derived from excavated materials with the exception of gravel for the access roads.

Based on site conditions presented in the preliminary Geotechnical Engineering Report, steel driven piles will be embedded to depths ranging from approximately 9 to 12 feet below existing grade. Permanent access roads will be constructed using approximately 8 inches of crushed gravel over native sub-soils, which will be stockpiled 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 practicable. 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 in Appendix 11-1 to this application. Excess fill materials will be stockpiled and stored for use on site. 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, wetland buffers, and environmentally sensitive areas.

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

Terracon, an engineering services company, conducted a geotechnical investigation at the Project Area, during which they advanced 13 test borings. Based on the findings of the investigation, the subsurface materials that were encountered within the Project Area are suitable for construction of the proposed structures.

Five test pits were excavated to approximate depths between 3.5 and 10 feet. Laboratory corrosion series testing was performed at nine locations, and thermal resistivity dry-out curves were performed at four locations. Infiltration testing was performed at six locations during the geotechnical investigation.

The results of the corrosion test are detailed in Table 21-4 below. Additional information on the corrosion series testing is provided in Section 21(v) of this Exhibit.

Table 21-4. Results of Laboratory Corrosion Analysis (reproduced from the Geotechnical Engineering Report, Appendix 21-1)

Boring	pH	Sulfates (ppm)	Sulfides (ppm)	Chlorides (ppm)	Red-Ox (mV)	Total Salts (ppm)	Resistivity (ohm-cm)
WG-3	8.22	83	Nil	55	+682	463	6063
WG-7	8.21	55	Nil	67	+678	132	6305
WG-8	7.74	113	Nil	38	+680	221	6596
WG-9	7.68	88	Nil	32	+681	357	6014
WTP-7	7.78	30	Nil	25	+679	254	1164
WTP-2	7.51	72	Nil	30	+680	222	1164
WTP-4	7.04	58	Nil	33	+679	171	11640
WTP-5	6.82	83	Nil	38	+681	309	14550
WGSS-1	7.93	110	Nil	30	+679	149	5723

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 be below this depth to prevent frost heave.

Organic-laden soil was encountered at the ground surface during the investigation. The depth of organic material in the topsoil was typically no more than approximately 12 inches, except at test pit WTP-1 where organic soils was found to a depth of 18 inches. This material will be stripped during earthwork so that new structures do not bear on organic-laden soil.

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

- Stratum 1 – Surficial layer consisting of topsoil;
- Stratum 2 – Native soil, consisting of silt, sand, and gravel mixtures with occasional rock fragments;
- Stratum 3 – Completely weathered shale bedrock; and
- Stratum 4 – Competent shale bedrock.

Stratum 1 – A thin layer of black topsoil containing significant organic matter was encountered from the soil surface to a depth of 1.5 feet. The stratum contains significant organic matter with some indication that the soil has been re-worked.

Stratum 2 – Silty sand and sandy silt was encountered from ground surface to a depth of between 2 and 20 feet below ground surface (bgs). This stratum is primarily composed of coarse to fine-grained, loose to hard silty sand or sandy silt with gravel, medium dense to very dense in texture. Standard Penetration Testing “N” values in this stratum ranged between 0 and greater than 50 blows per foot.

Stratum 3 – Weathered Shale was encountered at depths ranging from less than 1 to 26.5 feet bgs. This stratum is completely weathered, with all rock material disintegrated into soil. Standard Penetration Testing “N” values in this stratum typically require between 30 and 60 blows per foot.

Stratum 4 – Shale Bedrock was encountered at depths of 10.5 to 30.5 feet (maximum depth of exploration). The stratum material is medium strong with very thin bedding and close fractured. Bedrock showed slight weathering.

During the geotechnical investigation, groundwater was encountered at seven of the boring and test pit locations during drilling, though groundwater was present at only one of these locations during the second and/or third observation period. Groundwater was observed at four additional locations during the second observation period, which was not observed during drilling at depths ranging from soil surface to 16 feet with estimated depth to groundwater sitewide ranging from 7 to 10 feet. Groundwater conditions can change based on factors such as season and weather.

Temporary water wells were installed at six boring locations to monitor changes in groundwater levels during drilling. Of the six locations, five indicated groundwater seepage in follow-up inspections.

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 Blasting Plan has been prepared in the event that blasting is determined to be required. The Blasting Plan is provided in Appendix 21-3. If required, blasting activities will not occur within 200 feet of existing pipeline infrastructure without express approval of entities, which own the pipelines. Additional requirements of the pipeline owners are described in Appendices 12-4 and 12-5 have been incorporated into the Blasting Plan and will be implemented in the event blasting is required for excavation.

Soil conditions present throughout the Project Area indicate suitability for excavation using standard equipment. Some areas may contain very dense soils and weathered bedrock requiring consideration of “hard dig” conditions. Despite the potential to encounter dense soils, it is anticipated that the contractor for this Project can excavate with relatively little difficulty using an excavator, 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 be tailored to the structural integrity, depth, and robustness of the rock/bedrock encountered.

In the event that a unique situation requiring blasting arises, the Blasting Plan provided as Appendix 21-3, including procedural timeframes for notifying municipal officials, owners of existing infrastructure within the Project Area, 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 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

The bedrock encountered in the geotechnical survey consisted of shale. Stratums were sampled by coring. The recovered bedrock core was typically medium strong with close fractures and very thin bedding. Blasting and/or rock excavation techniques are not anticipated based on bedrock within the Project Area, therefore, no impacts are expected.

If blasting is determined to be required, the Blasting Plan provided in Appendix 21-3 will be used described in Section 21(j) above. Impacts from blasting operations may include but are not limited to ground vibration, air blast overpressure, and generation of fly rock, dust, noxious gases and chemical residue in the subsurface. Methods to prevent adverse impacts include site-specific design of load/charge configurations, the use of a blasting delay, and the use of blasting mats. Federal, state, and Occupational Safety and Health Administration (OSHA) regulations dictating the minimum distance for accessing blasting zones and protecting existing structures from blast impacts will be followed. Additionally, specifications regarding proximity to existing pipeline infrastructure will be implemented (see Appendices 12-4 and 12-5).

The Applicant will conduct pre- and post-blast surveys on structures, wells, septic systems, drain tiles, and pipelines within a one-half mile radius of the blasting area if requested by the property owner. Any damage determined to be a result of the blasting activities will be repaired. The Applicant will make all reasonable efforts to complete the post-blast survey within 30 days of a request from a property owner.

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, an investigation and evaluation of reasonable mitigation measures will be provided with the Contractor Blasting Plan. To minimize impacts, blasting shall be designed and controlled to meet the limits for ground vibration set forth in the United States Bureau of Mines (USBM) Report of Investigation (RI) 8507 Figure B-1 and air overpressure shall be under the limits set forth in the Conclusion section in USBM RI 8485 (USBM RI 8507 and USBM RI 8485). Mitigation measures will include alternative technologies and/or relocation of structures to eliminate the need for blasting. Where reasonable alternative measures cannot be employed, blast mats and backfill will be utilized to control any excessive rock movement where blasting occurs in close proximity to identified structures. Additionally, as explained above, the Applicant will outline a plan for securing compensation for damages that may occur as a result of blasting, including pre- and post-blast property surveys, if applicable.

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

In addition to the 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 Schuyler County (USDA, 2019), statewide bedrock geology mapping (NYSM/NYS Geological Survey, 1970), New York State surficial geology mapping (NYSM/NYS Geological Survey, 1970), 2014 New York State Hazard Map (DHSES), and USGS Earthquake Hazard Program (USGS, 2015).

Regional Geology

The Project Area is located within the finger lakes region of New York State in the glaciated portion of the Allegheny Plateau. The Allegheny Plateau is the most extensive physiographic province within the state and was formed by the erosion of glacial deposits by water and ice, leaving a flat-topped upland area with rugged relief. The province is marked by through valleys with steep side walls and large lakes, including the Finger Lakes (NYSDOT, 2013).

The Project Area is a hilly highland area with scattered wetlands. Elevations within the Project Area range from approximately 1,460 feet to 1,720 feet above mean sea level, according to the USGS web topographic maps.

Publicly available surficial geologic mapping suggests that the Project Area is primarily composed of glacial till dominated by stony silts and clays though soils tend to be highly variable throughout. The till material is variable in texture, consisting primarily of fine particles and rock fragments, with potential for land instability on steep slopes. The thickness of this till varies across the soil types found within the Project Area ranging from deep to moderately deep and shallow (approximately less than 1 to 5 meters thick). Fluvial outwash formed in proglacial lakes occurs throughout the Project Area, consisting of stratified sands and gravels. Soils formed in the outwash may be restricted by dense fragipan at depths of less than 1 meter. Formations prevalent throughout the Project Area may be subject to slow water movement and seasonal wetness or flooding. A detailed description of soils present in the Project Area is provided in Section 22(q). The bedrock material may be within 1 meter from the ground surface with possible sporadic crop outs. Surficial geology is composed of shale from the West Falls Group and consists of shale and siltstone formations including the Beers Hill shale, Grimes Siltstone, Dunn Hill, Millport, and Moreland shales. These units were formed in the Upper Devonian period and cover approximately 41.7% of Schuyler County.

Tectonic Setting and Seismology

According to USGS Seismic Hazards database, the Project Area is 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. This indicates relatively 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. Refer to Figure 21-4 for seismic hazards mapping of the Project Area and surrounding area. No faults were identified in the vicinity of the Project Area in a review of publicly available fault mapping data provided by the USGS.

Karst Topography

Publicly available mapping indicates that karst topography is not present within the Project Area or the surrounding county (Weary and Doctor, 2014). Additionally, no vulnerable karst features such as caves, sinkholes, or fractures were documented during surveys and studies conducted in the Project Area.

Risks and impacts to karst features are not anticipated as a result of excavation, post installation operations, HDD operations, limited blasting operations, and other construction-related soil disturbance activities. The risks and impacts of post installation as it pertains to the karst formations are generally limited. The main risk associated with post installation is the potential for highly variable depths to rock, which was indicated in select areas in the borings. Karst formations can make achieving the required post lengths for the required capacity challenging. The piles will be embedded to a depth of approximately 9 to 12 feet and, therefore, should not impact any potentially unmapped karst features, which could be present due to the shallow pile depths.

If blasting operations were to occur, blast-induced vibration and shock waves may result. Blasting could potentially cause fracturing of bedrock and limit groundwater availability and quality. The HDD locations proposed for the Project are not located within the areas containing karst formations. The subsurface conditions found within the borings drilled near the proposed HDD locations generally consisted of glacial till soils over limestone. Because HDD is not proposed in areas with evidence of karst features, risks to karst features from HDD are not anticipated.

As described in Exhibit 23 and Appendix 23-3 (Preliminary SWPPP) of the Application, potential impacts to the local water table during the construction phase of the Project can be avoided and mitigated through the use of best management practices (BMPs) and the specific measures outlined in the Preliminary SWPPP. The Applicant will employ BMPs including utilization of erosion and sediment controls, stormwater management, and avoidance of sensitive features to preserve the existing geologic character of the Project Area wherever possible. Stormwater management features proposed for the Project will route stormwater around or away from earth-disturbing activities and will slowly filter stormwater through the soil, preventing inundation of groundwater to underground features. Disturbed areas will be stabilized as soon as possible to prevent the transport of sediment and silt, and the Project Area will be revegetated following the completion of construction. In areas of excavation, trench breakers will be utilized 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 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.

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

The USGS Earthquake Hazard Program does not list any faults within the vicinity of the Project Area. Soils and bedrock encountered at the Project Area are consistent with a seismic site classification of D according to section 20.4 of American Society of Civil Engineers (ASCE) 7 and the International Building Code, indicating minimal potential for collapse under seismic loading. 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(o) Soils Types Map

Figure 21-2 delineates soil types and areas of Prime Farmland 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(p) 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 Schuyler County (USDA, 1979), USDA Web Soil Survey (2019), and Soil Survey Geographic Database (SSURGO, 2019).

The Soil Survey of Schuyler County, New York (USDA, 1979) and the USDA Web Soil Survey indicate that all proposed facilities and solar arrays are sited within 14 soil types. The surveys indicate that the Project Area predominantly consists of silty loams, ranging from poorly drained to well-drained soils.

Burdett series consists of very deep, somewhat poorly drained soils formed in till-dominated shale. The soil is formed in silty mantles that overlie till that is strongly influenced by shale. The potential for surface runoff is very low to very high with moderate permeability in the upper silt material and slow or very slow in the lower subsoil and substratum. Burdett soils are nearly level to steep with slopes ranging from 0 to 25%.

> **BuB** is Burdett channery silt loam with 3 to 8% slopes on footslopes, summits and base slopes of hills, drumlinoid ridges, and till plains. These soils, typically 0 to 60 inches thick, are developed in a thin silt mantle overlying till that is strongly influenced by shale. These soils are somewhat poorly drained.

Chippewa series consists of very deep, poorly drained, and very poorly drained soils formed in till deposits with dominantly sandstone, siltstone, and shale rock fragments. The potential for surface runoff is very low and very high and the saturated hydraulic conductivity is moderately high or high in the mineral soil above the fragipan and moderately low and low in the fragipan and substratum. Chippewa soils are nearly level areas with concave surface shapes.

> **Cp** is Chippewa silt loam with 0 to 3% slopes within depressions. These soils, typically 0 to 72 inches thick, are loamy till dominated by siltstone, sandstone, and shale fragments. The soils are poorly drained.

Fremont series consists of deep and very deep, somewhat poorly drained soils formed in till derived from soft shale, and some siltstone and sandstone. The saturated hydraulic conductivity is moderately high or high in the subsoil and low to moderately low in the substratum. Fremont soils are located on broad hilltops and hillsides and receive little runoff from adjacent areas. The soils have slopes ranging from 0 to 40%.

FrB is Fremont silt loam with 3 to 8% slopes on hills. These soils, typically 0 to 72 inches thick, are composed of till material. The soils are somewhat poorly drained.

Lordstown series consists of moderately deep, well-drained soils formed in till and cryoturbated material derived from siltstone and sandstone bedrock-controlled landforms of glaciated dissected plateaus. The potential for surface runoff is low to very high and the saturated hydraulic conductivity is moderately high or high throughout the soil. Lordstown soils are nearly level to very steep.

LoC is Lordstown channery silt loam with 8 to 15% slopes on hills and mountains. These soils, typically 0 to 40 inches thick, are loamy till derived from sandstone and siltstone. The soils are well drained.

Mardin series consists of very deep, moderately well-drained soils on glaciated uplands, mostly on broad hilltops, shoulder slopes, and backslopes. The potential for surface runoff is medium to high and the saturated hydraulic conductivity is moderately high or high in the mineral surface layer, subsurface layer, and upper part of the subsoil; and low or moderately low in the lower part of the subsoil and substratum. Mardin soils are nearly level to very steep.

MrB is Mardin channery silt loam with 3 to 8% slopes on hills and mountains. These soils, typically 0 to 72 inches thick, are loamy till. The soils are moderately well drained.

MrC is Mardin channery silt loam 8 to 15% on hills and mountains. These soils, typically 0 to 72 inches thick, are loamy till. The soils are moderately well drained.

MrD is Mardin channery silt loam 15 to 25% on hills and mountains. These soils, typically 0 to 72 inches thick, are loamy till. The soils are moderately well drained.

Tuller series consists of shallow, somewhat poorly drained soils that formed in thin deposits of till over acid sandstone, siltstone, or shale bedrock. These soils are in depressional areas of flatter hilltops and benched sideslopes of dissected uplands. The potential for surface runoff is low with moderate permeability in the surface layer and moderately slow to slow in the subsoil. Tuller soils occur primarily on long, narrow areas on hillsides and flatter hilltops that are often bordered by bedrock outcrops.

TuB is Tuller channery silt loam with 3 to 8% slopes on hills, ridges, and benches. These soils, typically 0 to 22 inches thick, are loamy till derived mainly from acid sandstone, siltstone, and shale. These soils are somewhat poorly drained.

TuC is Tuller channery silt loam with 8 to 15% slopes on hills, ridges, and benches. These soils, typically 0 to 22 inches thick, are loamy till derived mainly from acid sandstone, siltstone, and shale. These soils are somewhat poorly drained.

Valois series consists of very deep, well-drained soils on nearly level to steep lateral moraines along lower valley sides. The soils formed in till dominated by sandstone, siltstone, and shale. The potential for surface runoff is negligible to very high with permeability at moderate to rapid. Valois soils are nearly level to rolling.

VaB is Valois gravelly silt loam with 3 to 8% slopes on end moraines, valley sides, and lateral mountains. These soils, typically 0 to 60 inches thick, are loamy till derived mainly from sandstone, siltstone, and shale. These soils are well drained.

VaD is Valois gravelly silt loam with 15 to 25% slopes on end moraines, valley sides, and lateral mountains. These soils, typically 0 to 60 inches thick, are loamy till derived mainly from sandstone, siltstone, and shale. These soils are well drained.

Volusia series consists of very deep, somewhat poorly drained soils formed in loamy till. These soils are on concave to planar landscape positions in glaciated upland areas. The potential for surface runoff is low to very high and the saturated hydraulic conductivity in the mineral soils above the fragipan is moderately high or high and in the fragipan and substratum it is low to moderately high.

VoB is Volusia channery silt loam with 3 to 8% slopes on hills and mountains. These soils, typically 0 to 72 inches thick, are loamy till derived from interbedded sedimentary rock. These soils are somewhat poorly drained.

VoC is Volusia channery silt loam with 8 to 15% slopes on hills and mountains. These soils, typically 0 to 72 inches thick, are loamy till derived from interbedded sedimentary rock. These soils are somewhat poorly drained.

VoD is Volusia channery silt loam with 15 to 25% slopes on hills and mountains. These soils, typically 0 to 72 inches thick, are loamy till derived from interbedded sedimentary rock. These soils are somewhat poorly drained.

Table 21-5. Summary of Soil Types

Map Unit Symbol	Map Unit Name	Slope (%)	Acres within Project Area
BuB	Burdett silt loam	3–8	6.44
Cp	Chippewa silt loam	0–3	2.17
FrB	Fremont silt loam	3–8	9.91
LoC	Lordstown channery silt loam	8-15	20.24
MrB	Mardin channery silt loam	3–8	37.68
MrC	Mardin channery silt loam	8–15	66.93
MrD	Mardin channery silt loam	15–25	26.12
TuB	Tuller channery silt loam	3–8	1.72
TuC	Tuller channery silt loam	8–15	6.22
VaB	Valois gravelly silt loam	3–8	16.60
VaD	Valois gravelly silt loam	15–25	3.06
VoB	Volusia channery silt loam	3–8	281.19
VoC	Volusia channery silt loam	8–15	271.27
VoD	Volusia channery silt loam	15–25	21.13

The vast majority of soils in the Project area are channery silt loam. Soil drainage among mapped soil units is variable with approximately 77.8% of soils 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 of this Application.

The primary impact to the physical features of the Project Area will be the disturbance of soils during construction. The LOD for the Project is approximately 392 acres. Based on the assumptions outlined in Table 22-2 of Exhibit 22, disturbance to soils from all anticipated construction activities will total approximately 291 acres. Of this total, only approximately 6.61 acres will be permanent impacts where soils are converted to access roads, array foundations (posts), and structures, while the remaining will be restored and stabilized following the completion of construction. The area of disturbance calculations presented above assumes significant soil disturbance will occur in all areas in which construction occurs. Actual disturbance will include overlap of some components and 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, excessive fines, limited depth to saturation and limited depth to bedrock and are therefore, rated as being most limited in infiltration capacity for stormwater management. Implementing the erosion and sediment control measures outlined in the 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. 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 riprap 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 BMPs 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 of an 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 SWPPP (refer to Appendix 23-3). All excavations will comply with 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. The open sump pumping method is the most common and economical 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 with Final 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(q) Facility Construction and Operation Impacts to Drainage Features

A Geotechnical Engineering Report has been completed and is included in Appendix 21-1. In general, the conditions encountered are favorable for the Project. The available information suggests that the solar array areas will be underlain by sand and silt with varying amounts of gravel and potential shallow bedrock.

Given the nature of construction associated with Project development, minimal adverse impacts to drainage features are expected during the construction phase, and little to no temporary or permanent impacts are expected once the facility is operational. Project facilities will be designed and sited to avoid or minimize impacts to existing drainage features within the Project Area to the maximum extent practicable. Additionally, the Applicant will adhere to recommendations regarding the protection of drainage features provided by the NYSDAM in their guidance document *Guidelines for Solar Energy Projects – Construction Mitigation for Agricultural Lands Revision 10/18/2019*. Guidelines for measures to mitigate impact to existing drainage features during construction, restoration, remediation, and decommissioning are provided below.

Construction Requirements

The measures to be followed for the construction of the Project to comply, to the maximum extent practicable, with the NYSDAM's October 2019 guidance document "Guidelines for Solar Energy Projects – Construction Mitigation for Agricultural Lands" are detailed as follows.

- Before any topsoil is stripped, representative soil samples shall be obtained from the areas to be disturbed. The soil sampling shall be consistent with Cornell University's soil testing guidelines, and samples should be submitted to a laboratory for testing PH, percent organic material, cation exchange capacity, phosphorus/phosphate (P), and potassium/potash (K). The results are to establish a benchmark that the soil's pH, nitrogen (N), P, and K are to be measured again upon restoration. Should soil sampling not be performed, the Applicant will obtain fertilizer and lime application recommendations for disturbed areas at: https://www.agriculture.ny.gov/ap/agservices/Fertilizer_Lime_and_Seeding_Recommendations.pdf.
- Stripped topsoil shall be stockpiled from work areas (e.g., parking areas, electric conductor trenches, along access roads, equipment pads) and kept separate from other excavated material (rock and/or sub-soil) until the completion of the facility for final restoration. For proper topsoil segregation, at least 25 feet of additional temporary workspace (ATWS) will be provided along "open-cut" underground utility trenches. All topsoil will be stockpiled as close as is reasonably practical to the area where stripped/removed and shall be used for restoration on that particular area. Any topsoil removed from permanently converted agricultural areas (e.g., permanent roads, etc.) shall be temporarily stockpiled and eventually spread evenly in adjacent agricultural areas within the Project LOD, however, not to significantly alter the hydrology of the area. Topsoil stockpile areas and topsoil disposal areas will be clearly designated in the field and on construction drawings; changes or additions to the designated stockpile areas may be needed based on field conditions in consultation with the EM. Sufficient LOD area (as designated on the site plan or by the EM) shall be allotted to allow adequate access to the stockpile for topsoil replacement during restoration.
    - Topsoil stockpiles on agricultural areas left in place prior to October 31 shall be seeded with Aroostook Winter Rye or equivalent at an application rate of three bushels (168 lbs.) per acre and mulched with straw mulch at rate of two to three bales per 1,000 square feet.
    - Topsoil stockpiles left in place between October 31 and May 31 shall be mulched with straw at a rate of two to three bales per 1,000 square feet to prevent soil loss.
- The surface of access roads located outside of the Project's security fence and constructed through agricultural fields shall be level with the adjacent field surface. If a level road design is not feasible, all access roads should be constructed to allow a farm

crossing (for specific equipment and livestock) and to restore/maintain original surface drainage patterns.

- Culverts and waterbars shall be installed to maintain the natural drainage patterns.
- Vehicles or equipment will not be allowed outside the planned LOD without the EM seeking prior approval from the landowner (and/or agricultural producer), and associated permit amendments as necessary. All vehicle and equipment traffic, parking, and material storage will be limited to the access road and/or designated work areas, such as laydown areas, with exception the use of low ground pressure equipment. Where repeated temporary access is necessary across portions of agricultural areas outside the security fence, preparation for such access shall consist of either stripping/stockpiling all topsoil linearly along the access road, or the use of timber matting.
- Proposed permanent access shall be established as soon as possible by removing topsoil according to the depth of topsoil as directed by the EM. Any extra topsoil removed from permanently converted areas (e.g., permanent roads, equipment pads, etc.) shall be temporarily stockpiled and eventually spread evenly in adjacent agricultural areas within the Project LOD, however, not to significantly alter the hydrology of the area.
- For open-cut trenching, topsoil will be stripped from the work area adjacent to the trench (including segregated stockpile areas and equipment access). Trencher or road saw-like equipment will not be allowed for trench excavation in agricultural areas, as the equipment does not segregate topsoil from subsoil. HDD installations, primarily designed to avoid impacts to wetlands and an existing pipeline, will also help to minimize agricultural ground disturbances. Any HDD drilling fluid inadvertently discharged will be removed from agricultural areas. Narrow open trenches less than 25 feet long involving a single directly buried conductor or conduit (as required) to connect short rows within the array, will be considered exempt from topsoil segregation.
- Electric collection, communication, and transmission lines installed aboveground can create long-term interference with mechanized farming on agricultural land. Thus, interconnect conductors outside the security fence are proposed to be buried in agricultural fields wherever practicable. Where overhead utility lines are required (e.g., from the switchyard to the Point of Interconnection [POI]), installation will be located outside field boundaries or along permanent access road(s) wherever possible. Should overhead utilities must cross farmland, agricultural impacts will be minimized by using taller structures that provide longer spanning distances and locate poles on field edges to the greatest extent practicable.

- All buried utilities located within the Project's security fence will have a minimum depth of 18 inches of cover if buried in a conduit or a minimum depth of 24 inches of cover if directly buried (e.g., not routed in conduit).
- The following requirements shall apply to all buried utilities located outside the generation facility security fence:
  - In cropland, hayland, and improved pasture buried electric conductors shall have a minimum depth of 48 inches of cover. In areas where the depth of soil over bedrock is less than 48 inches, the electric conductors shall be buried below the surface of the bedrock if friable/rippable, or as near as possible to the surface of the bedrock.
  - In unimproved grazing areas or on land permanently devoted to pasture the minimum depth of cover shall be 36 inches.
  - Where electrical conductors are buried directly below the Project's access road or immediately adjacent (at the road edge) to the access road, the minimum depth of cover shall be 24 inches. Conductors shall be close enough to the road edge as to be not subject to agricultural cultivation/subsoiling.
- Should buried utilities alter the natural stratification of soil horizons and natural soil drainage patterns, the Applicant will rectify the effects with measures such as subsurface intercept drain lines. The Applicant shall consult the local Soil and Water Conservation District concerning the type of intercept drain lines to install to prevent surface seeps and the seasonally prolonged saturation of the conductor installation zone and adjacent areas. The Applicant shall install and/or repair all drain lines according to the NRCS conservation practice standards and specifications. Drain tiles shall meet or exceed the American Association of State Highway and Transportation Officials (AASHTO) M-252 specifications. Repair of subsurface drains tiles shall be consistent with the NYSDAM's details for "Repair of Severed Tile Line" found in the pipeline drawing A- 5[1].
- In pasture areas, it may be necessary to construct temporary fencing (in addition to the Project's permanent security fences) around work areas to prevent livestock access to active construction areas and areas undergoing restoration. For areas returning to pasture, temporary fencing will be erected to delay the pasturing of livestock within the restored portion of the LOD until pasture areas are appropriately revegetated. Temporary fencing including the Project's required temporary access for the associated fence

[1] (http://www.agriculture.ny.gov/ap/agservices/Pipeline-Drawings.pdf)

installations shall be included within the LOD as well as noted on the construction drawings. The Applicant will be responsible for maintaining the temporary fencing until the EM determines that the vegetation in the restored area is established and able to accommodate grazing. At such time, the Applicant shall be responsible for removal of the temporary fences.

Restoration Requirements

Agricultural areas temporarily disturbed during construction will be de-compacted to a depth of 18 inches to a level of no more than 250 lbs. per square inch when measured with a soil penetrometer. In areas where topsoil was stripped, soil decompaction will be conducted prior to replacing the topsoil. Rocks 4 inches and larger will be removed from the subsoil surface prior to topsoil replacement. The topsoil will be replaced to the original depth and contours where possible.

Rocks 4 inches and larger will be removed from the surface of the topsoil. Subsoil decompaction and topsoil replacement will be avoided after October 1. If areas are restored after October 1, provisions will be made to restore and reseed eroded and exposed areas the following spring to establish proper vegetative cover.

Access roads will be re-graded as needed to allow farm equipment crossing and to restore the original drainage patterns or incorporate the newly designed drainage pattern. Existing drain tiles will be identified and located before construction as much as is reasonably possible based primarily on consultation with 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 or replaced consistent with the NYSDAM's details for "Repair of Severed Tile Line" to the maximum extent practicable. The Applicant will coordinate with the landowner to continue to monitor drain tiles post-construction to ensure repairs are properly functioning.

Restored agricultural areas will be seeded as specified by the landowner to maintain consistency with the surrounding areas.

Restoration practices will be postponed until favorable soil conditions exist. Restoration will not occur when soils are in a wet or plastic state of consistency. Regrading stockpiled topsoil and de-compacting subsoils will not occur until the plasticity, as determined by the Atterberg field test, is adequately reduced. Restoration activities will not occur on agricultural fields between October and May unless favorable soil conditions exist.

Construction debris will be removed from the Project Area following restoration efforts and disposed in a licensed facility.

Monitoring and Remediation

The Applicant will provide monitoring and remediation for a period no less than 365 days following the date upon which the solar arrays are in commercial operations. The monitoring and remediation will identify remaining agricultural impacts associated with construction that need mitigation and follow-up restoration.

Monitoring efforts will assess the topsoil thickness, relative content of rock and large stones, trench settling, crop production, drainage and repair/replacement of severed subsurface drain line, fences, etc. If necessary, topsoil will be imported to the Project Area to repair trench settling and topsoil deficiency issues. Visual inspection will determine the presence of excessive amounts of rock and oversized stone material. Excess rocks and large stones will be removed as appropriate.

Should the subsequent crop productivity within affected areas fall to less than half that of adjacent unaffected agricultural land, the Applicant and other associated parties must determine the appropriate rehabilitation measures to be implemented.

Decommissioning

When the solar arrays are decommissioned, all aboveground structures will be removed from the Project Area. Concrete piers, footers, and other supports will be removed to a depth of 48 inches below the soil surface and underground electrical lines will be abandoned in place. The Project Area will be restored to as close to the previous condition as practicable. Previous agricultural lands will be restored with recommendations from the landowner, the Soil and Water Conservation District, and the NYSDAM. Access roads and landscaping in agricultural areas will be removed unless specified otherwise by the landowner.

Decommissioning activities will occur in accordance with the Decommissioning Plan. Refer to Exhibit 29 and Appendix 29-1 for additional information.

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

Figure 21-3 depicts anticipated depth of bedrock within the Project Area based on soils data from the USDA (USDA 2019). According to this figure, depth to bedrock within the Project Area will range anywhere from 0 inches to more than 67.2 inches below the ground surface. However, the mapping seems to indicate that bedrock is encountered at or near the soil surface over approximately 96.4% of the Project Area.

Results of test borings performed to date by Terracon indicate that the majority of bedrock is shale bedrock at depths greater than 10 feet bgs, with layers of weathered shale. The depth to bedrock, as identified on the available logs, varies across the boring locations and range from 10.5 foot bgs to 30.5 feet bgs. The bedrock extended to at least 30.5 feet bgs, which was the maximum depth explored in the borings. The majority of the bedrock encountered consists primarily of medium strong, close fractured shale.

The Rock Quality Designation (RQD) of the coreable rock ranges from 14% to 25%, indicating "very poor" condition using a standard RQD classification. The RQD was recorded from borings WG-1, WG-4, and WGSS-1. The RQD of 14% was experienced from a depth of 24 feet bgs to 28.5 feet bgs. The shale bedrock at this depth was slightly weathered and medium strong with close fractures. The RQD of 25% was experienced from a depth of 10.5 feet bgs to 14.5 feet bgs. The shale bedrock at this depth was slightly weathered and medium strong with close fractures.

Groundwater was encountered at 11 of the boring locations at depths ranging from 0 bgs to 16 feet bgs. The groundwater conditions may vary with seasonal changes and weather conditions. A more detailed geotechnical investigation will need to be completed prior to any site improvements to determine the actual elevations of groundwater in the area of the proposed solar array.

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 Geotechnical Engineering 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 include excavation; pouring of the 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 embedded poles, or rock anchors. 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 fine-grained soils subject to instability. Two zones were identified in the Project Area, segregated by soil conditions observed in the geotechnical investigations and suitability for construction. Foundation design specifications are provided for each foundation type by zone in the Geotechnical Engineering Report (Appendix 21-1) general considerations are described below.

Settlement potential of shallow foundations was analyzed using soil compressibility properties derived from the Standard Penetration Test borings drilled in the planned collection substation and switchyard location and assumed structural loads. Estimated total settlements will be less than 1 inch provided column loads are less than the estimated maximum loads (Downward: 5 kips; Lateral: 3.5 kips; Uplift: 2 kips) and the applied bearing pressure of small isolated slabs or mats is less than about 3,000 pounds per square foot. 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 the Geotechnical Engineering Report. Shaft drilling is anticipated to be somewhat difficult in areas of weathered shale or bedrock observed on site and may require concentrated effort where those conditions exist. Additionally, groundwater was encountered throughout the site, therefore, temporary casing may be required in some areas. Shaft excavations will be cleaned of water and loose material before placing steel or concrete reinforcements. Drilled shafts should be constructed as straight shafts at least 30 inches in diameter. Settlement of drilled shaft foundations using design properties presented in this report is expected to be less than 1 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 Geotechnical Engineering Report (Appendix 21-1).

(1) Preliminary Engineering Assessment

The Geotechnical Engineering Report analyzed spread footing and isolated reinforced concrete support slab foundations and drilled shaft foundation alternatives for the substation and switchyard foundations. The spread footing and isolated slab foundations were determined to be acceptable to support lightly loaded buildings and equipment pads provided the maximum loads are not exceeded. If drilled shaft foundations are utilized for the Project, a minimum shaft diameter of 30 inches is recommended for the foundations. Soils at or near the surface consisted of fine-grained materials that may be subject to instability during construction, particularly following precipitation events. Implementation of effective drainage systems early in construction and maintenance throughout as well as restricting construction to drier months should reduce the risk of undercutting or replacement of unstable subgrade. The available information suggests that substation and POI switchyard foundations will be underlain by glacial till and bedrock. Refer to Appendix 21-1 for additional information regarding the foundation engineering assessment and design recommendations.

Solar array racking will be installed by driving the posts directly into the subsurface. If refusal is encountered while driving the posts directly into the subsurface, there are three alternative methods for installation. A helical post (i.e., pile screw) can be installed directly into the subsurface. In cases of high ledge or bedrock, undersized holes can be pre-drilled into the rock to an appropriate depth prior to driving the post. In situations with very hard rock, an oversized hole may need to be pre-drilled, then grouted after the post is installed. See Preliminary Design Drawings included in Appendix 11-1.

Design frost depth is 4 feet in the Project Area, and foundations must bear below this depth to prevent movement due to frost heave. Additionally, the soil conditions observed on site indicate that embedment of approximately 9 to 12 feet is required to support racking and panels.

The glacial till found throughout much of the Project Area 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 12 inches over a length extending back at least 10 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 3,000 lbs. per square foot is appropriate for shallow foundations bearing on soils typical of the Project Area for spread footing foundations. An allowable bearing pressure of 2,000 lbs. per square foot is estimated for mat foundations.

(2) Pile Driving Impact Assessment

Pile driven foundations are not proposed for the substation and switchyard foundations; therefore, engineering feasibility and impact assessments were not conducted. If pile driven foundations are determined to be necessary for Project construction, the foundation will be assessed for impacts to surrounding properties and structures, mitigation methods for vibration will be evaluated, and the daily and total pile driving work estimates will be determined.

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 approximately 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 45 days assuming 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 the minimum required torque per manufacturer's recommendations. If refusal is encountered during installation, undersized holes will be pre-drilled and then the posts will be driven, or the posts will be installed within oversized 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

To minimize impacts associated with noise, post installation activities will be designed to minimize impacts to nearby residences and existing structures. Section 19(i) of Exhibit 19 describes noise abatement measures for construction activities.

As mentioned in Section 21(s)(2), pile driven foundation systems are not considered to support the collection substation and switchyard. Mitigation measures are not required for these components.

(4) Vibrational Impacts

All post installation operations that 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 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 decibels (dB) at 16, 31.5, or 63 Hertz (Hz), which are the outdoor criteria established in annex D of American National Standards Institute (ANSI) standard S12.9-2005/Part 4 and applicable portions of ANSI 12.2 (2008). 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. Although unlikely, posts in the array can be pre-drilled if driving directly into the native subsurface is difficult. As such, no vibrational impacts are anticipated. The closest distance to a structure where post installation is proposed is over 110 feet and is well over 200 feet in most locations.

As mentioned in Section 21(s)(2), pile driven foundation systems are not considered to support the collection substation and switchyard. Mitigation measures for vibrational impacts not are required for these components.

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% chance of an earthquake occurring in the next 50 years of peak acceleration exceeding 10% to 14% of the force of gravity in the Project Area. The Project Area 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 a review of publicly available data. The findings were provided in Section 21(n) above.

The Project is located entirely inland and over 300 miles from the Atlantic Ocean; therefore, the Project is not subject to tsunami events.

21(u) Consistency with New York State Guidelines

The Project will be in compliance with the NYSDAM *Guidelines for Solar Energy Projects – Construction Mitigation for Agricultural Lands Revision 10/18/2019,* to the maximum extent practicable.

The Applicant will hire an EM to oversee construction and restoration work on agricultural land. The EM will coordinate with the NYSDAM Division of Land and Water Resources as necessary to ensure the guidelines are being met to the maximum extent practicable. The EM will contact the NYSDAM Division of Land and Water Resources if a farm resource concern, management matter pertinent to the agricultural operation, and/or site-specific implementation conditions, cannot be resolved.

The Project will comply, to the maximum extent practicable, with the guideline requirements for construction, restoration, monitoring, remediation, and decommissioning as detailed in Section 21(q) above.

21(v) Soil Suitability and Shrink/Swell Potential

The extent to which a soil shrinks or swells changes with soil moisture content. The shrink-swell potential is influenced by the amount and type of clay in the soil. Site soils were predominantly composed of silts and sands with varying degrees of gravel (refer to Appendix 21-1). Many soil units identified in a review of the USGS Soil Survey indicated poor drainage, which may contribute to increased shrink/swell potential; however, clay content and water content in the 1/3 bar is less than 20% for all mapped soil units, indicating overall low shrink/swell potential for the on-site soils.

Frost action for the soils found in the Project Area is predominantly high throughout. Geotechnical investigations determined that soils within the Project Area are frost susceptible and frost heave on pile foundations may be significant. Frost action may cause uplift of foundation systems, which are not designed to withstand the forces of frost heave. To prevent the impacts of frost action, foundations for new site structures will be below 48 inches from the soil surface. Additionally, pile driven foundations will be designed to withstand frost heave of 1,500 psf along the pile perimeter to depths up to 30 inches, per recommendations provided in the geotechnical report (refer to Appendix 21-1).

Some soils on site may be suitable for re-use as structural fill, provided proper compaction occurs during construction. However, should construction occur during wet months, many of the on-site soils will have higher moisture content than allowable to achieve required compaction. Soils which have excessive moisture content and cannot be compacted will be removed from the site or used as common fill in non-structural areas to re-establish grade. Fill compaction requirements to determine suitability for use as fill are provided in Appendix 21-1. Filtering will follow specification outlined by the Geotechnical Report as follows. Common fill will have a maximum particle size of 6 inches and no more than 20% by weight passing through a number 200 sieve. Several soils within the Project Area were identified as NSF and may be used in areas where frost action is anticipated to be high. NSF fill will have no more than 5% by weight passing through a number 200 sieve. Soil types meeting these designations are discussed in Appendix 21-1. Samples of material to be used as structural fill will be provided to the geotechnical engineer for evaluation prior to use.

21(w) Quarries and Mines Map

No mines or quarries or were identified in the Project Area based on publicly available data. Four quarries were identified within 2 miles of the Project (USGS 2019). Three of the four quarries are past producers of sand, gravel, or other materials for construction. One quarry is listed as a current producer of sand, gravel, or other construction material. Additionally, five aboveground mines were identified within the 2-mile Project Study Area. Four of the five mines are for sand and gravel, while the fifth mine is for extraction of glacial till material. Two mines have been closed. The Blanchard Pit Mine for glacial till was closed in 1994 after 3 years of operation. One un-named gravel mine owned by the Nickanthony Construction Co. was closed in 1985. The remaining mines are operational. The locations of these mines and quarries are shown on Figure 21-5.

21(x) Survey of New York State Department of Environmental Conservation-regulated Oil and Gas Wells

Figure 21-6 shows the locations of identified oil and gas wells within the Project Area and Study Area, as identified in the New York State Department of Environmental Conservation (NYSDEC) Oil and Gas Database (NYSDEC 2019). Additionally, Geographic Information System (GIS) data on the NYSDEC wells was extracted from the Rextag energy mapping database (Rextag, 2019) and cross-referenced with the NYSDEC dataset. Both databases identified five wells within the Project Area including one abandoned well, one development well, and three exploration wells, though none are reported as active. Locations of the wells are provided in Table 21-6 below. There are 13 wells located in the 2-mile Study Area, though none are currently listed as active. Locations of the wells are provided in Table 21-7 below.

Table 21-6. NYSDEC-Regulated Oil and Gas Wells within the Project Area

Well Name	API Well Number	NYSDEC Reported Status	Rextag Well Status	Lon	Lat
WGI 1	31097230530000	Unknown Not Found	Exploration	-76.946852	42.335435
WGI 1-A	31097230530100	Plugged Back Multilateral	Exploration	-76.946852	42.335435
WGI 5	31097238250000	Plugged Back Multilateral	Abandoned	-76.932000	42.329120
WGI 10	31097239300000	Plugged and Abandoned	Exploration	-76.936650	42.342740
WGI 11	31097239490000	Plugged and Abandoned	Development	-76.941530	42.342760

Table 21-7. NYSDEC-Regulated Oil and Gas Wells within the 2-mile Study Area

Well Name	API Well Number	NYSDEC Reported Status	Rextag Well Status	Lon	Lat
Wentz 1	31097005260000	Expired Permit	N/A	-76.908150	42.317630
Ganung 1	31097228860000	Expired Permit	Abandoned	-76.895820	42.309210
Ganung 1-A	31097228860100	Inactive	Abandoned	-76.895820	42.309210
Ganung 1-B	31097228860200	Plugged and Abandoned	Abandoned	-76.895820	42.309210
Ganung 2	31097230080000	Inactive	Exploration	-76.896560	42.312510
WGI 2	31097230670000	Capped	Unknown	-76.908480	42.341450
WGI 2	31097231390000	Capped	Unknown	-76.908130	42.341820
WGI 3	31097231520000	Expired Permit	Unknown	-76.932410	42.342830
WGI 4	31097238240000	Plugged Back Multilateral	Abandoned	-76.915440	42.340540
WGI 6	31097238300000	Inactive	Unknown	-76.945281	42.327381
WGI 7	31097238810000	Plugged and Abandoned	Development	-76.947247	42.345189
WGI 8	31097238820000	Inactive	Unknown	-76.903625	42.340444
WGI 9	31097239290000	Inactive	Unknown	-76.932000	42.342990

A magnometer study was conducted by Dudek, an environmental engineering firm, from November 15 to 17, 2019, to detect known or existing wells, including those which do not have surface expression. The results of this study did not indicate additional wells within the Project Area. Wells WGI 1, WGI 1-A, and WGI 11 identified through the study correspond with the locations of known regulated wells identified by the NYSDEC. The location of well WGI 10 was confirmed via visual reconnaissance as it consists of an aboveground, fenced-in structure. Additionally, signatures detected through the study identified existing pipelines that traverse the Project Area owned by TransCanada and National Fuel (Figure 21-6). The location of well WGI

5, mapped by NYSDEC, was not confirmed with the magnetometer survey as no evidence of the well was found.

21(z) NYSDEC Notification of Wells within the 100-Foot Buffer Area

Project Components have been sited as to not have been located within a 100-foot buffer area surrounding known wells. Based on the Preliminary Design Drawings provided in Appendix 11-1, there are three locations at which Project Components are not located within 100 feet of mapped wells. As noted above, well WGI 5 as mapped by the NYSDEC, was not located during the magnetometer survey. This location is in the area of the Project POI facilities. Additional field surveying will be conducted prior to construction to further confirm it is not present. The Applicant will notify the NYSDEC of any encroachment of the buffer surrounding known wells within the Project Area prior to submitting the Compliance Filings.

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