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August 15, 2017

Ms. Barcy F. McNeal, Secretary
Ohio Power Siting Board
Docketing Division
180 East Broad Street, 11th Floor
Columbus, Ohio 43215-3797

Re: Supplement to Application
Case No. 17-774-EL-BGN
In the Matter of the Application of Vinton Solar Energy LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Vinton County, Ohio.

Dear Ms. McNeal:

On July 6, 2017, Vinton Solar Energy LLC ("Applicant") filed an application with the Ohio Power Siting Board ("Board") for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Vinton County, Ohio ("Application"). At this time, the Applicant is filing this supplement, in order to provide the Board with additional information as promised in the Application. Therefore, the Applicant requests that the Board consider the following supplemental information as part of the Application in this matter:

1. **Attachment 1**: In response to Ohio Administrative Code ("O.A.C.") Rule 4906-4-06(F)(5), on page 35 of the narrative, the Applicant committed to provide a Decommissioning Report within 45 days following the filing of the Application. Pursuant to this commitment, as Attachment 1 to this supplemental filing, the Applicant has included the July 25, 2017 Decommissioning Plan completed by Santec Consulting Services, Inc.

2. **Attachment 2**: In response to O.A.C. Rules 4906-4-08(A)(3)(a) through (e), on pages 50-52 of the narrative, the Applicant committed to provide a report within 45 days following the filing of the Application on: the construction and operational sound levels at the nearest property boundary; the location of noise-sensitive areas within 1 mile of the facility; the mitigation of sound emissions during construction and operation; and the preconstruction background sound study. Pursuant to this commitment, as Attachment 2 to this supplemental filing, the Applicant has included the August 7, 2017 Noise Analysis completed by Hankard Environmental, Inc.

3. **Attachments 3a and 3b**: In response to O.A.C. Rules 4906-4-08(A)(5)(a) through (c), on page 54 of the narrative, the Applicant committed to provide a report within 45 days following the filing of the Application on the following regarding the proposed site: geological suitability; soil suitability for grading, compaction, and drainage; and plans for test boring. Pursuant to this commitment, as Attachments 3a and 3b to this supplemental filing, the Applicant has included the following report

and results conducted by Terracon Consultants, Inc. on behalf of the Applicant:

a. **Attachment 3a**: The geological findings regarding the subsurface exploration and geotechnical recommendations for the Vinton Solar project dated June 1, 2017, which were prepared by Terracon Consultants, Inc. ("Terracon").

b. **Attachment 3b**: The thermal resistivity test results for the Vinton Solar project dated June 27, 2017, which were prepared by Terracon.

4. **Attachment 4**: In response to O.A.C. Rule 4906-4-08(C)(1)(a), in Figure 08-5 referred to on page 72 of the narrative, the Applicant provided a map of land uses that depicts the proposed facility, the land use, structures, and the incorporated areas and population centers. Since the filing of the Application, the Applicant has revised the map to include the economic use of all parcels within 1 mile of the facility. Therefore, the Applicant is providing Figure 08-5.1 dated July 12, 2017, as a supplement to the Application in this matter.

The original of this supplement to the Application has been filed electronically. In addition, 5 complete paper copies and 10 USB drives containing the supplemental information to the Application have been provided.

We are available, at your convenience, to answer any questions you may have.

Respectfully submitted,

/s/ *Christine M.T. Pirik*
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CMTP:KB
Enclosures

COLUMBUS 39579-29 74269v1

Vinton Solar Energy LLC
Case No. 17-774-EL-BGN
Supplement to Application
August 15, 2017

Attachment 1

Decommissioning Plan

by Santec Consulting Services, Inc.
July 25, 2017

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Attorneys for Vinton Solar Energy LLC

Decommissioning Plan
Vinton Solar Energy Project
Vinton County, Ohio

Stantec

Prepared for:
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Prepared by:
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1165 Scheuring Road
De Pere, Wisconsin 54115

Project No: 193705143
July 25, 2017

This document entitled Decommissioning Plan Vinton Solar Energy Project, Vinton County, Ohio was prepared by Stantec Consulting Services Inc. ("Stantec") for the use of Vinton Solar Energy LLC (the "Client"), and the applicable regulatory agencies. Any reliance on this document by any other third party is strictly prohibited. The material in this document reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in this document are based on conditions and information existing at the time this document was published and do not take into account any subsequent changes.

Prepared by ______________________

STANTEC CONSULTING SERVICES INC.

Technical Review by ______________________
Allen D. Robinson, P.E.

Independent Review by ______________________
Dave Rautmann, P.E.

PE CERTIFICATION

NAME: Allen D. Robinson

TITLE: Senior Construction Manager

COMPANY: Stantec Consulting Services Inc.

REGISTRATION NO: E-51460

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PROFESSIONAL ENGINEER

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1.0 Introduction

Vinton Solar Energy LLC (Vinton Solar), a subsidiary of Invenergy Solar Development North America LLC (Invenergy), is proposing to construct the Vinton Solar Energy Center in Vinton County, Ohio. The proposed Vinton Solar Energy Center (the Project) is to be located within the township of Elk, east of the Village of McArthur, Vinton County, Ohio (Figure 1). Major components of the Project include solar modules, fixed tilt racking, inverters, transformers and a Project substation. The Project will occupy approximately 1,950 total acres of land with approximately 658 acres within perimeter fencing. The Project will have a maximum nameplate generating capacity of up to 125 megawatts $(MW)_{[AC]}$.

This Decommissioning Plan (Plan) provides a description of the decommissioning and restoration of the Project. A start-of-construction is planned for early 2018, with a projected Commercial Operation Date in mid-2019. The Project will consist of the installation of the perimeter fencing; solar arrays and associated fixed tilt racking, foundations, and steel piles; transformers; inverters; access and internal roads; and electrical collection system (Figure 2). Solar modules being considered include the Q.PLUS L-G4.2 (340 watt) manufactured by Hanwha Q Cells, the Eagle PERC 72 (350-355 watt) manufactured by Jinko Solar and other similar models.

This Plan includes an overview of the primary decommissioning Project activities; dismantling and removal of facilities, and restoration of land. A summary of estimated costs associated with decommissioning the Project is also included in Section 4.0. Summary statistics and estimated costs are provided for a 125-MW Project array design.

1.1 SOLAR FARM COMPONENTS

The main components of the Project include:

- Solar panels and fixed tilt racking
- Foundations and steel piles
- Transformers and inverters
- Electrical cabling and conduits
- Project substation
- Perimeter fencing, and internal access roads

1.2 TRIGGERING EVENTS AND EXPECTED LIFETIME OF PROJECT

Project decommissioning may be triggered by events, such as: abandonment during Project construction or when the Project reaches the end of its operational life.

If properly maintained, the expected lifetime of a utility-scale solar panel is approximately 25 to 30 years with an opportunity for a project lifetime of 50 years or more with equipment replacement and repowering. Depending on market conditions and project viability, the solar arrays may be retrofitted with updated components (e.g., panels, frame, tracking system, etc.) to extend the life of the project. In the event that the modules are not retrofitted, or at the end of the Project's useful life, the panels and associated components will be decommissioned and removed from the Project site.

Components of the solar facility that have resale value may be sold in the wholesale market. Components with no wholesale value will be salvaged and sold as scrap for recycling or disposed of at an approved offsite licensed solid waste disposal facility (landfill). Decommissioning activities will include removal of the arrays and associated components as listed in Section 1.1 and described in Section 2.

1.3 DECOMMISSIONING SEQUENCE

Decommissioning activities will begin within twelve months of the Project ceasing operation and are anticipated to be completed in three to six months. Monitoring and site restoration may extend beyond this period to ensure successful revegetation and rehabilitation. The anticipated sequence of decommissioning and removal is described below; however, overlap of activities is expected.

- Reinforce access roads, if needed, and prepare site for component removal
- Install temporary fencing and best management practices (BMPs) to protect sensitive resources
- De-energize solar arrays
- Dismantle panels and racking
- Remove frame and internal components
- Remove portions of structural foundations less than three feet (36 inches) below the surface and backfill sites
- Remove inverters and transformers
- Remove electrical cables and conduits less than three feet (36 inches) below the surface
- Remove access and internal roads and grade site
- De-compact subsoils (if required), restore and revegetate disturbed land to pre-construction conditions to the extent practicable

2.0 Project Components and Decommissioning Activities

The solar facility components and decommissioning activities necessary to restore the Project area, as near as practicable, to pre-construction conditions are described within this section.

2.1 OVERVIEW OF SOLAR FACILITY SYSTEM

Vinton Solar anticipates utilizing approximately 504,000 solar modules, with a total nameplate generating capacity of up to approximately 125 $MW_{[AC]}$ (173.9 $MW_{[DC]}$) on the 1,950-acre site. Statistics and cost estimates provided in this Plan are based on a 345-watt module.

Foundations, steel piles, and electric cabling and conduit less than three feet (36 inches) below the soil surface will be removed. Components and cabling deeper than 36 inches below the surface will be abandoned in place. Access roads may be left in place if requested and/or agreed to by the landowner. Public roads damaged or modified during the decommissioning and reclamation process will be repaired upon completion of the decommissioning phase.

Estimated quantities of materials to be removed and salvaged or disposed of are included in this section. Most of the materials described have salvage value; although, there are some components that will likely have none at the time of decommissioning. All recyclable materials, salvaged and non-salvage, will be recycled to the furthest extent possible. All other non-recyclable waste materials will be disposed of in accordance with state and federal law in an approved licensed solid waste facility. For purposes of this report, no estimated recovery or salvage values were considered, as directed by the Ohio Power Siting Board (OPSB) for the Project.

Table 1 presents a summary of the primary components of the Project included in this decommissioning plan.

Table 1 Primary Components of Solar Farm to be Decommissioned

Component	Quantity (345-watt)	Unit of Measure
Solar Modules (approximate)	504,000	Each
Fixed Tilt Racking (approximate length)	850,000	Feet
Steel Piles (above 48-inch depth; based on 600 piles per $MW_{[DC]}$)	104,340	Each
Inverters and Transformers	40	Each
Concrete Foundations (Inverters/Transformers)	40	Each
Electrical Cables and Conduits (approximate, left in place below 72-inch depth)	50,000	Lineal Foot (estimated)
Perimeter Fencing	70,730	Lineal Foot (estimated)
Internal Access Roads (approximate)	41,800	Lineal Foot (estimated)
Project Substation	1	Each

2.2 SOLAR MODULES

Vinton Solar is considering the Hanwha Q Cell (340-watt), Jinko Solar (350 to 355-watt) or similar model of module for the Project. Each module assembly (with frame) has a total weight of approximately 53 to 58 pounds. The modules are approximately 77 inches by 39 inches in size and are mainly comprised of non-metallic materials such as silicon, mono- or poly-crystalline glass, composite film, plastic, and epoxies, with an anodized aluminum frame.

At the time of decommissioning, module components in working condition may be refurbished and sold in a secondary market yielding greater revenue than selling as salvage material.

2.3 FIXED TILT RACKING AND SUPPORT

The solar modules will be mounted on a fixed-tilt racking system. Each rack is approximately 85 meters (183 feet) in length and will support approximately 108 solar modules. Smaller trackers may be employed at the edges of the layout, to efficiently utilize available space. The racking systems are mainly comprised of galvanized and stainless steel; the steel piles that support the system are comprised of structural steel.

The solar arrays will be deactivated from the surrounding electrical system and made safe for disassembly. Liquid wastes, including oils and hydraulic fluids (if present) will be removed and properly disposed of or recycled according to regulations current at the time of decommissioning. Electronic components, and internal electrical wiring will be removed and salvaged. The steel piles will be cut and removed to a depth of four feet (48 inches) below the ground surface.

The supports, racks and posts contain salvageable materials which can be sold to provide revenue to offset the decommissioning costs. As stated earlier, the revenue generated from salvageable equipment has not been included in the decommissioning estimate.

2.4 INVERTERS AND TRANSFORMERS

Inverters and transformers generally sit on small concrete footings within the array. The inverters and transformers will be deactivated, disassembled and removed. Depending on condition, the equipment may be sold for refurbishment and re-use. If not re-used, they will be salvaged or disposed of at an approved solid waste management facility. All oils, lubricants, and hazardous materials will be collected and disposed of at a licensed facility.

2.5 ELECTRICAL CABLING AND CONDUITS

The Project's underground electrical collection system will be placed at a depth of three feet (36 inches) or greater. Cabling that is above a depth of three feet will be removed and salvaged, while cable greater than three feet in depth will be abandoned in place. The system will not interfere with future farming activities because of the depth. If, at the time of decommissioning, the salvage value of the underground cable exceeds the cost of extraction and restoration, the cables may be removed and salvaged.

2.6 PROJECT SUBSTATION

Vinton Solar will include a Project substation as shown on the attached figures. The substation footprint will be approximately 150 feet by 150 feet and will contain within its perimeter, a gravel pad, power transformer and footings, electrical control house and concrete foundations, as needed. The substation transformer may be sold for re-use or salvage. Components of the substation that cannot be salvaged will be transported off-site for disposal at an approved waste management facility. The substation will service Vinton Solar and although it may be retained at the end of the Project life, an estimated decommissioning cost has been included in this Plan.

2.7 PERIMETER FENCING, SITE ACCESS AND INTERNAL ROADS

The Vinton Solar site will include a chain-link security fence around the perimeter of the site. Township Highway 23 intersects the Project and internal roads will be located within the array to allow access to the equipment. The internal access roads will be approximately 16 feet wide and total approximately 41,800 linear feet (7.92 miles). The internal access road length may change with final Project design. To be conservative, the decommissioning estimate assumes that all internal roads will be completely removed.

During installation of the Project site access road, subgrade conditions may be stabilized by either the placement of Geogrid reinforced granular fills over soft ground; chemical stabilization, or cement stabilization. This Plan assumes the installation of Geogrid and fill of up to 8 inches of granular materials (No. 2 stone), followed by compacted granular backfill during the initial site construction. The estimated quantity of these materials is provided in Table 2. A typical access road cross-section is shown in Figure 3.

Table 2 Typical Access Road Construction Materials

Item	Quantity	Unit
Geogrid	74,311	Square Yards
No. 2 stone, 8" thick	16,513	Cubic Yards
Compacted granular backfill, 4" thick	8,257	Cubic Yards

Decommissioning activities include the removal and stockpiling of aggregate materials onsite for salvage preparation. It is conservatively assumed that all Geogrid and aggregate materials will be removed from the Project site and hauled up to five miles from the Project area. Following removal of aggregate and Geogrid, the access road areas will be graded, de-compacted with deep ripper or chisel plow (ripped to 18 inches), back-filled with native subsoil and topsoil, as needed, and land contours restored as near as practicable to preconstruction conditions.

3.0 LAND USE AND ENVIRONMENT

3.1 SOILS AND PRIME FARMLAND

The proposed solar facility is predominantly located on land currently utilized for agricultural purposes. The Project area lays within remnants of glacially produced lakes that have long since drained, with the old lake beds still evident. The Project area consists of level to rolling broad flats that lie several tens of feet above the current lowlands. The geology results in well-drained, very deep silty clay loam soils, more than 60 inches in depth. The Project area lies within the Raccoon Creek watershed and natural drainage occurs via intermittent waterways that flow generally southeast towards Racoon Creek and to a lesser degree west towards Elk Fork.

Soils within the proposed Project area predominantly include: Bethesda silty clay loam (BhB), 0-8 percent slopes; Bethesda silty clay loam (BhC), 8-20 Percent slopes; and Wharton-Latham silt loam (WhL1E1) 25 to 40 percent slopes. In general, the Project area and the land surrounding it are well drained by a system of natural drainage features. Less than 1% of the Project area is considered prime farmland (if drained and protected from flooding); no soils within the perimeter fence and/or utilized for the solar array are considered prime farmland.

Areas of the Project that were previously utilized for agricultural purposes will be restored to their preconstruction condition and land use. Topsoil reserved during construction and stored in long-term berms will be used if available, and supplemented with comparable soils. Restored areas will be revegetated in consultation with the current landowner and in compliance with regulations in place at the time of decommissioning.

3.2 RESTORATION AND REVEGETATION

Project sites that have been excavated and back-filled will be graded as previously described to restore land contours as near as practicable to preconstruction conditions. Topsoil will be placed on disturbed areas and seeded with appropriate vegetation to reintegrate it with the surrounding environment. Soils compacted during de-construction activities will be de-compacted, as necessary, to restore the land to pre-construction land use. Work will be completed to comply with the conditions agreed upon by Vinton Solar and the OPSB or as directed by regulations in affect at the time of decommissioning.

3.3 SURFACE WATER DRAINAGE AND CONTROL

As previously described, the proposed Project facilities are predominantly located in non-forested upland areas. The terrain consists of level to rolling broad flats that lie several tens of feet above the lowlands. The area drains to intermittent waterways and wetlands. The Project facilities are being sited to avoid wetlands, waterways, and drainage ditches (Figure 4) to the extent practicable. The existing Project site conditions and proposed BMPs to protect surface water features are described in a Stormwater Pollution Prevention Plan (SWP3) currently being prepared for the Project construction activities.

Surface water conditions at the Project site will be reassessed prior to the decommissioning phase. Vinton Solar will obtain the required water quality permits from the Ohio Environmental Protection Agency (OEPA) and the U.S. Army Corp of Engineers (USACE), if needed, before decommissioning of the Project. Construction storm water permits will also be obtained and a SWP3 prepared describing the protection needed to reflect conditions present at the time of decommissioning. BMPs may include: construction entrances, temporary seeding, permanent seeding, mulching (in non-agricultural areas), erosion control matting, silt fence, filter berms, and filter socks.

3.4 MAJOR EQUIPMENT REQUIRED FOR DECOMMISSIONING

The activities involved in decommissioning the Project include removal of the above ground components of the Project: solar modules, fixed tilt racking, foundations and piles (to a depth of four feet below the surface), inverters, transformers, access roads, and electrical cabling and conduits (to a depth of four feet below the surface). Restoration activities include back-filling of pile and foundation sites; de-compaction of subsoils; grading of surfaces to pre-construction land contours and revegetation of the disturbed areas.

Equipment required for the decommissioning activities is similar to what is needed to construct the solar facility and may include, but is not limited to: small cranes, low ground pressure (LGP) track mounted excavators, backhoes, LGP track bulldozers, LGP off-road end-dump trucks, front-end loaders, deep rippers, water trucks, disc plows and tractors to restore subgrade conditions, and ancillary equipment. Over-the-road dump trucks will be required to transport material removed from the site to disposal facilities.

4.0 Decommissioning Cost Estimate Summary

Expenses associated with decommissioning the Project will be dependent on labor costs at the time of decommissioning. For the purposes of this report approximate late 2016 to early-2017 average market values were used to estimate labor expenses. Fluctuation and inflation of the labor costs were not factored into the estimates.

4.1 DECOMMISSIONING EXPENSES

Project decommissioning will incur costs associated with the backfilling, grading, and restoration of the proposed Project site as described in Section 2. Table 3 summarizes the estimates for activities associated with the major components of the Project.

Table 3 Estimated Decommissioning Expenses – 125 MW Solar Array

Activity	Unit	Number	Cost per Unit	Total
Overhead and management (includes estimated permitting required)	Lump Sum		$125,000.00	$125,000
Solar modules; disassembly and removal	Each	504,000	$1.25	$630,000
Racking and support system disassembly and removal	Linear Feet	850,000	$2.50	$2,125,000
Steel pile/post removal	Each	104,340	3.00	$131,020
Transformers and inverters	Each	40/ea	$950.00/set	$38,000
Concrete foundation removal	Lump Sum		$18,000	$18,000
Access road excavation and removal	Lump Sum		$87,500	$87,500
Substation removal	Lump Sum	1	$50,000	$50,000
Perimeter fence removal	Linear Feet	67,930	$2.25	$152,843
Topsoil replacement and rehabilitation of site	Lump Sum		$115,000	$115,000
Total estimated decommissioning cost				**$3,654,363**

4.2 DECOMMISSIONING REVENUES

Revenue from decommissioning the Project will be realized through the sale of the solar facility components and construction materials. Modules and other components may be sold within a secondary market or as salvage. For purposes of this report, no estimated recovery or salvage values were considered, as directed by the OPSB.

4.3 DECOMMISSIONING COST SUMMARY

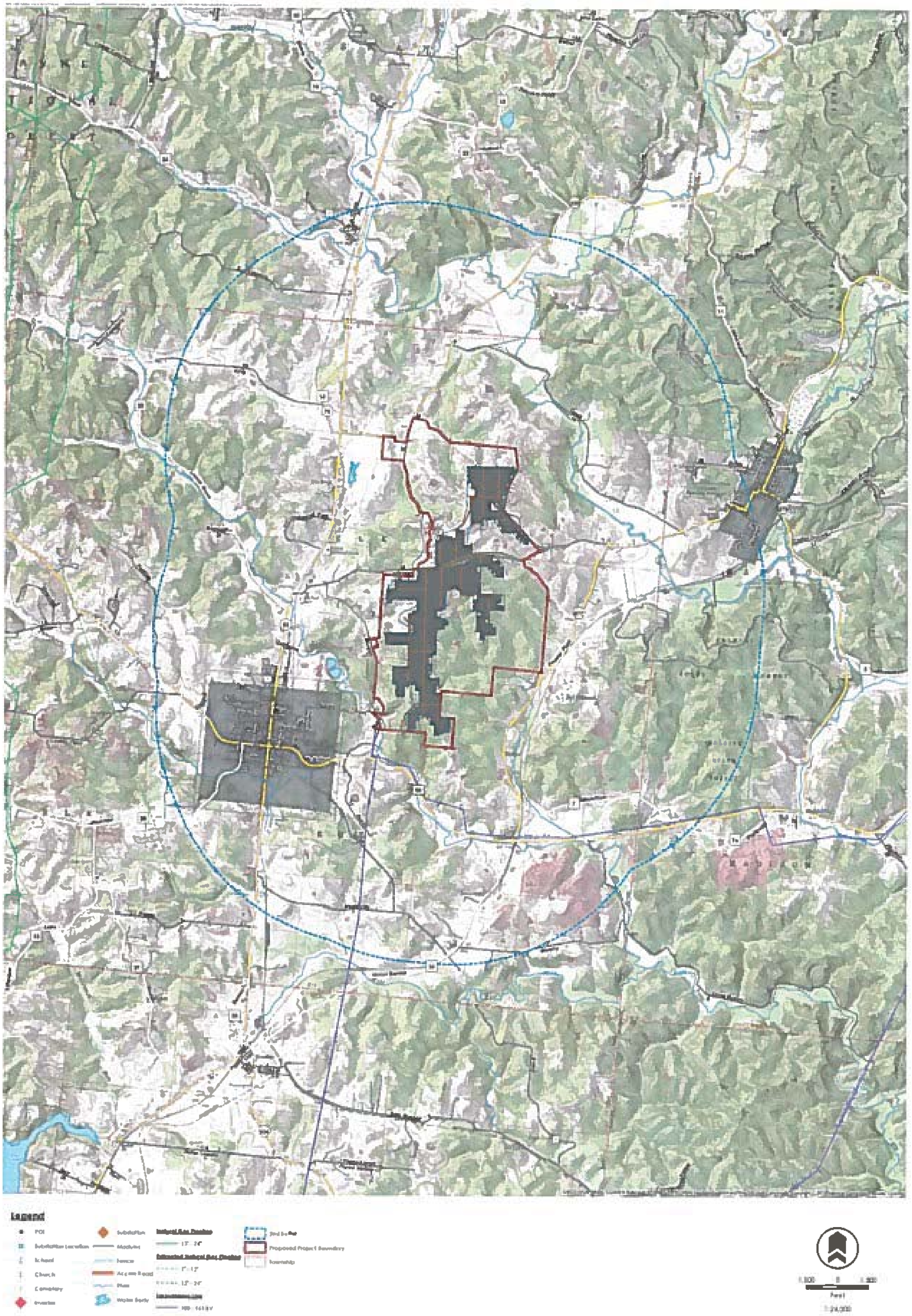
The estimated cost to decommission the Project, using the information detailed in this Plan are based on 2017 prices, with no market fluctuations or inflation considered. The total cost to decommission the Project facilities as described in this Plan is $3,654,363. This cost does not include the expected revenue from the recovery or salvage of facilities.

4.4 FINANCIAL ASSURANCE

Vinton Solar will post decommissioning funds in the form of a performance bond prior to the preconstruction conference to cover the removal cost of the arrays to be constructed.

FIGURES

Figure 1 Project Location and Topography



Project Location and Topography Map

Vinton Solar Energy Center, Vinton County, Ohio

June 13, 2017 Rev. 00

Invenergy

Figure 2 Proposed Project Layout

Legend

- POI
- Inverter
- Substation
- Modules
- Fence
- Access Road
- Airport Runway
- Airport Ground
- Proposed Project Boundary

1,500 0 1,500
Feet
1:24,000

Project Facilities Map

Vinton Solar Energy Center, Vinton County, Ohio

Rev. 00
June 13, 2017

Invenergy

Figure 3 Access Road Detail

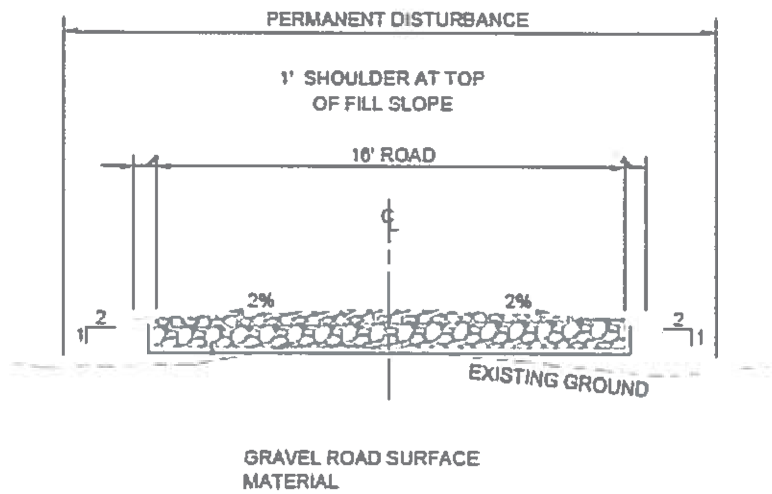


Figure 4 Potential Wetlands and Waterways with Proposed Facility Locations

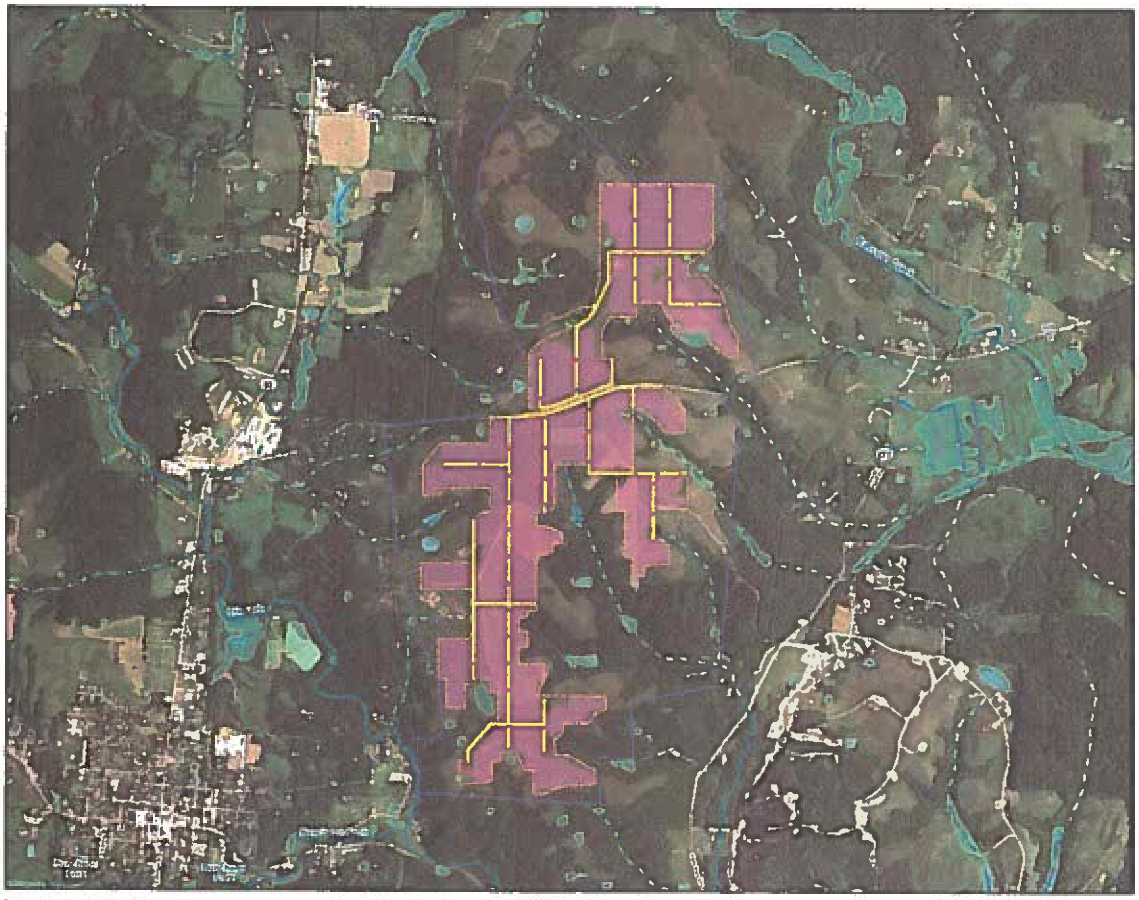


Figure No.
4

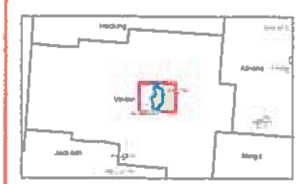
Title
Potential Wetlands and Waterways with Project Facilities

Invenergy, LLC
Vinton Solar Energy Project

0 1,000 2,000 Feet

N

Legend
Project Boundary
Fence Boundary
Substation
Inverter
Racs
National Wetlands Inventory
National Hydrography Dataset
Perennial Stream
Intermittent Stream
Canal Ditch
Lake/Pond



Notes
1. Coordinate System: NAD 1983 StatePlane Ohio South FIPS 3402 Feet
2. Data Sources Include: Stantec, Invenergy, NAIP, USFWS, USGS
3. Orthophotography: 2015 NAIP

Stantec

Vinton Solar Energy LLC
Case No. 17-774-EL-BGN
Supplement to Application
August 15, 2017

Attachment 2

Noise Analysis

by Hankard Environmental, Inc.
August 7, 2017

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Attorneys for Vinton Solar Energy LLC

Pre-Construction Noise Analysis

for the proposed

Vinton Solar Energy Center

August 7, 2017

Prepared for:

Vinton Solar Energy LLC
Chicago, Illinois

Prepared by:

Hankard Environmental, Inc.
Verona, Wisconsin

HANKARD ENVIRONMENTAL
ACOUSTICS AND VIBRATION CONSULTING

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Executive Summary

This report describes the results of an analysis of the noise levels that will be generated from the construction and operation of the Vinton Solar Energy Center (Project). The Project is proposed to be located in Vinton County, Ohio, near McArthur. The Project is expected take 12 to 18 months to construct. Once operational it will generate 125 megawatts of electrical power. Noise will be generated by the Project during construction from typical equipment such as bulldozers, excavators, pile drivers, cranes, etc. The primary sources of noise from the operation of the Project include multiple inverters and one transformer.

Noise emissions from the Project are subject to the provisions of the Ohio Administrative Code, Chapter 4906-4. The Code requires the Project to (1) measure existing ambient (background) noise levels prior to construction, and (2) predict noise levels from the construction and operation of the Project at sensitive receptor locations. Furthermore, the Project is required to compare operational noise levels to a standard consisting of the ambient noise level plus five decibels. This standard is applied at noise sensitive receptors (i.e.: residences, schools, churches, etc.) located within one mile of the Project.

Ambient noise levels were measured in the summer of 2017 at six locations surrounding the Project. Average daytime and nighttime noise levels were calculated from the measured data, and are 43 and 39 dBA, respectively. This results in daytime and nighttime noise level standards of 48 and 44 dBA, respectively (ambient plus 5 dB). A mathematical model of noise levels from the construction and operation of the Project was generated and utilized to predict worst-case (loudest) noise levels at each of the approximately 200 residences located within approximately one mile of the Project. Noise levels were also predicted at the six noise measurement locations, and at several locations along the Project property boundary.

During construction, the loudest noise levels expected at the nearest residences to each construction area range from about 35 to 55 dBA. These levels assume that all of the equipment associated with any given phase of construction is operating close to the Project boundary in the direction of the nearest residences. Noise levels during pile driving, which will occur for up to ten months, are slightly louder (61 dBA). Much of the time construction noise levels will be less than these ranges, and at many times it will be inaudible. These levels of noise are consistent with most regulatory limits and health guidelines, particularly for construction noise that will only occur during the daytime and will occur only for the 12 to 18-month construction of the Project.

The primary noise sources of noise from the operation of the Project are the 45 inverters located throughout the site and one transformer located on the south end of the Project. As expected, the predicted noise levels are very low. The loudest operational noise level, 34 dBA, is predicted at a single residence on the east side of the Project just south of Infirmary Road. About 10% of the residences have noise levels in the low 30's (dBA), while 90% have levels in the 20's (dBA) or lower. These are lower than the measured existing nighttime noise levels of 34 dBA to 41 dBA. Therefore, noise levels from the operation of the Project are not only expected to be well below both the daytime and nighttime standards of the ambient plus 5 dB, but less than the existing ambient levels themselves and likely inaudible at most residential locations.

1. Introduction

This report describes the results of a pre-construction noise analysis conducted by Hankard Environmental for the proposed Vinton Solar Energy Center (Project). The proposed Project is a photovoltaic solar electric generation facility located in Vinton County, Ohio. The Project is located about 55 miles southeast of Columbus, Ohio, as shown in Figure 1-1. The solar facility has a maximum generating capacity of 125 megawatts (MW) and will connect to the adjacent Elk Substation. The Project is located on the site of a former open-pit coal mine that has been revegetated.

The noise analysis demonstrates that the Project satisfies the requirements of Chapter 4906-4 of the Ohio Administrative Code, *Certificate Applications for Electric Generation Facilities.* Section 4906-4-08(3)(a) requires the Project to provide a study of pre-construction (existing) noise levels, a description of construction and operational noise levels at the nearest property boundary and at all noise-sensitive receptors located within approximately one mile of the Project property boundary, and the measures that will be taken by the Project to mitigate noise emissions.

The following sections of this report describe the noise regulation applicable to the Project, the Project site and the location of noise sensitive receptors, the results of the pre-construction ambient noise study, the methods and data used to predict construction and operation noise emissions, the predicted construction and operational noise levels and their associated mitigative measures to be employed.

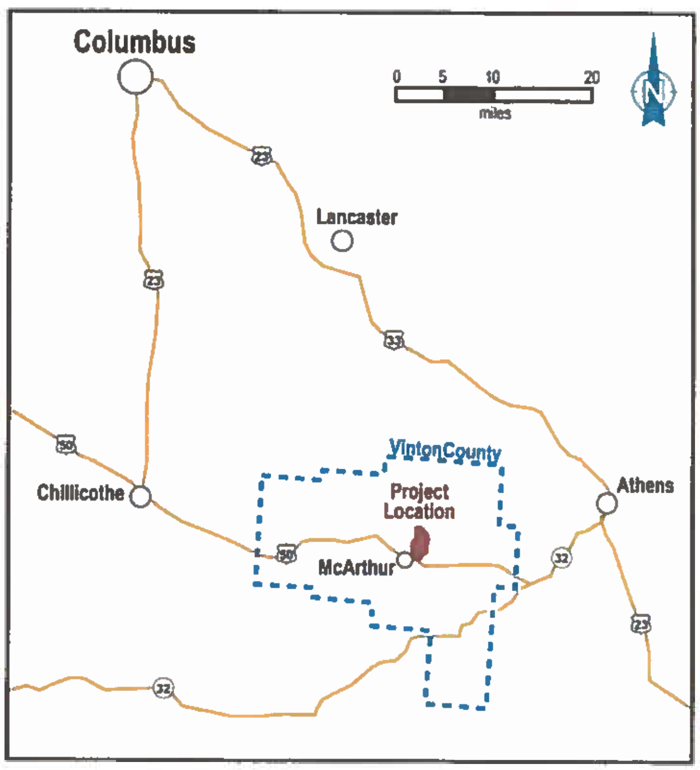

Figure 1-1. General Location of the Proposed Vinton Solar Energy Center

2. Applicable Regulation

Chapter 4906-4 of the Ohio Administrative Code, *Certificate Applications for Electric Generation Facilities,* sets forth the rules governing standard certificate applications for electric generation facilities. Section 4906-4-08, *Health and Safety, Land Use and Ecological Information,* describes the noise information required as part of a certificate application. Specifically, paragraph (A) requires:

(3) The applicant shall provide information on noise from the construction and operation of the facility.

(a) Describe the construction noise levels expected at the nearest property boundary. The description shall address:
(i) Blasting activities.
(ii) Operation of earth moving equipment.
(iii) Driving of piles, rock breaking or hammering, and horizontal directional drilling.
(iv) Erection of structures.
(v) Truck traffic.
(vi) Installation of equipment.

(b) Describe the operational noise levels expected at the nearest property boundary. The description shall address:
(i) Operational noise from generation equipment. In addition, for a wind facility, cumulative operational noise levels at the property boundary for each non-participating property adjacent to or within the project area, under both day and nighttime operations. The applicant shall use generally accepted computer modeling software (developed for wind turbine noise measurement) or similar wind turbine noise methodology, including consideration of broadband, tonal, and low-frequency noise levels.
(ii) Processing equipment.
(iii) Associated road traffic

(c) Indicate the location of any noise-sensitive areas within one mile of the proposed facility, and the operational noise level at each habitable residence, school, church, and other noise-sensitive receptors, under both day and nighttime operations.

(d) Describe equipment and procedures to mitigate the effects of noise emissions from the proposed facility during construction and operation, including limits on the time of day at which construction activities may occur.

(e) Submit a preconstruction background noise study of the project area that includes measurements taken under both day and nighttime conditions.

3. Project Site

The Project is located in Vinton County near McArthur, Ohio on land that was previously an open-pit coal mine, but has since been revegetated and is being used as ranch land today. Figure 3-1 shows the Project site, including the location of the solar panels, inverters (the primary noise source), existing and proposed electrical substations, and the Project property boundary. Figure 3-1 also shows the location of all noise-sensitive areas within approximately one mile of the Project. All noise-sensitive areas are believed to be residences, as no schools, churches, parks, etc. were identified. The immediately surrounding land use is a mix of rural residential areas, forested areas, saw mills, and the Austin Powder industrial facility.

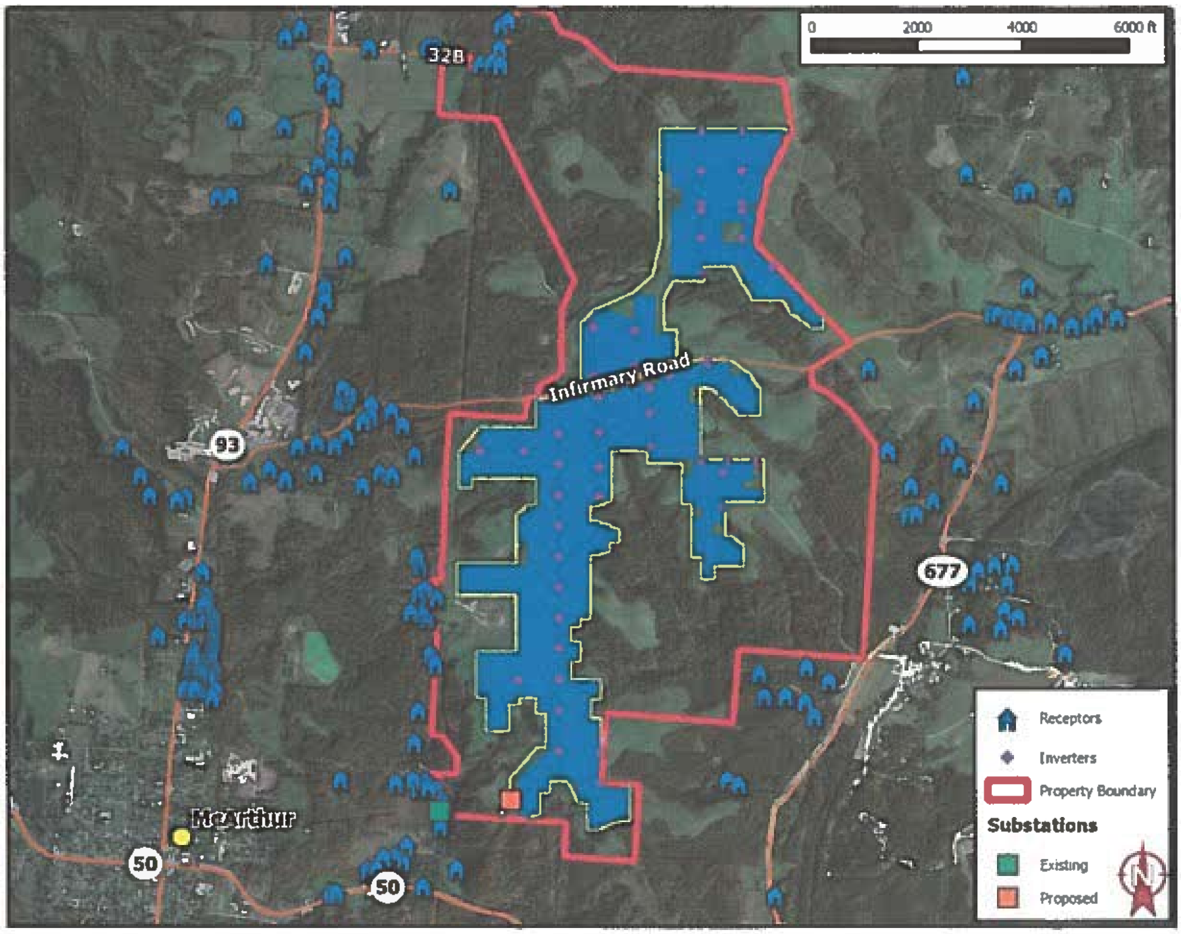

Figure 3-1. Proposed Vinton Solar Energy Center Layout

4. Pre-Construction Background Noise Study

A background (ambient) noise level survey was conducted in June 2017 to document existing noise levels in and around the Project area. A combination of short-term attended measurements and long-term unattended measurements were taken over a two-week period. The following describes the noise measurement methods, equipment, locations, and results.

Measurement Methods

Ambient noise levels were measured and analyzed according to applicable portions of American National Standards Institute (ANSI) standard S12.9-2013/Part 3 *Quantities and Procedures for Description and Measurement of Environmental Sound – Part 3: Short-term Measurements with an Observer Present*, as well as ANSI S12.18-1994(R2009) *Procedures for Outdoor Measurement of Sound Pressure Level*. Noise levels were measured at six locations surrounding the Project, which were selected to represent the nearest residences in different directions. Short-term (20 minute) attended measurements were conducted at each location on two different nights and one day between June 12 and 14, 2017. The sound level meter was set to log, in one-minute intervals, the L_{eq}, L_{50}, L_{90}, L_{max}, and L_{min} overall (dBA) levels, as well as the one-third octave band L_{eq} values. During the nighttime attended measurements, occasionally a single car or truck pass-by would substantially influence the measured L_{eq}. These times were noted and those intervals were removed from the analysis. Generally, this only affected one to four minutes per measurement, and the total measurement period was extended such that 20 minutes of valid data were collected. This was not done during the daytime attended measurements when traffic was more constant and audible. Wind conditions during the attended measurements were measured using a hand-held anemometer. A week-long unattended measurement was conducted at M6 from June 16 to 23, 2017. Measurements included the same metrics as described above. Weather conditions during these measurements were obtained online from a National Weather Service station located near Albany, Ohio (www.wunderground.com, Station ID: KUNI), which was used to eliminate noise measurement data during periods of high winds or precipitation.

Equipment

Larson Davis LxT sound level meters (serial numbers 4616 and 4617) were used, and both conform to Type 1 specifications for sound level measurement systems as defined in ANSI S1.4-1983(R2006), *American National Standard Specification for Sound Level Meters*. Both meters were calibrated in the field using a handheld calibrator (Larson Davis CAL200 speakerphone calibrator, serial number 9194) before and after the measurement survey. The drift in the measured noise level was minimal (-0.2 to +0.2 dB over the measurement period) and within accepted limits (±0.5 dB per ANSI S12.9). In addition, all equipment was certified by a traceable laboratory within the past 18 months. Laboratory calibration records and certificates are available upon request. At each measurement location, the microphone was mounted on a tripod and positioned five feet above the ground (per ANSI S12.9), in an open area, and at least 25 feet away from acoustically reflective surfaces. The microphones were covered with hydrophobically treated seven-inch-diameter 80 pores-per-inch density windscreens (ACO Pacific model WS7-80T). During the attended measurements, a handheld Kestrel Model 3000 was used to note ground wind speed, wind direction, temperature and relative humidity.

Measurement Locations

The purpose of the measurements was to obtain a representative sample of pre-construction noise levels in and around the Project area. Hankard Environmental staff chose the specific locations based on standard industry procedures, analysis requirements, aerial photograph surveys, accessibility, and an in-person site visit. Measurement locations M1 through M6 are shown in Figure 4-1. Short-term daytime and nighttime measurements were collected at each location, while unattended week-long measurements were also made at M6.

M1 is located southwest of the Project at the intersection of Pony Road and Morgan Road. Residences are located to the north, west, and east of this location. The primary noise source in this area is traffic on State Highway 50. During the daytime, highway traffic was the primary noise source, with bird and cricket noise in the background. At night, noise from frogs and crickets became more significant, and highway traffic and distant air conditioner noise was noticeable. Local traffic was also audible along Pony Road and Morgan Road immediately adjacent to the noise meter.

M2 is located on the west side of the Project on Infirmary Road near a small public structure. Residences are located to the south and west of this site. During the daytime measurement, crickets, wind through foliage, birds, distant traffic, local traffic, and the distant hum of a saw mill were audible. At night, crickets, frogs, wind through foliage, distant residential air conditioning units, distant traffic, commercial aircraft overflights, and occasional distant dogs barking were audible.

M3 is located northwest of the Project on State Route 328. There are three residences located in the immediate vicinity of M3, and about five more located to the east toward the Project. During the daytime, the main noise sources were birds, distant traffic on State Route 93, wind through the foliage, and occasional local traffic. At night, distant traffic on State Route 93 was generally the main noise source. Also audible were frogs, crickets, and occasionally birds and dogs.

M4 is located northeast of the Project on Infirmary Road. Most of the residences in this area are located east of M4, and one is located about 0.4 miles closer to the Project. During the daytime, noise sources included water flowing in the creek, birds, crickets, wind through the foliage, and traffic on Infirmary Road. At night, frogs and crickets became more significant, along with distant traffic and distant air conditioners.

M5 is located southeast of the Project on Powder Plant Road with residences to the south. During the daytime, traffic on Powder Plant Road would dominate at times, but also audible were birds, crickets, distant traffic, and a faint 'hum' from the Austin Powder facility. At night, frogs and crickets were the dominant noise source, but the Austin Powder facility was also audible.

M6 is located within the proposed Project area near the eastern property line, roughly equidistant from M1 and M2. The nearest residences are downhill from this location about 300 feet to 1,000 feet to the west and northwest along Morgan Road. Both short-term and long-term measurements were collected at this location. During the daytime, noise sources included birds, crickets, distant traffic, wind through the foliage, and a hum from a saw mill about one mile to the southwest.

During the nighttime, frogs down the hill became dominant, as well as crickets, traffic (distant and along unpaved Morgan Road), and distant air conditioner hum.

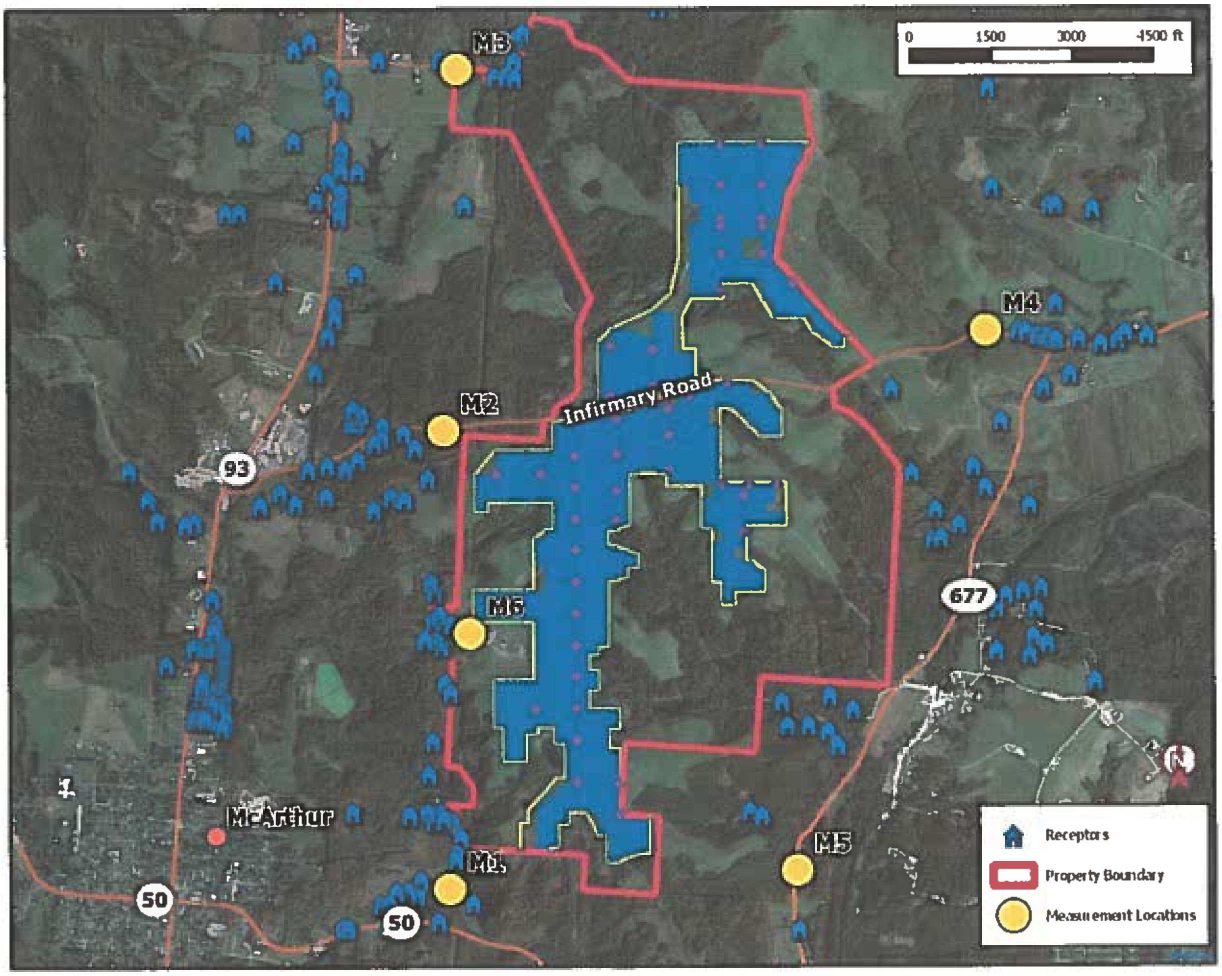

Figure 4-1. Ambient Noise Measurement Locations for the Vinton Solar Energy Center

Attended Noise Measurement Results

Table 4-1 summarizes the attended noise measurement results. Nighttime noise levels generally ranged from 34 to 41 dBA, with one outlier of 50 dBA due to frogs at M4. Nighttime noise sources generally included crickets, frogs, and distant traffic. Daytime noise levels ranged from about 39 to 53 dBA, and were generally influenced by local and distant traffic, crickets, and wind through foliage. Weather conditions consisted of generally very low winds (0 to 3 miles per hour), no precipitation, temperatures ranging from 66 to 78 °F, and relative humidity ranging from 70% to 100%.

Table 4-1. Attended Noise Measurement Summary

Location	Time of Day	Date	Time	$L_{eq\text{-}20min}$ (dBA)	Audible Sounds
M1	Night	6/13/2017	23:52-00:15	40	crickets, frogs, US50 traffic
		6/14/2017	00:25-00:45	41	crickets, frogs, US50 traffic, res. a/c
	Day	6/13/2017	17:38-17:58	47	US50 traffic, birds, crickets
M2	Night	6/12/2017	22:19-22:39	35	crickets, wind thru foliage
		6/13/2017	22:00-22:22	34	crickets, frogs, res. a/c
	Day	6/13/2017	16:09-16:29	42	crickets, birds, wind thru foliage, saw mill
M3	Night	6/13/2017	00:30-00:50	37	distant traffic, crickets, birds
		6/14/2017	01:00-01:20	35	frogs, distant traffic, birds
	Day	6/13/2017	18:08-18:28	45	birds, distant & local traffic, wind thru foliage
M4	Night	6/12/2017	22:49-23:10	37	crickets, frogs, distant traffic, res. a/c
		6/13/2017	23:15-23:39	50	frogs (loud), crickets
	Day	6/13/2017	16:37-16:57	50	birds, crickets, water in creek
M5	Night	6/12/2017	23:22-23:44	35	crickets, distant traffic, powder plant hum
		6/13/2017	23:50-00:13	35	frogs, crickets, powder plant hum
	Day	6/13/2017	17:09-17:29	53	birds, crickets, distant and local traffic
M6	Night	no data*	no data*	no data*	no data*
		6/13/2017	22:37-22:57	37	frogs, crickets, distant traffic, res. a/c
	Day	6/13/2017	15:35-15:55	39	birds, crickets, distant traffic, saw mill, wind

* access to measurement site granted on 6/13

Unattended Noise Measurement Results

Unattended noise level measurements were conducted at M6 from June 16 to June 23, 2017. A plot of the measured noise levels is shown in Figure 4-2, with the periods of high winds (> 7 mph) and/or precipitation identified and removed from the dataset. These invalid periods accounted for 28% of the total measurement time, with a majority of this invalid data occurring during two consecutive days (June 18 at 8:00 am through June 20 at 8:00 am). Nighttime levels are generally in the 30s (dBA) and daytime levels are generally in the 40s (dBA), with occasional spikes above 50 dBA due to traffic.

The $L_{eq\text{-}1min}$ data from the week-long unattended noise monitor at M6 was used to calculate the average daytime (7:00 a.m. to 7:00 p.m.) and average nighttime (7:00 p.m. to 7:00 a.m.) ambient noise levels for the site. After removing all weather-affected data, mainly consisting of the one 48-hour period during when there was significant rain and wind, the average L_{eq} was calculated for the remaining days and nights, which were then averaged together to determine the overall average. The resulting daytime L_{eq} is 43 dBA, and the resulting nighttime L_{eq} is 39 dBA. The overall 24-hour L_{eq} is 41 dBA.

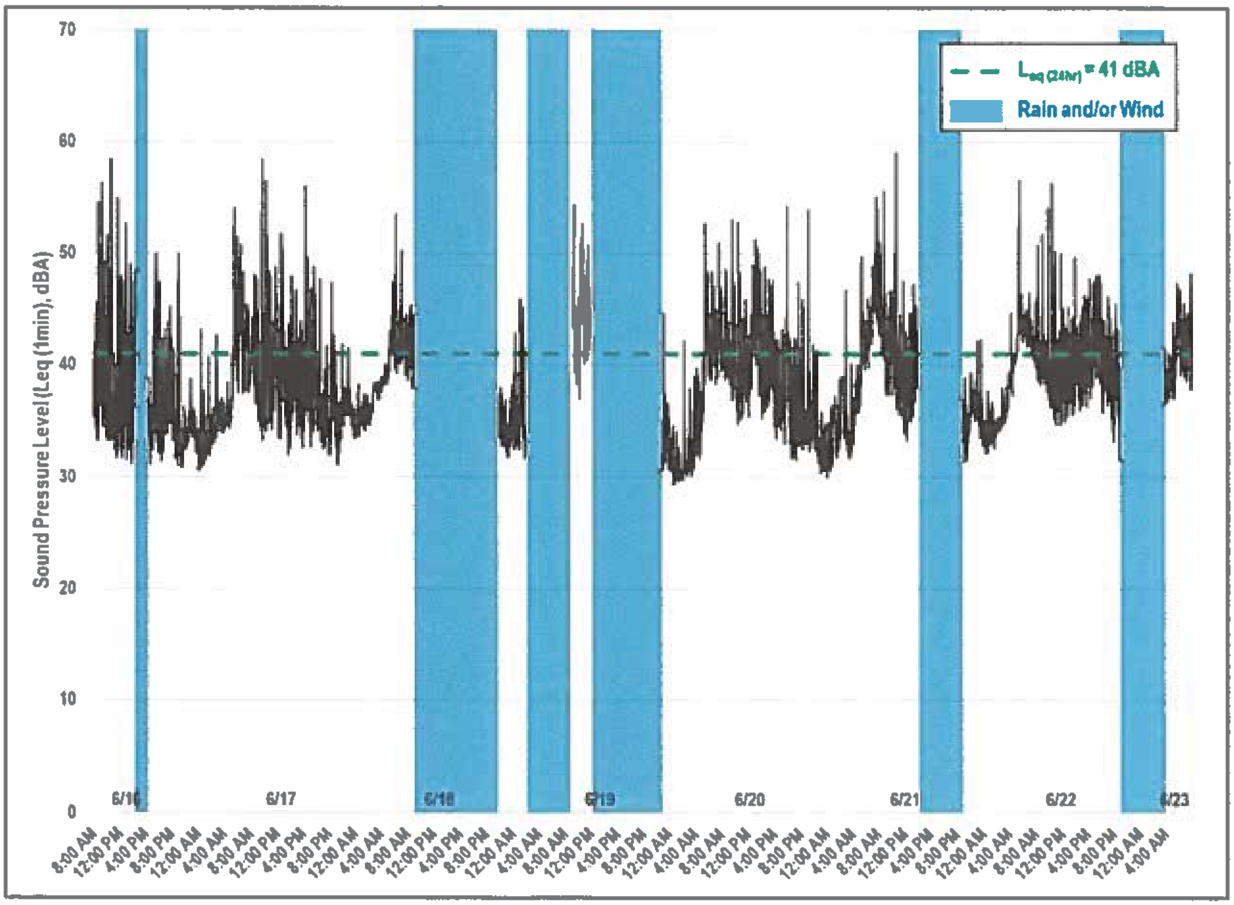

Figure 4-2. Unattended Measured Noise Levels at M6

5. Noise Modeling Method

Noise levels from the proposed Vinton Solar Project were predicted using the International Organization for Standardization (ISO) Standard 9613-2, *Attenuation of Sound During Propagation Outdoors - Part 2: General method of calculation*. The calculations were implemented using the SoundPLAN v7.4 acoustical modeling software program. There are several parameters in the ISO 9613-2 method, including the location of the noise sources and receivers, noise source spectral characteristics, terrain and ground type, and atmospheric propagation conditions. The ISO method assumes optimal acoustic propagation in all directions, specifically that a "well-developed, moderate ground-based temperature inversion" is present or, equivalently, that all receptors are downwind of all noise sources at all times. The sections below describe the specific ISO 9613-2 settings used in this analysis to predict the noise levels from the four phases of construction noise and the one operational phase.

Terrain and Ground Effect

The terrain for this model uses Digital Elevation Model (DEM) data from the U.S. Geological Survey (USGS) National Elevation Dataset. The acoustical effect of the ground material was modeled using the ISO 9613-2 General Method. This method requires the selection of ground factors for the ground near the source, near the receiver, and in between. A ground factor of 0.0 represents a completely reflective surface such as pavement, which would result in a higher level of sound reaching a receiver. A ground factor of 1.0 represents absorptive ground such as thick grass or fresh snow, resulting in a lower level of sound reaching the receiver. For this Project, a ground factor of 0.5 was used. Actual ground conditions could, at rare times, be 0.0 when the ground is completely frozen and bare, but would generally be closer to 0.5 when the ground is covered with vegetation or is bare and unfrozen.

Atmospheric Conditions

The air temperature, relative humidity, and atmospheric pressure were set to standard day conditions of 10°C, 70%, and 1 atmosphere, respectively. Per ISO 9613-2, these values result in the least amount of atmospheric sound absorption and the highest levels of sound reaching the receivers.

Receptors

In the SoundPLAN model, prediction points were located along the Project Boundary, as well as at sensitive receivers within approximately one mile of the Project Boundary. All the noise sensitive receivers are believed to be residences, and no churches, schools or other sensitive receptors were identified. In accordance with ISO 9613-2, the height above the ground for each receiver was set to 5 feet. Prediction locations are shown in Figures 5-1 through 5-3.

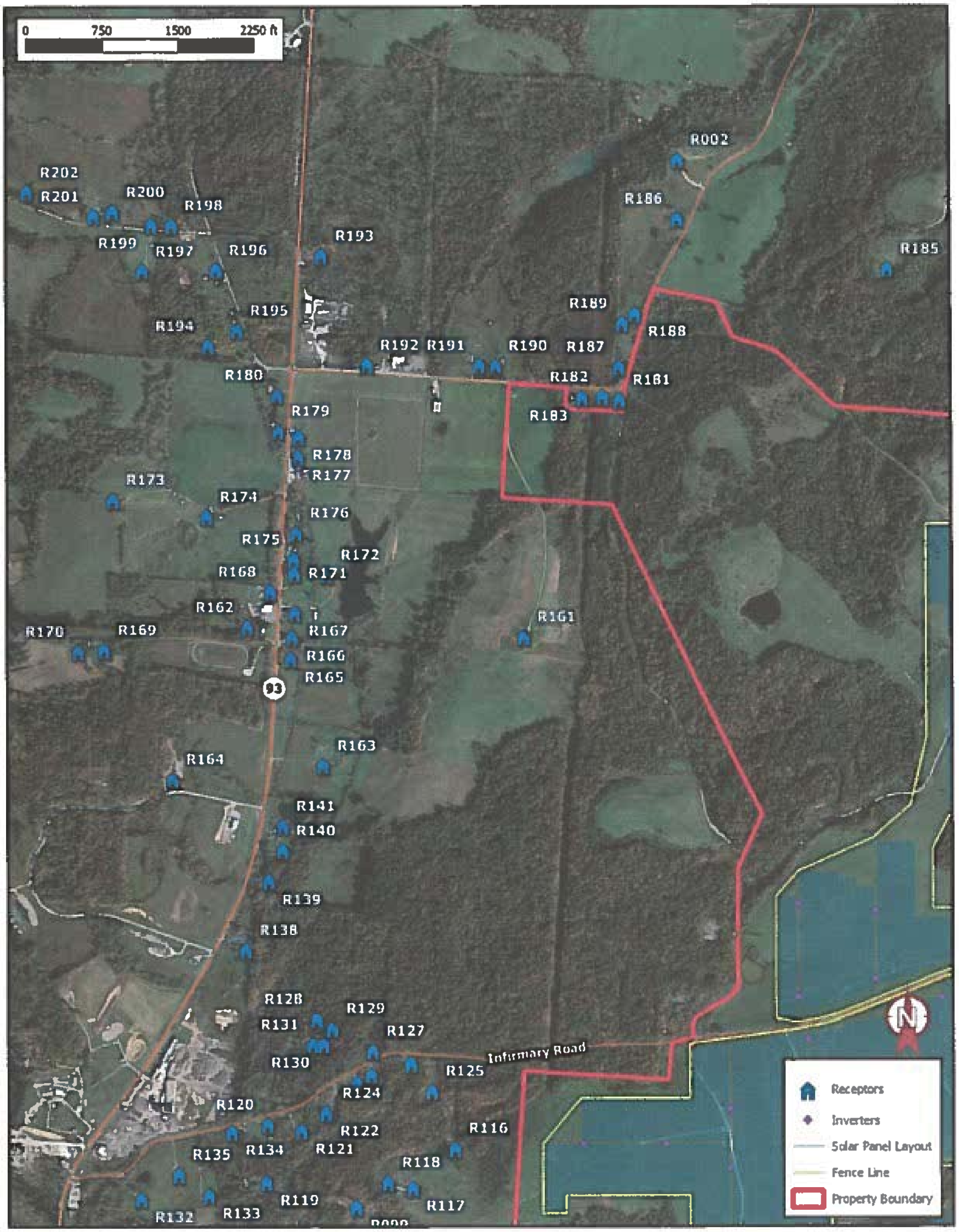

Figure 5-1. Vinton Solar Noise Analysis Layout – Northeast

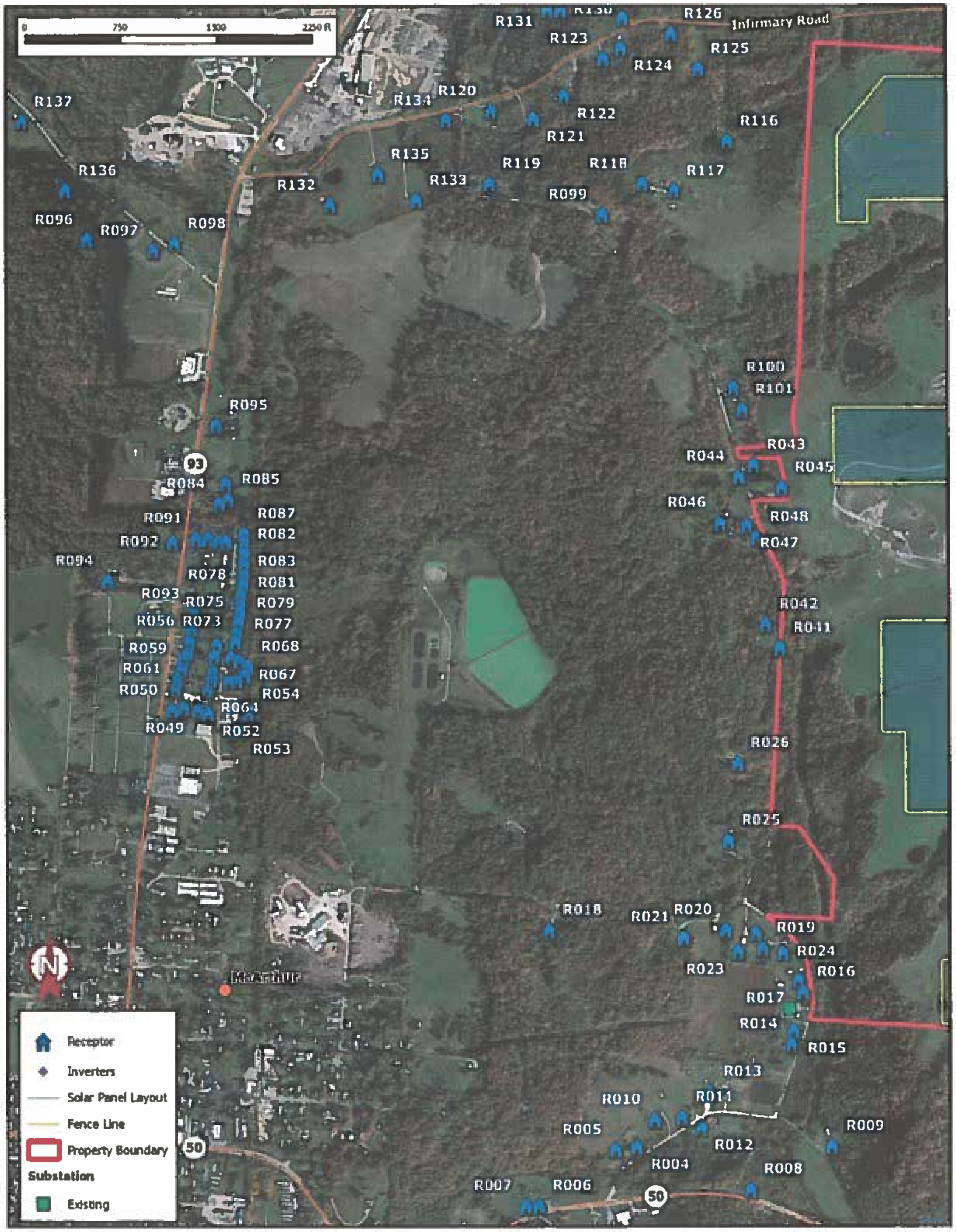

Figure 5-2. Vinton Solar Noise Analysis Layout – Southeast

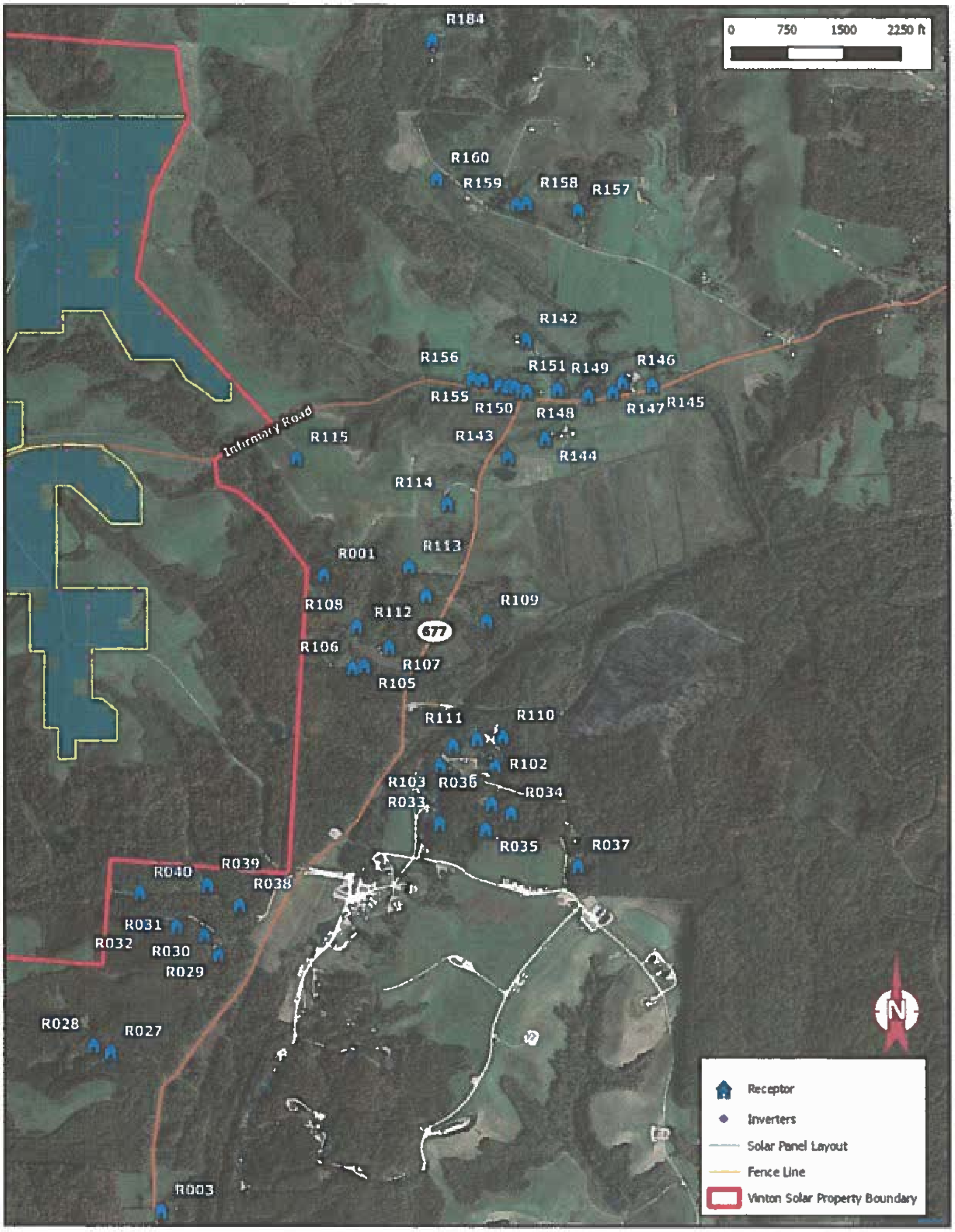

Figure 5-3. Vinton Solar Noise Analysis Layout – West

Construction Noise Sources

Noise levels were predicted for the four phases of construction: site preparation, civil work, mechanical assembly, and electrical work. Table 5-1 lists the equipment associated with each phase, as well as the numbers of units to be employed, the sound power level of each, and the percent of time that each piece of equipment is expected to be used at full capacity. Construction noise source levels were generally based on measurements of construction equipment taken by Hankard Environmental on previous projects. The usage factors were taken from the Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM) v1.1. All construction noise sources were modeled at 10 feet above the ground.

Table 5-1. Sound Power Levels of Construction Equipment

Phase	Equipment (quantity)	Usage (%)	Octave Band Sound Power Level (dB)									Overall Sound Power Level (dBA)
			31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	
1 Site Preparation	Bulldozer (1)	40%	116	111	116	116	105	107	104	95	85	112
	Excavator (2)	40%	103	112	112	107	99	97	95	92	85	104
	Motograder (2)	40%	100	99	110	104	101	110	103	94	89	112
	Water Truck (1)	40%	103	107	112	103	106	104	98	94	85	108
	Dump Truck (1)	40%	98	112	105	103	97	98	96	90	82	103
2 Civil Work	Roller (1)	40%	--	138	128	115	101	98	97	94	90	116
	Dump Truck (1)	40%	98	112	105	103	97	98	96	90	82	103
	Excavator (2)	40%	103	112	112	107	99	97	95	92	85	104
	Trenchers (1)	50%	109	114	114	108	105	102	101	95	87	108
	Motograder (2)	40%	100	99	110	104	101	110	103	94	89	112
	Water Truck (1)	40%	103	107	112	103	106	104	98	94	85	108
3 Mechanical Assembly	Pile Driving (1)	20%	128	130	132	121	125	126	124	119	111	130
	Pickup Trucks (2)	40%	100	114	107	105	99	101	98	92	84	105
	Man Lift (2)	20%	102	108	101	92	92	93	94	87	81	99
	Crane (1)	16%	—	139	117	104	102	100	96	90	85	114
	Backhoe/Loader (1)	40%	105	102	111	101	99	101	99	96	91	106
4 Electrical Work	Pickup Trucks (2)	40%	100	114	107	105	99	101	98	92	84	105
	Flatbed Truck (1)	40%	100	114	107	105	99	101	98	92	84	105
	Man Lift (1)	20%	102	108	101	92	92	93	94	87	81	99
	Small Generator (1)	50%	103	109.9	107.9	107.9	105	103.9	102.9	102	98	110
	Compressor (1)	40%	106	112.9	110.9	110.9	108	106.9	105.9	105	101	113

Operational Noise Sources

Noise sources associated with the operation of the Project include 45 inverters located throughout the Project and one transformer located at the substation. Table 5-2 lists the sound power levels for each source. The inverter overall sound power level was obtained from the Project team (L_p < 70 dBA at 50 feet), and the octave band levels were obtained from published sources. The transformer (153 MVA) sound power level was estimated using the procedures outlined in NEMA TR 1-1993 and IEEE C57.12.90-1993. Noise emissions from the inverters and the transformer were modeled at 10 feet above the ground.

Table 5-2. Sound Power Levels of Operational Equipment

Equipment (quantity)	Usage (%)	Octave Band Sound Power Level (dB)									Overall Sound Power Level (dBA)
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	
Solar Inverter (45)	100%	--	91	95	101	95	91	85	79	68	97
Transformer (1)	100%	95	101	103	97	98	92	86	82	75	98

6. Predicted Construction Noise Levels

Noise levels from construction of the proposed Vinton Solar Energy Center were predicted along the Project property boundary, as well as at all noise sensitive receivers located within approximately one mile of the Project. Noise levels were predicted for each of the four primary phases of construction. The first phase is site preparation (clearing), which is expected to last approximately nine weeks. The second phase involves grading (thirty weeks), the construction of access roads (thirty weeks), and final site grading and landscaping (four weeks). The third phase is assembly of the solar panels, which involves installing piers, racks, modules, etc., and is expected to last about ten months. The final phase is the electrical work, which consists of connecting all the equipment and is expected to last about eleven months. Some of this work will be conducted concurrently, although in different portions of the site, resulting in an approximate overall schedule of 12 to 18 months.

Construction noise levels were predicted for each of these four construction phases, assuming that activities were occurring at the eight locations near the edges of the Project shown in Figure 6-1. These locations are representative of where construction activities are closest to residences and are considered "worst-case". Noise levels were predicted assuming that all the equipment listed in Table 5-1 is was operating at each of the eight locations. Noise levels were predicted at the nearest point on the Project boundary to each assessment location, and at the nearest residence to each assessment area.

As shown in Table 6-1, noise levels along the boundary of the Project range from 33 to 79 dBA. These levels are worst-case, as they assume all of the equipment associated with each phase is operating close to the Project boundary. Much of the time noise levels will be far lower or even inaudible when (1) some or all the equipment is idling or off, (2) construction takes place further into the interior of the Project, or (3) atmospheric conditions are less conducive to sound propagation than the worst-case condition modeled here.

As shown in Table 6-2, noise levels predicted at the nearest residences to each construction area range from 33 to 54 dBA without pile driving, and 33 to 61 dBA with pile driving. Again, these levels assume that all the equipment for each phase is operating close to the boundary. Much of the time noise levels will be far lower or even inaudible. These levels of noise are consistent with most regulatory limits and health guidelines that are applicable to construction noise which generally takes place during the daytime. Construction noise level predictions at each receptor are provided in Appendix A.

Note that in some cases the predicted levels at the residences are slightly louder than the levels at the Project boundary, despite these locations being further from construction. This is due to the significant terrain in the area such that line of sight to the closer Project property boundary is blocked by the terrain.

In terms of mitigation, the primary measure is to limit construction to daytime only, certainly for loud operations near the Project boundary. Secondly, the contractor should be required to use well-maintained equipment, particularly with respect to mufflers. Finally, a construction noise or general complaint telephone hotline should be established as well.

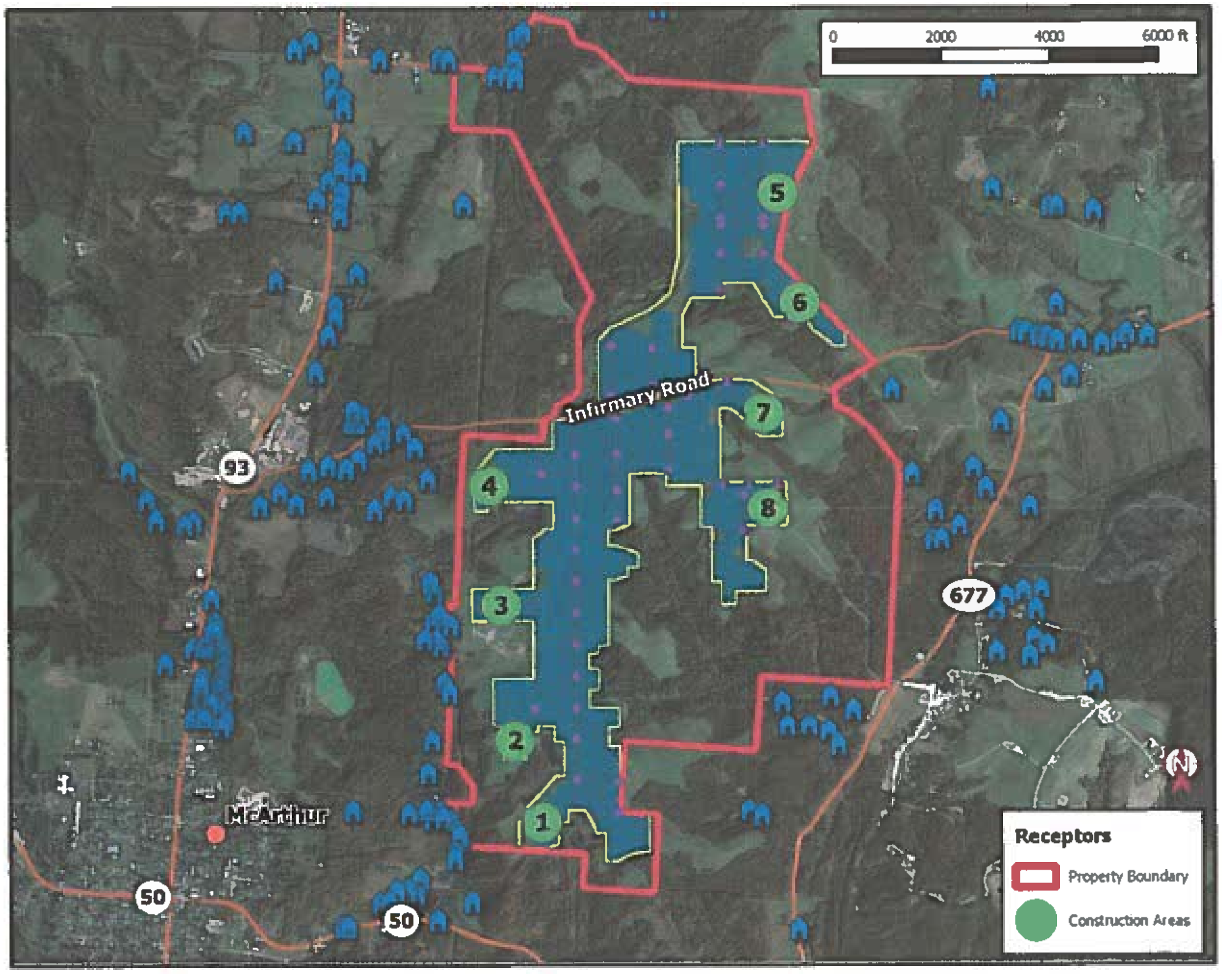

Figure 6-1. Construction Activity Areas for Noise Predictions

Table 6-1. Predicted Worst-Case Construction Noise Levels along Project Boundary

Construction Phase	$L_{eq\text{-}1hr}$ (dBA) Construction Area							
	1	2	3	4	5	6	7	8
1 – Site Preparation	63	50	51	47	64	72	47	37
2 – Civil Work	64	53	53	53	64	67	49	42
3 – Mechanical Assembly (w/o pile driving)	61	46	51	52	61	64	49	37
3 – Mechanical Assembly (w/ pile driving)	74	58	63	59	79	77	60	45
4 – Electrical Work	64	45	48	50	69	66	41	33

Table 6-2. Predicted Worst-Case Construction Noise Levels at Residences

Construction Phase	$L_{eq\text{-}1hr}$ (dBA) Construction Area							
	1	2	3	4	5	6	7	8
1 – Site Preparation	41	51	44	42	36	47	44	39
2 – Civil Work	46	54	47	47	39	48	47	44
3 – Mechanical Assembly (w/o pile driving)	43	48	46	43	34	43	44	38
3 – Mechanical Assembly (w/ pile driving)	53	61	53	51	46	59	54	46
4 – Electrical Work	42	46	38	40	33	47	37	35

7. Predicted Operational Noise Levels

The primary noise sources associated with the operation of the Project include the 45 inverters located throughout the site and the one new transformer located in the southwest corner of the site. The panels are fixed, and thus there is no tracking motor noise. Operational noise levels were predicted along the property boundary and at all sensitive noise receptors located within at least one-mile of the property boundary. A summary of the predicted levels is provided below. Appendix B lists the predicted operational noise levels at each receptor.

Along the property boundary, the predicted noise levels range from 27 dBA to 66 dBA ($L_{eq\,(1\,hr)}$), with an average level of 40 dBA. The highest noise levels occur in locations where an inverter is located within approximately 30 feet of the Project boundary. In these cases, adjacent land use is agricultural and/or undeveloped wooded areas that do not have any noise-sensitive land uses. Overall, 85% of the predicted property boundary noise levels are below 50 dBA.

More importantly, noise levels at the residences nearest to the Project are, as expected, quite low. The loudest predicted $L_{eq\text{-}1hr}$ is 34 dBA, which is a single residence on the east side of the Project just south of Infirmary Road. The next loudest levels (32 dBA) are predicted at the residences located in the southwest portion of the Project area along Morgan Road. Of the levels predicted at 202 residences, only 24 residences (12%) exceed 30 dBA. For comparison, the measured nighttime ambient noise levels around the Project ranges from 34 dBA to 41 dBA (attended) and 39 dBA (unattended). Therefore, noise levels from the Project are expected to be below ambient levels, and likely inaudible at most residential locations.

The Ohio Power Siting Board has historically judged noise levels from a project against the site-wide average daytime and nighttime ambient noise level plus 5 dBA. For this Project, the site-wide average ambient noise levels are 43 dBA (daytime) and 39 dBA (nighttime). Table 7-1 compares the predicted operational noise levels to ambient levels and the ambient level plus 5 dBA standards at each of the locations where attended ambient sound levels were measured. As can be seen, Project noise levels are far lower than both the daytime and nighttime ambient plus 5 dBA standards, lower than all of the measured daytime ambient noise levels, and in almost all cases lower than any of the measured nighttime ambient noise levels.

Operational noise levels are illustrated graphically in Figure 7-1, which shows the predicted operational noise level contours of 44 dBA and 48 dBA. In all areas, predicted operational noise levels at residences are lower than these standards.

In terms of mitigation, the Project should properly maintain the inverters and transformer such that they do not exceed the sound power levels listed in Table 5-2. All maintenance activities should be conducted during daytime hours using well properly muffled vehicles and equipment. Finally, a general complaint telephone hotline should be established as well.

Table 7-1. Comparison of Project and Ambient Noise Levels

Receiver	Operational $L_{eq\text{-}1hr}$ (dBA)	Measured Ambient $L_{eq\text{-}1hr}$ (dBA)		Site-Wide Ambient $L_{eq\text{-}1hr}$ + 5 dBA (dBA)	
		Daytime*	Nighttime**	Daytime*	Nighttime**
M1	30	47	41	48	44
M2	35	42	35	48	44
M3	26	45	36	48	44
M4	29	50	47	48	44
M5	27	53	35	48	44

* Daytime: 7:00 am – 7:00 pm   ** Nighttime: 7:00 pm – 7:00 am

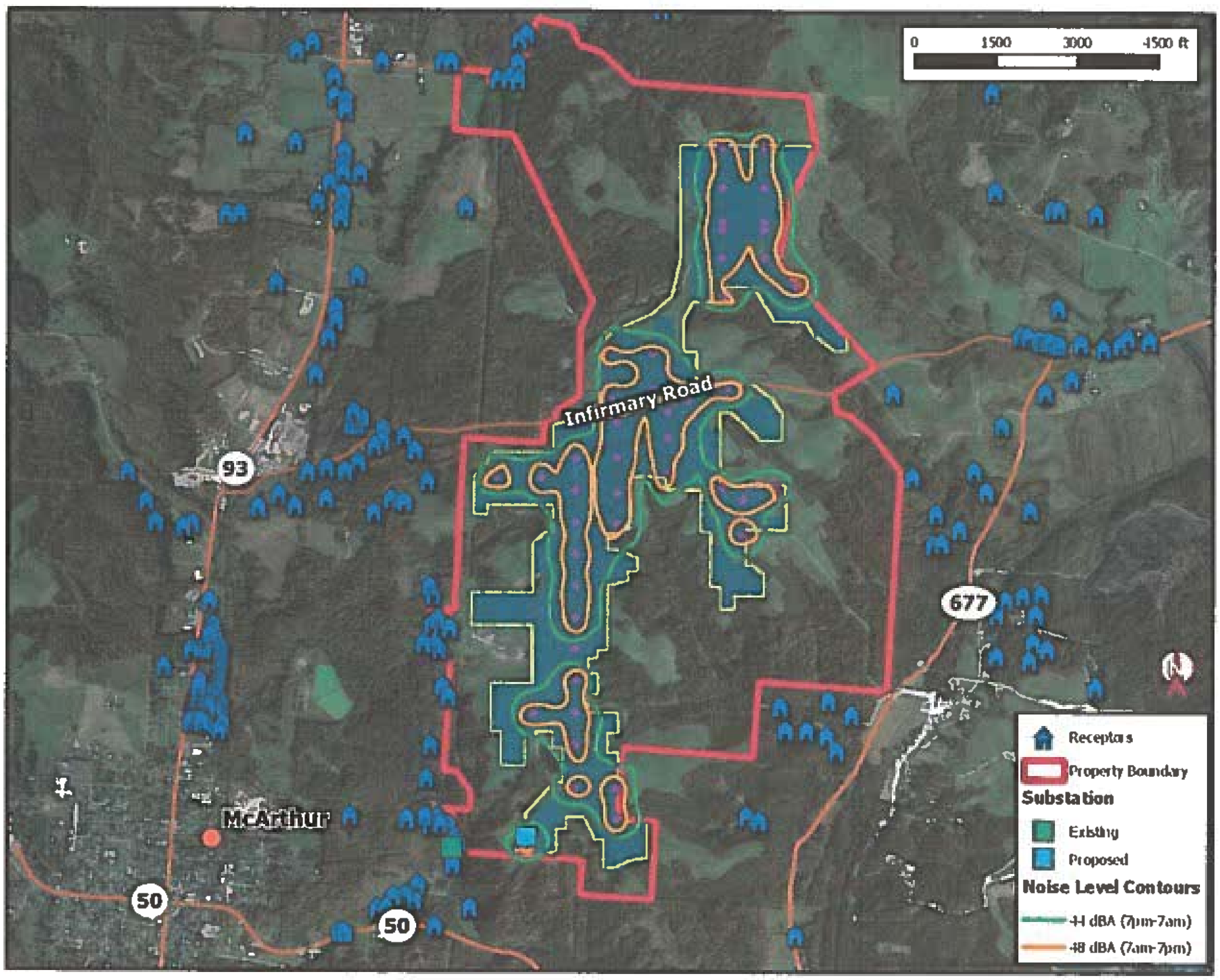

Figure 7-1. Predicted Noise Level Contours for Operation of the Vinton Solar Energy Center

APPENDIX A

Predicted Construction Noise Levels

Table A-1. Predicted Construction Noise Levels

Receiver	Predicted L_{eq} (dBA)				
	Phase 1	Phase 2	Phase 3: Mechanical Assembly		Phase 4
	Site Preparation	Civil Work	No Pile Driving	With Pile Driving	Electrical Work
M1	40	44	41	45	33
M2	44	51	46	56	44
M3	27	34	30	36	25
M4	37	40	36	43	33
M5	30	36	32	38	26
M6	53	56	51	60	45
Property Line (worst case)	72	67	64	79	69
R001	38	43	39	47	36
R002	29	34	30	37	25
R003	28	34	31	35	22
R004	38	42	41	47	36
R005	38	42	41	47	36
R006	35	40	39	45	33
R007	35	40	39	45	33
R008	39	43	39	47	35
R009	35	42	38	43	30
R010	39	43	42	48	37
R011	40	43	43	49	37
R012	39	43	39	49	37
R013	40	44	40	50	38
R014	41	46	43	53	41
R015	41	46	43	52	42
R016	40	45	43	48	39
R017	40	45	42	48	37
R018	40	45	40	49	37
R019	41	45	41	49	38
R020	43	45	41	53	39
R021	42	45	43	52	39
R022	41	45	41	49	38
R023	41	45	41	52	39
R024	40	45	41	49	37
R025	45	47	42	52	40
R026	50	52	48	59	46
R027	33	38	33	38	27
R028	25	35	31	33	23

Receiver	Predicted L_{eq} (dBA)				
	Phase 1	Phase 2	Phase 3: Mechanical Assembly		Phase 4
	Site Preparation	Civil Work	No Pile Driving	With Pile Driving	Electrical Work
R029	32	37	33	41	29
R030	32	38	34	42	29
R031	32	38	33	41	27
R032	30	37	31	38	27
R033	31	36	33	40	28
R034	29	35	31	38	27
R035	33	39	36	43	29
R036	34	40	36	43	29
R037	24	32	28	33	22
R038	27	37	30	35	24
R039	34	39	35	44	30
R040	30	36	32	39	28
R041	51	54	47	59	45
R042	51	52	46	61	45
R043	41	45	44	51	38
R044	41	44	43	51	39
R045	46	50	46	57	42
R046	45	47	44	56	41
R047	47	49	44	58	42
R048	48	50	43	58	42
R049	32	39	33	39	27
R050	31	39	32	39	27
R051	31	39	32	39	27
R052	32	40	33	39	27
R053	31	37	33	40	28
R054	32	36	33	40	28
R055	30	37	32	39	27
R056	30	37	32	39	27
R057	30	37	32	39	27
R058	30	37	32	39	27
R059	31	38	32	39	27
R060	31	38	32	39	27
R061	31	36	33	39	27
R062	32	38	32	39	27
R063	32	38	33	39	27
R064	32	38	32	39	27
R065	32	38	32	40	27

Receiver	Predicted L_{eq} (dBA)				
	Phase 1	Phase 2	Phase 3: Mechanical Assembly		Phase 4
	Site Preparation	Civil Work	No Pile Driving	With Pile Driving	Electrical Work
R066	32	38	33	40	28
R067	32	38	33	40	28
R068	31	38	33	40	28
R069	31	38	33	40	28
R070	30	38	32	40	28
R071	30	37	32	39	27
R072	30	37	32	39	27
R073	31	38	32	40	28
R074	31	37	32	40	28
R075	31	37	32	40	28
R076	31	37	32	40	28
R077	30	37	32	40	28
R078	30	37	32	40	28
R079	30	37	32	40	28
R080	30	37	32	40	28
R081	30	37	32	40	28
R082	30	36	32	40	28
R083	30	36	32	40	28
R084	30	36	32	40	27
R085	30	36	32	39	27
R086	30	36	32	40	27
R087	30	36	32	40	27
R088	30	36	32	40	28
R089	30	36	32	40	28
R090	30	36	32	40	28
R091	29	36	32	39	27
R092	29	36	32	39	27
R093	30	37	32	39	27
R094	29	35	32	38	26
R095	29	35	32	40	27
R096	28	34	33	37	26
R097	29	35	32	38	27
R098	29	35	32	39	27
R099	41	46	40	48	37
R100	41	45	41	47	38
R101	42	44	42	49	37
R102	32	38	33	40	28

Receiver	Predicted L_{eq} (dBA)				
	Phase 1	Phase 2	Phase 3: Mechanical Assembly		Phase 4
	Site Preparation	Civil Work	No Pile Driving	With Pile Driving	Electrical Work
R103	32	37	34	41	30
R104	32	37	33	41	29
R105	33	38	34	42	31
R106	35	40	36	46	34
R107	35	39	36	44	32
R108	35	40	36	44	32
R109	31	37	33	41	29
R110	30	36	32	40	28
R111	31	37	33	40	29
R112	30	37	33	41	27
R113	38	43	39	47	33
R114	35	39	35	43	32
R115	47	48	44	59	47
R116	37	42	42	47	35
R117	39	44	43	51	40
R118	41	44	42	48	39
R119	36	40	37	44	32
R120	34	39	36	43	31
R121	36	42	38	44	35
R122	37	43	39	45	36
R123	37	44	40	48	37
R124	38	44	41	49	38
R125	39	47	43	49	38
R126	39	46	42	51	39
R127	38	45	41	50	38
R128	32	40	36	42	30
R129	33	41	37	42	31
R130	32	40	36	42	30
R131	32	41	37	42	31
R132	32	38	34	41	30
R133	34	40	36	43	32
R134	34	41	36	43	33
R135	33	39	35	42	31
R136	27	34	31	37	25
R137	27	34	31	36	25
R138	32	39	35	43	31
R139	32	39	35	43	30

Receiver	Predicted L_{eq} (dBA)				
	Phase 1	Phase 2	Phase 3: Mechanical Assembly		Phase 4
	Site Preparation	Civil Work	No Pile Driving	With Pile Driving	Electrical Work
R140	32	38	34	43	30
R141	31	38	34	42	29
R142	33	37	33	41	30
R143	31	36	33	40	28
R144	32	37	33	41	30
R145	29	35	31	39	26
R146	30	36	31	39	27
R147	30	36	32	39	28
R148	30	35	32	39	27
R149	29	34	31	37	26
R150	33	38	34	42	31
R151	34	38	34	43	31
R152	34	39	34	43	31
R153	33	38	34	43	31
R154	34	39	35	44	32
R155	35	39	35	44	32
R156	35	40	35	44	33
R157	30	37	33	39	27
R158	32	37	34	41	28
R159	32	38	34	41	29
R160	34	39	34	44	31
R161	34	41	36	45	32
R162	28	35	31	38	26
R163	31	38	33	41	29
R164	29	36	32	40	28
R165	29	36	32	39	27
R166	29	35	31	38	26
R167	28	35	31	38	26
R168	28	35	31	37	25
R169	27	34	30	36	25
R170	26	34	31	36	24
R171	28	35	31	37	25
R172	28	35	31	38	26
R173	25	33	31	35	23
R174	26	33	30	36	24
R175	27	34	31	37	25
R176	27	34	30	37	25

Receiver	Predicted L_{eq} (dBA)				
	Phase 1	Phase 2	Phase 3: Mechanical Assembly		Phase 4
	Site Preparation	Civil Work	No Pile Driving	With Pile Driving	Electrical Work
R177	26	33	30	35	23
R178	25	33	30	35	23
R179	25	33	29	35	23
R180	24	32	29	34	22
R181	26	33	29	35	23
R182	26	34	29	35	23
R183	26	34	30	35	23
R184	34	38	33	43	30
R185	35	39	34	43	31
R186	29	35	31	38	26
R187	27	34	30	35	23
R188	30	35	31	38	26
R189	29	35	31	38	26
R190	27	34	30	35	24
R191	27	34	30	35	24
R192	25	32	29	34	22
R193	24	31	27	33	21
R194	23	31	27	33	21
R195	23	32	28	33	21
R196	22	31	28	32	20
R197	22	30	26	31	19
R198	21	30	26	31	19
R199	21	30	26	31	19
R200	21	30	26	30	19
R201	21	30	26	30	19
R202	20	29	25	30	18

APPENDIX B

Predicted Operational Noise Levels

Table B-1. Predicted Operational Noise Levels

Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)
M1	30	R028	27	R062	25	R096	24	R130	27
M2	35	R029	27	R063	24	R097	25	R131	28
M3	26	R030	27	R064	24	R098	25	R132	27
M4	29	R031	29	R065	25	R099	30	R133	28
M5	27	R032	27	R066	25	R100	32	R134	28
M6	34	R033	26	R067	25	R101	32	R135	27
Property Line (worst case)	66	R034	24	R068	25	R102	27	R136	24
R001	31	R035	27	R069	25	R103	28	R137	23
R002	25	R036	27	R070	25	R104	27	R138	27
R003	26	R037	20	R071	25	R105	25	R139	27
R004	29	R038	26	R072	25	R106	29	R140	28
R005	29	R039	30	R073	25	R107	29	R141	28
R006	27	R040	26	R074	25	R108	29	R142	27
R007	26	R041	30	R075	25	R109	27	R143	27
R008	29	R042	32	R076	25	R110	26	R144	26
R009	25	R043	29	R077	25	R111	27	R145	24
R010	30	R044	30	R078	25	R112	26	R146	25
R011	30	R045	32	R079	25	R113	30	R147	25
R012	31	R046	32	R080	25	R114	28	R148	25
R013	31	R047	32	R081	25	R115	34	R149	25
R014	31	R048	32	R082	25	R116	28	R150	27
R015	31	R049	24	R083	25	R117	32	R151	27
R016	30	R050	24	R084	25	R118	31	R152	27
R017	30	R051	24	R085	25	R119	27	R153	27
R018	29	R052	24	R086	24	R120	27	R154	27
R019	30	R053	25	R087	25	R121	29	R155	28
R020	30	R054	25	R088	25	R122	30	R156	28
R021	32	R055	24	R089	25	R123	30	R157	25
R022	30	R056	24	R090	25	R124	31	R158	26
R023	30	R057	24	R091	25	R125	32	R159	26
R024	30	R058	24	R092	25	R126	31	R160	26
R025	28	R059	24	R093	24	R127	31	R161	31
R026	32	R060	24	R094	24	R128	28	R162	26
R027	29	R061	24	R095	24	R129	28	R163	28

Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)	Receiver	L_{eq} (dBA)
R164	27	R172	26	R180	24	R188	26	R196	22
R165	27	R173	24	R181	27	R189	26	R197	22
R166	26	R174	25	R182	27	R190	26	R198	22
R167	26	R175	26	R183	27	R191	26	R199	21
R168	26	R176	25	R184	26	R192	25	R200	21
R169	25	R177	25	R185	31	R193	23	R201	21
R170	25	R178	25	R186	27	R194	23	R202	20
R171	26	R179	24	R187	27	R195	23		

Vinton Solar Energy LLC
Case No. 17-774-EL-BGN
Supplement to Application
August 15, 2017

Attachment 3a

Geological Findings

by Terracon Consultants, Inc.
June 1, 2017

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Summary Report

Vinton Solar Power Facility
Infirmary Road
Vinton County, Ohio

June 1, 2017
Terracon Project No. N4175101

Prepared for:
Invenergy Solar Development, LLC
Chicago, Illinois

Prepared by:
Terracon Consultants, Inc.
Columbus, Ohio

Terracon

June 1, 2017

Invenergy Solar Development, LLC
One South Wacker Drive, Suite 1800
Chicago, Illinois 60606

Attn: Ms. Utopia Hill
312-582-1442
uhill@invenergyllc.com

Re: Summary Report
Vinton Solar Power Facility
Vinton County, Ohio
Terracon Project No. N4175101

Dear Ms. Hill:

Terracon Consultants, Inc. (Terracon) has completed the preliminary geotechnical engineering services for the above-referenced project. The services were performed in general accordance with our proposal PN4175101 dated March 2, 2017. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations for the design and construction and the associated site work.

We appreciate the opportunity to be of service to you. Should you have any questions concerning this report, or if we may be of further service, please contact us.
Sincerely,

Terracon Consultants, Inc.

Sushanta Bhusal, E.I
Staff Engineer

Yogesh S. Rege, P.E
Principal/Department Manager

Reviewed by Jon Sheng, P.E. (APR for Invenergy Projects)

cc: 1 – Client (PDF)
1 – File

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APPENDICES

Summary Report

Vinton Solar Power Facility

McArthur, Vinton County, Ohio

Terracon Project No. N4175101

June 1, 2017

1.0 INTRODUCTION

Terracon has completed the preliminary geotechnical engineering services for the proposed solar facility to be located on two parcels along Infirmary Road in McArthur, Vinton County, Ohio. The services included a field exploration program and preliminary engineering evaluation of the subsurface conditions and foundation recommendations.

The existing subsurface conditions within the project site were explored with a total of six (6) Standard Penetration Test (SPT) borings. A detailed presentation of the subsurface soils encountered at each borehole location during site exploration can be found on the SPT borings included in **Appendix A** of this report, along with a site location map and an exploration location plan.

The purpose of our geotechnical services is to explore and evaluate the existing subsurface conditions at the project site and develop conclusions and limited geotechnical recommendations for this stage of the project. The following study was conducted per our scope of services outlined in our proposal PN4175101 dated March 2, 2017:

- contributory risk components
- groundwater observations
- subsurface soil conditions
- preliminary pile embedment analysis

2.0 PROJECT INFORMATION

Our initial understanding of the project was provided in our proposal and was discussed in the project planning stage. Our final understanding of the project conditions is as follows:

Item	Description
Project location	The two construction areas totaling approximately 1632±acres are located on the north and south sides of Infirmary Road in McArthur, Vinton County, Ohio. The project site approximate coordinates at the center of the two sites are 39.278106°N/82.44185°W and 39.260690°N/82.449927°W.
Proposed structure	We anticipate the sites will be developed with a photovoltaic (PV) solar electric power plant consisting of steel piles, racking system and PV modules. The steel pile foundations for the solar array are anticipated to consist of wide flange steel piles (W6x9 or similar). In addition, we understand inverters may also be supported on wide flange steel piles, while transformers, and other appurtenant equipment are anticipated to be supported on shallow spread or mat foundations. The anticipated loads and maximum deflections of piles have not been provided by the Client at this time.
Existing topography	Based on our observations during site visit and Google Earth® view, the proposed site appeared to be gently rolling with ground surface elevation across the two sites ranging from about 869 to 960 feet.
Maximum loads	The loads are not provided at the time of this report preparation and loads of similar solar projects are used for pile foundation analyses in this study.
Grading	Finished grade elevations have not been provided at this time. Finished grade elevations are assumed to be close to the existing ground surface elevation. It is anticipated that the site work will involve a nominal amount of cut / fill to develop final grade for the solar facility.

Should any of the above information or assumptions be inconsistent with the planned construction, Terracon should be informed so that modifications to this report can be made as necessary.

3.0 GEOLOGIC AND MINING RECORDS REVIEW

Terracon performed a review of available geologic information and mining records of the site. The purpose of this records review was to attempt to establish the extent of the surface and underground mining on the property and the depth to the bottom of mine spoils.

3.1 Physiography

The project site lies within a portion of the Appalachian Plateau Province, referred to as the Appalachian Highlands Division, which is comprised of the Allegheny (Kanawha) Plateau Section, among others. The Unglaciated Appalachian Plateau is a rugged, eroded plain of sedimentary rock, marked by flat-topped highlands and rounded hills. This strongly dissected plateau forms areas of steep slopes and sharp relief from the active down-cutting and erosion from a vast dendritic network of streams. Mature-stage streams form well-developed floodplains, and meanders. Hills between major streams generally exhibit rounded summits and moderately shallow slopes. Elevation relief of the region is on the order of a few hundred feet.

The Appalachian Plateau is largely underlain by sedimentary strata of Permian and Pennsylvanian age that appear near horizontal in road cuts and outcrops. The actual structure of the rocks is gently folded, with fold limbs generally less than 2 or 3 degrees. The region is rich in mineral resources such as coal, natural gas, and petroleum. Surface and underground mines are common throughout the plateau, contributing to subsidence hazards. Soils in this area are often low in fertility and acidic.

The soils in the unglaciated plateau portion of the project site consist of mainly residuum, colluvium, glacial outwash, lacustrine/glacio-lacustrine, and alluvium. Some areas also contain a thin veneer of loess deposits.

Residuum (also sometimes called residual soil) is defined as unconsolidated, completely or partly weathered mineral material that accumulated as sound rock disintegrated in place. The texture and composition of residuum reflects the parent rock type. Residual soil derived from siltstones, mudstones and shale are therefore fine-grained and often result in unstable slope conditions. Given sufficient slope, fine-grained residuum is prone to landslide movement.

Colluvium (colluvial soil) is defined as loose, unconsolidated sediments that have been moved by creep, slide, water, or a combination of processes and deposited at the base of steep slopes. Colluvium is commonly composed of a heterogeneous range of rock types and sediments with grain sizes ranging from silt up to rock fragments of various sizes. Unlike residuum, the composition of colluvial soil is often different than the bedrock below it.

Glacial outwash includes sand and gravel deposits deposited by meltwater streams in front of a glacier in stratified deposits. Typically outwash deposits are coarse textured, weakly to strongly bedded, sand and gravels overlain by finer textured silty or loamy deposits. Outwash may be pitted with kettles or dissected by postglacial streams. Outwash plains are commonly cross-bedded with units of alternating grain size.

Lacustrine/Glacio-lacustrine deposits are located in scattered areas throughout the unglaciated plateau portion of this project. Glaciers blocked the natural drainage ways in the area which in turn caused the formation of lakes. Silts and clays were deposited in the bottom of lakes and as the glaciers retreated, lacustrine deposits remained in the form of terraces and valley fills.

Alluvium (alluvial soil) is comprised of sand, silt, or clay that has been deposited on land by streams. Alluvium, within the Project, is typically subdivided into old and recent deposits. Old alluvium (old floodwater deposits) are found in areas containing low and high terraces located along major streams. Recent alluvium (recent floodwater deposits) is the younger deposit which continues to accumulate as fresh sediment is deposited by streams overflowing their banks.

Loess is a geologically recent deposit consisting of silt-sized particles transported and deposited by wind (aeolian). Loess deposits are typically a few inches to a few feet thick. Loess deposits in the Project area typically overly residuum.

3.2 Bedrock

Bedrock at the site consists of the Pennsylvanian aged Allegheny and Pottsville Group-Undivided, characterized by an abundance of shale, sandstone, and conglomerate and subordinate amount of limestone, clay, flint and coal. Rapid horizontal and vertical changes between these rock types are common. Shale is gray to black in color, clayey to sandy, thin to medium bedded, locally calcareous and fossiliferous. Underclay is clayey to silty, non-bedded, and underlies the coal beds. Sandstone is typically gray to brown in color, very fine to coarse grained, thin to massively bedded, locally conglomeratic, quartz rich and calcareous. Limestone is gray to black in color, micritic to medium grained, thin to medium bedded, nodular to irregular bedded and may grade to flint (chert). Non-marine limestones occur in upper portion of the Allegheny Group and micritic limestones are commonly found underlying the coal beds of the Allegheny Group. Coals are banded, bituminous, and thin to thick bedded. Economic coals in this unit are the Lower Mercer No. 3, Upper Mercer No. 3a, Newland No. 4 (Brookville), Clarion No. 4a, Lower Kittanning No. 5, Middle Kittanning No. 6, Lower Freeport No. 6a, and the Upper Freeport No. 7. Mineable coals are abundant throughout this unit but are generally restricted to localized areas. Underclays from this unit were mined for the production of bricks, pottery, etc. Limestone found within these Groups was mined in various locations. Sandstones from this unit have been noted to produce economic quantities of oil, gas, and brine in the shallow subsurface. Sandstone, limestone, and conglomerate are resistant to weathering. Shale, clay, and coal are less resistant to weathering and form thin to thick colluvium deposits on slopes. Rock falls occur where resistant sandstone and limestone have been undermined by erosion of weaker shale and clay layers. Subsidence can occur in areas where voids have been left from underground mining of coal. The Allegheny Pottsville Group-Undivided has a sharp upper contact with the Conemaugh Group and a sharp lower contact with the Cuyahoga Formation (in northeast Ohio) and the Logan Formation, Maxville Limestone, or the Rushville Formation (in southeastern Ohio). These two formations/groups are combined in Ohio due to the Newland (No.4 Brookville) coal is missing either due to never being deposited or it has been eroded. In Pennsylvania and West Virginia the base of the Newland (No. 4 Brookville) is dividing line between the Allegheny Formation and the Pottsville Formation. The Allegheny Pottsville Group -Undivided ranges in thickness from 450 to 620 feet in Ohio.

3.3 Mining Records and Maps

We contacted the Ohio Department of Natural Resources (ODNR) – Division of Mineral Resources Management (DMRM) in order to obtain available documentation and maps related to the Abandoned Mine Lands (AML). The ODNR – Division of Geologic Survey was also contacted to obtain geologic data for the site, including available regional mapping of coal seams that were historically known to be surface mined at the site. The objective of this records review was to determine the elevation range of the coal seam(s) mined, the current elevation range of the project site, and the thickness of the resultant spoil material.

ODNR records indicate that nearly the entire footprint of the proposed project site lies upon strip and underground mined land. Exhibit C-3, provided in Appendix C illustrates the extent of permitted mines at the project site. VN-OGS-043 and VN-OGS-036 are abandoned underground mines of unknown extent, as is VN-115, which only has undocumented mine drift entries. These mines were removed by later strip mining.

Strip mine spoil from abandoned strip mines in the Lower Kittanning No. 5 coal seam is at elevation of about 900 feet at the south end, rising to elevation of about 950 feet at the north end of the site. Higher thin coals from the Upper Kittanning No. 6 and Lower Kittanning No. 6A were also mined where the coal seam was present. These strip mine permit numbers were C-77 (Benedict Inc. application of 10/2/1979), C-1194 (Benedict Inc. application of 3/20/1984), D-0524 (Benedict Inc. application of 1/12/1988), and D-0609, an active permit for Waterloo Coal Co. approved on 8/26/1986. The last D-0609 mine map was filed on 8/25/2006. Any maps for these strip mines are in the paper permit files at ODNR DMRM and are un-scanned. If copies are needed, an onsite visit for copies can be requested and must be arranged, if DMRM staff time allows.

Comparison of this surface elevation data and the No. 5 and 6 coal seam elevation indicate that the mine spoil thickness probably approached as much as about 30 to 50 feet.
During our site visit, we contacted the property owner, Mr. Jim Wes. Mr. Wes indicated that the surface mining activity at the project site started around the year of 1975 and was terminated in 2011.

He also indicated that the average depth of the overburden affected was approximately 50 feet and that all overburden was blasted and side-cast by a dragline or shovel, or loaded and hauled by large trucks.

4.0 SUBSURFACE CONDITIONS

4.1 Typical Profile

The widely spaced borings were performed in areas that had previously been surface-mined and reclaimed. The borings encountered mine spoil materials related to the surface mining operations to the maximum depths explored by the borings (maximum depth explored was 20 feet in Borings B-1 & B-2). Based on the geologic information and mine records summarized in **Section 3.0,** the thickness of the mine spoil fill is anticipated to vary across the site with thickness approaching to 30 to 50 feet. We anticipate the bottom of the mine spoil fill would approximately correspond with the bottom elevation of the Kittanning No. 5 & 6 coal bed. Based on historical outcrop mapping of the No. 5 & 6 coal seam (Exhibit C-1), the elevation of the coal appeared to vary from about elevation 900 feet at the south side rising to about 950 feet at the north side of project site.

The mine spoil fill encountered in the borings was a random combination of soil and bedrock materials resulting from the mine reclamation process. The materials encountered included clay and sand, with varying amounts of gravel and rock fragments, and cobble to boulder size shale, coal and sandstone fragments. The relative density of the materials encountered varied from loose to dense based on Standard Penetration Test (SPT) N-values. Please note that due to the random nature of the mine spoil materials, SPT N-values may not provide reliable correlations for in-situ density and consistency of the material and these values may be somewhat elevated due to the sampler contacting rock fragments, cobbles, boulders, etc. within the fill.

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found in **Appendix A**.

4.2 Frost Heave Potential

Frost heave has the potential to occur where there are frost susceptible soils, a water source such as shallow groundwater and freezing air temperatures. Frost heave begins with a hard freeze that creates a frost front that penetrates the soil causing pore water in the soil to freeze. As ice forms, the volumetric expansion is approximately 10%. In some cases, ice lenses form in the soil and when fed by a continuous water source, the ice lens grows lifting anything in or above the ice lens.

4.3 Groundwater

The boreholes were observed while drilling/excavating and after completion for the presence and level of groundwater. Groundwater was not encountered in the borings while drilling or for the short duration the boreholes were allowed to remain open.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings/ were performed. In addition, perched water could develop in more porous zones of the fill overlying lower permeability materials following periods of heavy or prolonged precipitation. Therefore, groundwater levels during construction or at other times in the life of the structure may be present.

5.0 CONTRIBUTORY RISK COMPONENTS

ITEM	DESCRIPTION
Suitability Statement	Ground conditions in coal-mining regions require special attention when development is considered. The large scale prior surface mining operations have altered the landforms at the site through mining and reclamation. The reclaimed land, however, is composed of deep soil and rock fills. Such fills undergo long-term settlement under their own heavy weight. Even when carefully placed with compaction, such fills continue to settle under their self weights for many years. Selection of the appropriate foundation system will depend on the level of risk to the structure and costs related to minimizing the potential risk of settlements that may cause damage to the structures proposed for the project. Based on provided information, the solar arrays for this project are anticipated to be supported on driven H pile. For this type of foundation system, provisions for flexible or adjustable connection between the posts and the array superstructure are recommended. Despite the presence of mine-spoil fills, in our opinion, the site should be suitable for the proposed solar development, provided the owner understands and accept the risk associated with the presence of mine spoil fills. Additional soil test borings/test pits should be performed to adequately investigate the site as part of a design-level study. Additionally, a full-scale pile load testing (PLT) program should be considered as the project design progresses. The results of a full scale PLT program in conjunction with soil test boring/test pit results are often successful in reducing the design embedment depth when compared to designs solely based on explorative results and analytical methods alone.
Soil Conditions	The on-site soils appear to be existing mine-spoil fills to the depths explored.

ITEM	DESCRIPTION
Mine Spoil Settlement	From a geotechnical engineering perspective, the principal concern with development of the site is the presence of considerable depths of mine spoil fill material. Volume reduction of this fill can occur owing to various processes such as collapse compression from crushing of rock to rock contact points upon wetting or long-term creep associated with self-weight of the mine spoil. Hydro-compression settlement can also occur from the presence of water (saturating or percolating through the fill). Softening, squeezing, consolidation, and internal erosion of particles into open voids can also occur. It is differential settlement rather than the magnitude of total settlement that causes distortion and damage of structures and differential settlement can be attributed to a number of factors including: ■ variability of fill quality ■ non-uniform distribution of loading ■ variations in depth of fill The differential settlement potential can be reduced by improving the ground using soil improvement measures such as undercutting and replacement, deep dynamic compaction, deep soil mixing, etc.
Liquefaction	Groundwater was not encountered within the depth of the borings during the time of field exploration. As such, liquefaction is not a concern at this project.
Access	Wet and loose/soft surface conditions due to rainwater will create access issues for vehicles. The site will generally be more accessible in the summer and early fall due to the improved drying conditions. The existing drainage canals have a limited number of crossings, likely designed to facilitate access with agricultural equipment.
Grading	We anticipate nominal site grading will be required to match the existing surface grades. On-site materials that are used as fill or backfill will likely require sorting to remove deleterious materials, large rock fragments, breaking down of weathered rock into particle sizes that acceptable as fill, and drying prior to re-compaction as engineered fill. Alternatively, these materials could be replaced with imported soils containing appropriate materials and moisture contents. We expect areas of unsuitable conditions will be encountered prior to placing fill and within the subgrade for roadways and foundations that are planned. Stabilization measures, such as over-excavation and replacement, should be expected. Construction traffic should be limited after rain events as the clayey soil could become unstable under those conditions.
Groundwater	No groundwater was observed within 20 feet of existing ground surface at the time of this exploration.
Site Drainage	The existing perimeter ditches / canals were likely installed to facilitate farming activities and site access. Filling the drainage canals or destruction of other site drainage systems will result in increased groundwater levels, softer soils, and generally undesirable subsurface conditions.

ITEM	DESCRIPTION
Corrosion Hazard	Based on laboratory testing for electrical resistivity and chemical properties, the site soils have aggressive corrosion to buried metal according to a corrosion guideline from U.S Department of Transportation Federal Highway Administration. The results of our laboratory testing of soil chemical properties (provided in Exhibit B-3) are expected to assist a qualified engineer to design corrosion protection for the production piles and other project elements. The soils also likely contain pyrite, which when exposed to atmospheric conditions and water has a tendency to expand, which can cause damage to the proposed structures.
Excavation Hazards	Based on the results of our borings, we expect that difficult excavation conditions or widespread obstructions to pile driving operations could be encountered during construction due to the uncontrolled nature of the mine spoils which may contain large rocks, rock slabs and boulders. As previously noted groundwater is not expected to be encountered during pile-driving activities or shallow foundation excavations. Additionally, we expect general instability in the form of caving, sloughing, and raveling to be encountered in excavations due to the presence of mine-spoil fill. Excavations will likely require bracing, sloping, and/or other means to create safe and stable working conditions.
Expansive Soil Hazards	The mine spoil soils are anticipated to consist of pyritic materials. Therefore, we believe the on-site mine spoil materials could exhibit expansive behavior.
Slope Hazards	Since the site is comprised of gently sloping rolling hills, we do not anticipate slope stability issues other than some sloughing within the slopes during construction.
Anticipated Pile Drivability	Due to the presence of mine-spoil fill, cobbles/boulders are anticipated to be encountered during pile driving. Therefore, we anticipate pre-drilling to be required at some locations.
General Construction Considerations	To the extent practical, earthwork should be performed during warmer and drier periods of weather to reduce the amount of necessary subgrade remedial measures for loose/soft and unsuitable conditions beneath access roadways, equipment pads, etc.

Note: The soil properties that can significantly affect the aggressiveness of corrosion to buried metal structures include: pH, oxidation-reduction potential, sulfates, sulfides, total dissolved salts, chlorides, resistivity, and moisture content. These properties were measured and the results are reported in Exhibit B-3 of Appendix B. These test results are provided to assist the designers of corrosion protection for the project.

6.0 PRELIMINARY EMBEDMENT ANALYSIS

We have performed preliminary geotechnical and structural analyses for evaluating the embedment depths of driven pile foundations to support the typical PV panel racking system. This analysis is based on the results of our widely-spaced soil test borings, our prior experience in performing full-scale pile load testing, structural loads as provided by Soltec and assumed loads for NexTracker racking systems and LPile parameters derived from this preliminary exploration, and other noted assumptions. Subsequent analyses will be required once design level geotechnical information is available and once other design considerations are more fully defined. **THEREFORE, THE RESULTS OF THE ANALYSES DESCRIBED BELOW ARE NOT SUITABLE FOR DESIGN.** Instead, this analysis is intended to assist you in roughly evaluating construction costs and development viability for the proposed project. It should also be noted that our analyses is based on short-term conditions based on boring information and does not account for risks associated with settlement and subsidence of the uncontrolled mine spoil material which can cause distortion and damage to the proposed structures. For this type of foundation system, provisions for flexible or adjustable connection between the posts and the array superstructure are recommended.

6.1 Geotechnical Axial Capacity

The following preliminary geotechnical parameters can be used to estimate the capacity of driven W-section pile foundations. These values should also be suitable to prepare a full-scale pile load testing program which is recommended as part of the overall project design. Final design values will vary from the preliminary estimates below.

Layer (feet)	Allowable Unit Skin Friction (psf)	Allowable End Bearing Pressure (psf)
0-3[1]	--	--
3-5	100	--
5-15	370	750 [2]

1. Depth to ignore frost heave
2. Appropriate for pile toe bearing at depths of at least 5 feet below the ground surface.

The axial tensile (pull-out) capacity can be developed from skin friction while the axial compressive capacity can be developed from skin friction and end bearing. The above indicated allowable skin friction is appropriate for uplift and compressive loading. The skin friction perimeter can be calculated using the perimeter of the pile which equals twice the sum of the flange width and web depth. The end bearing is applicable for piles founded at depths greater than 5 feet below existing ground surface. The upper 3 feet of soil should be neglected when calculating skin friction due to the frost heave depth.

Piles should have a minimum center-to-center spacing of at least 3 times their largest cross-sectional dimension to prevent reduction in the axial capacities due to group effects. If the piles are designed using the above parameters, settlements are not anticipated to exceed 1 inch, however this does not include settlement that may occur due to long-term compression of mine spoil fill.

6.2 Geotechnical Lateral Capacity

The parameters in the following table can be used for a preliminary analysis of the lateral capacity of driven steel piles in support of solar panel arrays. The mine spoil materials encountered included clay and sand, with varying amounts of gravel and rock fragments, and cobble to boulder size shale, coal and sandstone fragments. Therefore, we treated the subsurface materials as sand for analysis of lateral capacity.

Depth (feet bgs)	p-y model	Effective Unit Weight γ, (pcf)	Effective Friction Angle, Φ'	Soil Modulus (pci)	P-Multiplier
0-3	Sand (Reese 1974)	113	29	50	0.7
3-15	Sand (Reese 1974)	115	30	80	1.0

Note: default values were used for spring constant and p-multiplier

The above indicated effective unit weight, effective friction angle, and soil modulus have no factor of safety and may be used to analyze suitability of the proposed section and serviceability requirements. These parameters are based on correlations with SPT results, published values, and our past experience with similar soil types. A P-multiplier of 0.7 should be applied to the upper 3 feet of loose and cultivated, near-surface soils to account for potential strength losses due to construction disturbance, seasonal effects (frost depth), and other factors. These values should be considered approximate.

6.3 Structural Capacity Analysis & Discussion

We have performed a preliminary structural embedment analysis using the geotechnical parameters outlined above. Our analyses have not considered the potential loss of steel due to corrosion during the design life of the structure. The final structural design should consider the anticipated steel loss as determined by a qualified corrosion engineer. Thicker foundation sections or additional corrosion protection measures may be required if steel loss is predicted by the corrosion analyses.

Approximate structural load conditions were analyzed based on top-of-pile load documents for two single-axis tracker racking systems under similar structural design conditions (100 mph 3-second wind gust, 15 psf ground snow load, maximum pile reveal of 6 feet, etc.). The actual top-of-pile structural loads will vary based on the selected racking system and the manufacturer's load information as determined in accordance with requirements by the applicable building codes and local municipality.

For the NexTracker 13 pile array, the following table outlines the top-of-pile loads used in our structural analysis and the resulting preliminarily recommended pile section and embedment depths.

NexTracker 13 Pile Array						
Pile Type	Approximate Factored Loads				Structural Analysis Results	
	Compression (kips)	Uplift (kips)	Shear (kips)	Moment (kip-ft.)	Recommended Pile Section	Recommended Pile Embedment (ft.)
Motor - Exterior	2.96	1.68	1.28	15.7	W8x18	14
P2 - Exterior	3.21	1.83	1.75	0	W6x15	10
P3 & P5 - Exterior	3.09	1.78	2.41	0	W8x18	12
P4 & P6 - Exterior	2.91	1.62	2.67	0	W8x18	12
P7 - Exterior	0.86	0.51	1.04	0	W6x8 5	9
Motor - Interior	2.28	0.84	0.72	10 5	W6x15	10
P2 & P7 - Interior	2.43	0.81	0.91	0	W6x8 5	9
P3, P5 & P6 - Interior	2 39	0.78	1.10	0	W6x8 5	9
P4 - Interior	2 24	0.71	1.23	0	W6x8 5	9

For the Soltec 2x42P pile array, the following table outlines the top-of-pile loads used in our structural analysis and the resulting preliminarily recommended pile section and embedment depths.

Soltec 2x42P						
Pile Type	Approximate Factored Loads				Structural Analysis Results	
	Compression (kips)	Uplift (kips)	Shear (kips)	Moment (kip-ft.)	Recommended Pile Section	Recommended Pile Embedment (ft.)
2x42P_Simple - Exterior	2.47	0.71	2.25	0	W8x18	11
2x42P_Motor- Exterior	2.39	0.62	2.14	23.34	W10x26	13
2x42P_Simple - Interior	1.58	0.14	0.62	0	W6x8.5	8
2x42P_Motor- Interior	1.56	0.09	0.59	22.76	W8x18	11
2x45P_Simple - Exterior	2.13	0.62	1.88	0	W8x13	10
2x45P_Motor- Exterior	2.29	0.54	1.98	24.58	W10x26	13
2x45P_Simple - Interior	1.72	0.16	0.68	0	W6x8.5	8
2x45P_Motor- Interior	1.93	0.10	0.73	24.09	W8x24	12

It should be noted that greater quantities of steel (i.e. thicker sections, greater pile lengths) may be required for foundation support in the area due to the presence of mine spoils and corrosive environment. We expect that the results of a full-scale pile load test program could demonstrate more favorable geotechnical parameters and, consequently, a more economical final design for the racking system foundations, however the full-scale pile load test will not be able to simulate the long-term conditions and risks associated with mine spoil fill.

As previously noted in this report, our analyses have been performed using preliminary information and are intended to assist you in roughly evaluating construction costs and viability for the proposed project. Ultimately, the design of foundations for the solar panel racking system will depend on a number of factors including the actual structural loading conditions, the structural serviceability requirements, anticipated corrosion losses, a detailed understanding of the site soil conditions, risks associated with development on a site that consists significant depth of mine spoil fill and other factors where complete and final information is not available at this time.

7.0 GENERAL COMMENTS

Terracon should be consulted to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the project design and specifications. Terracon should also be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analyses and recommendations presented in this report are based upon the data obtained from the explorations performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between exploration locations, across the site, or may be caused due to the modifying effects of construction or weather. Bear in mind that the nature and extent of such variations may not become evident until construction has started or until construction activities have ceased. If variations do appear, Terracon should be notified immediately so that further evaluation and supplemental recommendations can be provided. The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, and bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or hazardous conditions. If the owner is concerned about the potential for such contamination or pollution, please advise so that additional studies may be undertaken.

Support of foundations structure above existing fill soils is discussed in this report. However, even with the recommended construction testing, there is a risk that unsuitable materials within or buried by the fill will not be discovered. This risk cannot be eliminated without removing the fill, but can be reduced by thorough exploration and testing during construction.

This report has been prepared for the exclusive use of our client for specific application to the project and site discussed, and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes, and then either verifies or modifies the conclusions of this report in writing.

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SB	Project No. N4175101	Terracon Consulting Engineers & Scientists	SITE LOCATION MAP	Exhibit
Drawn by: SB	Scale: N.T.S		Vinton Solar Power Facility	A-1
Checked by: YSR	File Name: N4175101SLP		Infirmary Road	
Approved by: YSR	Date: May 2017		McArthur, OH	

APPROXIMATE BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SB	Project No. N4175101	Terracon Consulting Engineers & Scientists	**BORING LOCATION PLAN**
Drawn by: SB	Scale: N.T.S.		Vinton Solar Power Facility
Checked by: YSR	File Name: N4175101 BLP		Infirmary Road
Approved by: YSR	Date: May, 2017		McArthur, OH

Exhibit

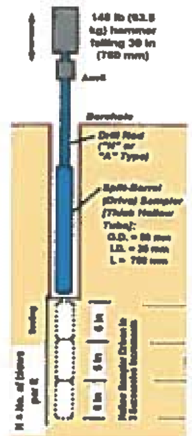
A-2

Field Exploration Description

The locations of Standard Penetration Test (SPT) and hand auger borings are determined by Terracon based on the proposed plan and were located in the field using a hand-held GPS unit and in reference to the existing features. These locations are shown in the Exploration Location Plan in **Exhibit A-2** and should be considered approximate.

Standard Penetration Testing

The SPT borings were performed in accordance with ASTM D1586 with a trailer-mounted CME drilling rig using mud rotatory drilling techniques. Samples of the soil encountered in the borings were obtained using split-barrel sampling procedures. In the split barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in situ relative density of cohesionless soils and consistency of cohesive soils. A rope and cathead hammer was used to advance the split-barrel sampler in the borings performed on this site.



Source: FHWA NHI-06-088

BORING LOG NO. B-1

PROJECT: Vinton Solar Power Facility

CLIENT: Invenergy LLC
One South Wacker Drive, Suite 1800

SITE: Infirmary Road
McArthur, OH

LOCATION See Exhibit A-2

Latitude: 39.284059° Longitude: -82.440797°

Approximate Surface Elev: 945 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.1	TOPSOIL (3")	945+/-							
	FILL - Mine spoils (contains gravel, sand, silt, clay, sandstone, shale, and coal fragments)				X	15	5-6-10 N=16	9	
					X	14	4-7-4 N=11	12	NP
			5						
					X	12	3-12-7 N=19	11	
					X	12	3-4-4 N=8	12	
			10						
					X	12	4-4-8 N=12	12	
			15						
					X	10	2-7-4 N=11	13	
20.0		925+/-	20						
	Boring Terminated at 20 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" Hollow Stem Auger

Abandonment Method:
Auger Cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 5/10/2017	Boring Completed: 5/10/2017
Drill Rig: ATV #651	Driller: S. McMurray
Project No.: N4175101	Exhibit: A-4

BORING LOG NO. B-2

PROJECT: Vinton Solar Power Facility

CLIENT: Invenergy LLC
One South Wacker Drive, Suite 1800

SITE: Infirmary Road
McArthur, OH

LOCATION See Exhibit A-2

Latitude: 39.274131° Longitude: -82.44732°

Approximate Surface Elev: 957 (Ft.) +/-

DEPTH	Graphic Log / Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.3	TOPSOIL (4")	956.5+/-							
	FILL - , Mine spoils (contains gravel, sand, silt, clay, sandstone, shale, and coal fragments)				X	14	10-11-7 N=18	9	
					X	15	3-3-4 N=7	13	
			5		X	15	8-9-9 N=18	11	
					X	16	5-10-5 N=15	6	
			10						
					X	10	2-3-3 N=6	19	
			15						
20.0		937+/-	20		X	14	3-4-4 N=8	13	
	Boring Terminated at 20 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" Hollow Stem Auger

Abandonment Method:
Auger Cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 5/10/2017	Boring Completed: 5/10/2017
Drill Rig: ATV #651	Driller: S. McMurray
Project No.: N4175101	Exhibit: A-5

BORING LOG NO. B-3

PROJECT: Vinton Solar Power Facility

CLIENT: Invenergy LLC
One South Wacker Drive, Suite 1800

SITE: Infirmary Road
McArthur, OH

LOCATION See Exhibit A-2

Latitude: 39.26517° Longitude: -82.442156°

Approximate Surface Elev: 952 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	0.3 TOPSOIL (3")	952+/-							
	FILL - , Mine spoils (contains gravel, sand, silt, clay, sandstone, shale, and coal fragments)				X	18	8-8-20 N=28	12	
					X	18	5-8-6 N=14	13	
			5		X	18	20-21-13 N=34	6	21-13-8
					X	18	4-4-3 N=7	9	
			10						
					X	18	2-3-7 N=10	11	
	15.0	937+/-	15						

Boring Terminated at 15 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" Hollow Stem Auger

Abandonment Method:
Auger Cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 5/10/2017	Boring Completed: 5/10/2017
Drill Rig: ATV #651	Driller: S. McMurray
Project No.: N4175101	Exhibit: A-8

BORING LOG NO. B-4

PROJECT: Vinton Solar Power Facility

CLIENT: Invenergy LLC
One South Wacker Drive, Suite 1800

SITE: Infirmary Road
McArthur, OH

LOCATION See Exhibit A-2

Latitude: 39.268544° Longitude: -82.453633°

Approximate Surface Elev: 937 (Ft.) +/-

DEPTH	GRAPHIC LOG / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.3	TOPSOIL (3")	937+/-							
	FILL - , Mine spoils (contains gravel, sand, silt, clay, sandstone, shale, and coal fragments)				X	18	4-5-6 N=11	17	
					X	16	3-3-4 N=7	17	
			5		X	16	8-10-11 N=21	12	
			10		X	17	3-3-3 N=6	9	
15.0		922+/-	15		X	18	18-18-15 N=33	3	
	Boring Terminated at 15 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" Hollow Stem Auger

Abandonment Method:
Auger Cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 5/10/2017	Boring Completed: 5/10/2017
Drill Rig: ATV #651	Driller: S. McMurray
Project No.: N4175101	Exhibit: A-7

BORING LOG NO. B-5

PROJECT: Vinton Solar Power Facility

CLIENT: Invenergy LLC
One South Wacker Drive, Suite 1800

SITE: Infirmary Road
McArthur, OH

LOCATION See Exhibit A-2

Latitude: 39.260421° Longitude: -82.45449°

Approximate Surface Elev: 934 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.3 TOPSOIL (3")	934+/-							
FILL - , Mine spoils (contains gravel, sand, silt, clay, sandstone, shale, and coal fragments)				X	18	8-12-11 N=23	9	
				X	18	5-9-11 N=20	13	
		5						
				X	16	11-15-14 N=29	8	
				X	12	7-8-6 N=14	7	
		10						
15.0	919+/-	15		X	14	5-5-5 N=10	12	

Boring Terminated at 15 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" Hollow Stem Auger

Abandonment Method:
Auger Cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 5/10/2017	Boring Completed: 5/10/2017
Drill Rig: ATV #651	Driller: S. McMurray
Project No.: N4175101	Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N4175101 VINTON SOLAR POWE.GPJ TERRACON_DATATEMPLATE.GDT 5/30/17

BORING LOG NO. B-6

PROJECT: Vinton Solar Power Facility

CLIENT: Invenergy LLC
One South Wacker Drive, Suite 1800

SITE: Infirmary Road
McArthur, OH

LOCATION See Exhibit A-2

Latitude: 39.25113° Longitude: -82.450495°

Approximate Surface Elev: 922 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)
0.2	TOPSOIL [3]"	921.5+/-
	FILL - , Mine spoils (contains gravel, sand, silt, clay, sandstone, shale, and coal fragments)	
15.0		907+/-
	Boring Terminated at 15 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		X	16	7-10-11 N=21	5	
5		X	14	10-7-5 N=12	15	
		X	12	2-3-3 N=6	15	
10		X	18	4-8-12 N=20	14	
15		X	13	2-3-4 N=7	14	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25" Hollow Stem Auger

Abandonment Method:
Auger Cuttings

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 5/10/2017	Boring Completed: 5/10/2017
Drill Rig: ATV #651	Driller: S. McMurray
Project No.: N4175101	Exhibit: A-9

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Laboratory Testing

The split barrel samples obtained in the field were observed and tested in the laboratory under the direction of the geotechnical engineer. Descriptive classifications of the soils encountered indicated on the boring logs are in accordance with the enclosed General Notes. Also shown are estimated Unified Soil Classification System (USCS) symbols. A brief description of the USCS is attached to this report. Classification of the split-barrel samples was performed using visual manual procedures (ASTM D2488).

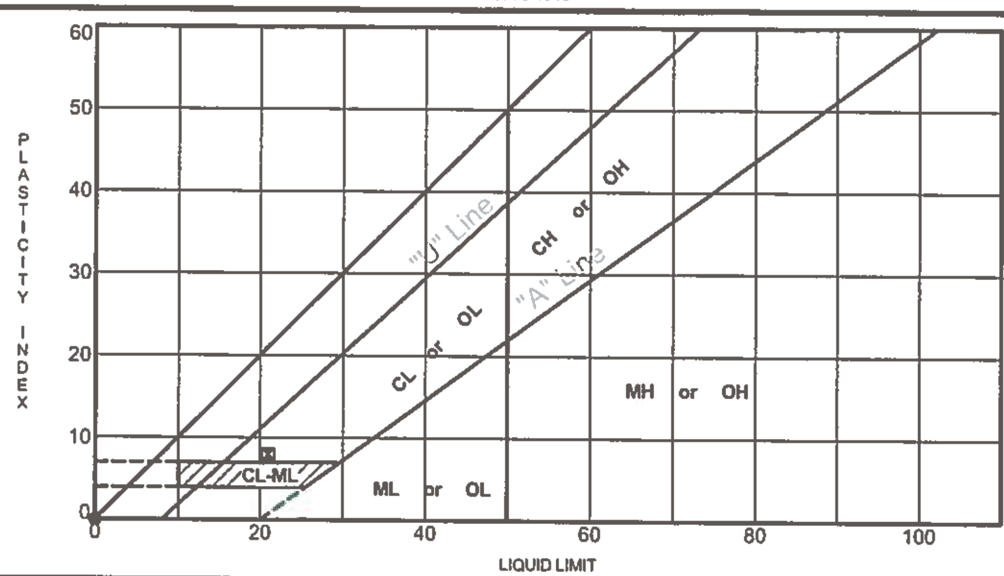
Soil samples from SPT borings and hand auger borings were used to test in the laboratory for physical properties and engineering characteristics as described below.

Atterberg Limits tests and standard Proctor tests were performed in general accordance with ASTM D4318 and ASTM D698, respectively. The laboratory chemical testing was also performed on the soil samples in general accordance with the corresponding AAWA and ASTM standards

Variations in soil composition may influence laboratory resistivity testing results. Laboratory results should be evaluated based on the measured data in conjunction with published values for the material types.

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-1	3.5 - 5	NP	NP	NP			FILL (Mine Spoils)
⊠	B-3	6 - 7.5	21	13	8			FILL (Mine Spoils)

PROJECT: Vinton Solar Power Facility

SITE: Infirmary Road
McArthur, OH

Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4175101

CLIENT: Invenergy LLC
One South Wacker Drive, Suite 1800

EXHIBIT: B-2

CHEMICAL LABORATORY TEST REPORT

Project Number: N4175101
Service Date: 05/24/17
Report Date: 05/24/17
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Invenergy, LLC
One South Wacker Drive, Sutie 1800

Project

Vinton Solar Power Facility

Sample Submitted By: Columbus (N4) **Date Received:** 5/19/2017 **Lab No.:** 17-0485

Results of Corrosion Analysis

Sample No.	Bulk	Bulk
Sample Location	B-1	B-6
Sample Depth (ft.)	0.9-5.0	0.9-5.0
pH Analysis, AWWA 4500 H	7.94	7.93
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	433	134
Chlorides, ASTM D 512, (mg/kg)	113	100
Sulfides, AWWA 4500-S D (mg/kg)	Nil	Nil
Red-Ox, AWWA 2580, (mV)	+655	+721
Resistivity, ASTM G 57, (ohm-cm)	1164	1940

Analyzed By: Kurt D. Ergun
Kurt D. Ergun
Chemist

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger | Shelby Tube | Split Spoon
Rock Core | Macro Core | Modified California Ring Sampler
Grab Sample | No Recovery | Modified Dames & Moore Ring Sampler

WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, tsf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	0.50 to 1.00	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
			Hard	> 4.00	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay
[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

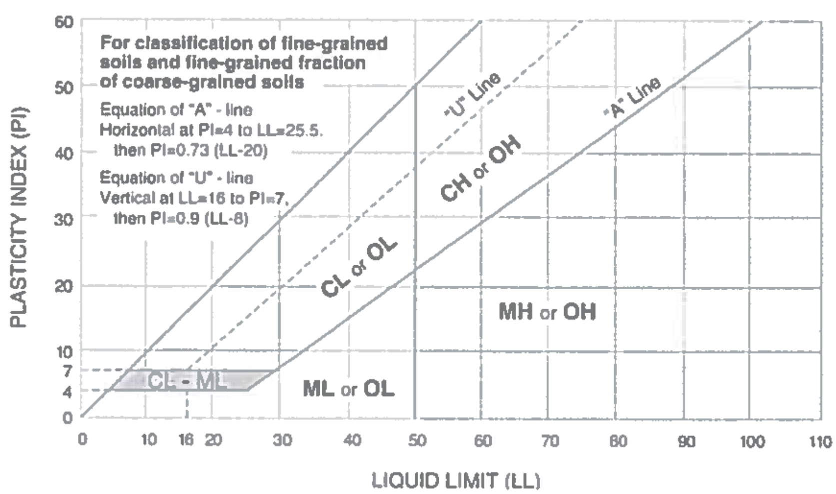

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Exhibit C-2

DESCRIPTION OF ROCK PROPERTIES

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding, and Foliation Spacing in Rock [a]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

Rock Quality Designator (RQD) a

RQD, as a percentage	Diagnostic description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

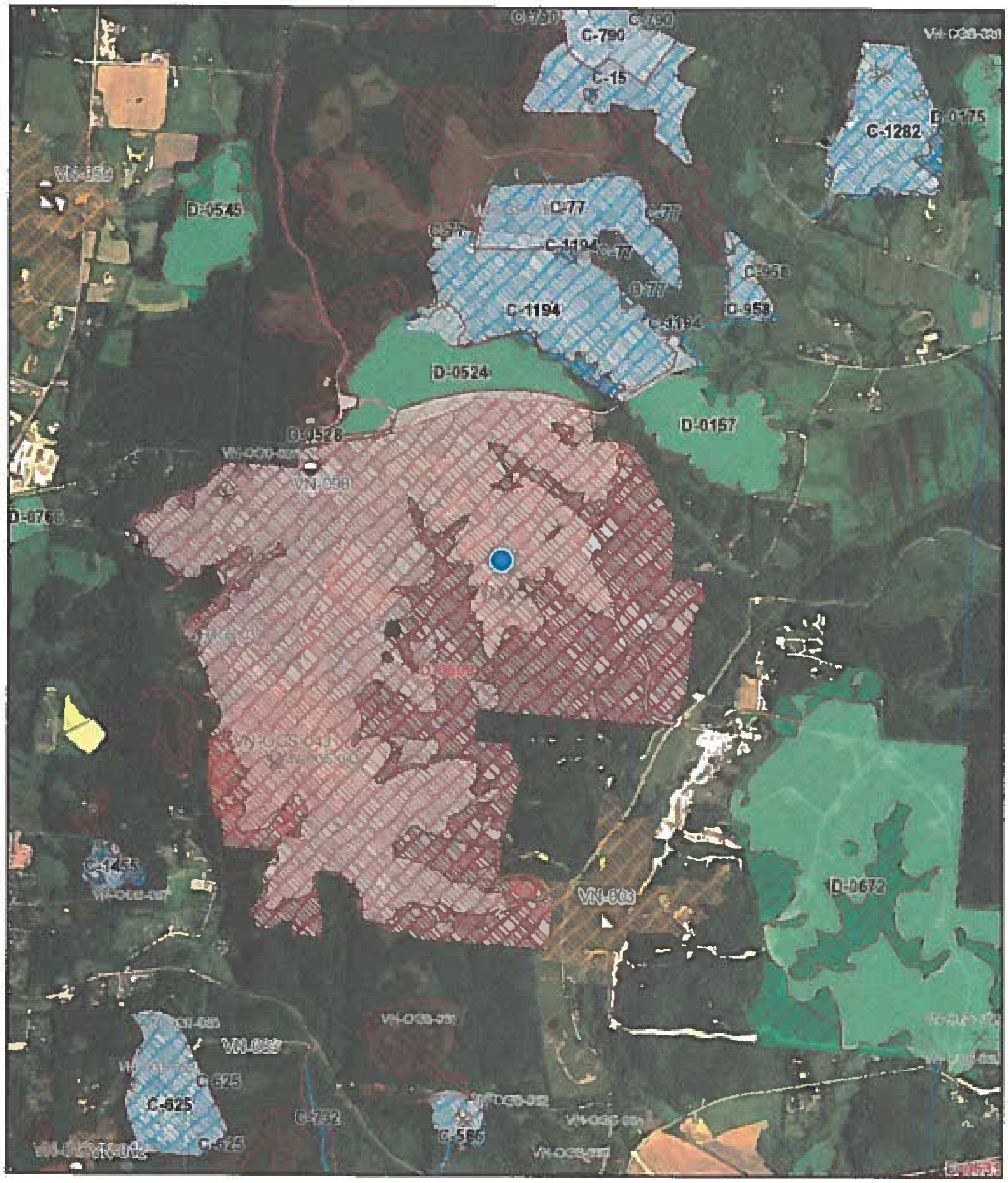
a. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

Joint Openness Descriptors

Openness	Descriptor
No Visible Separation	Tight
Less than 1/32 in.	Slightly Open
1/32 to 1/8 in.	Moderately Open
1/8 to 3/8 in.	Open
3/8 in. to 0.1 ft.	Moderately Wide
Greater than 0.1 ft.	Wide

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers. 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

Vinton Solar Project



May 1, 2017

Current	Past
Air Shaft	Air Shaft
Drift Entry	Drift Entry
Vertical Mine Shaft	Vertical Mine Shaft
Slope Entry	Slope Entry
	Locations

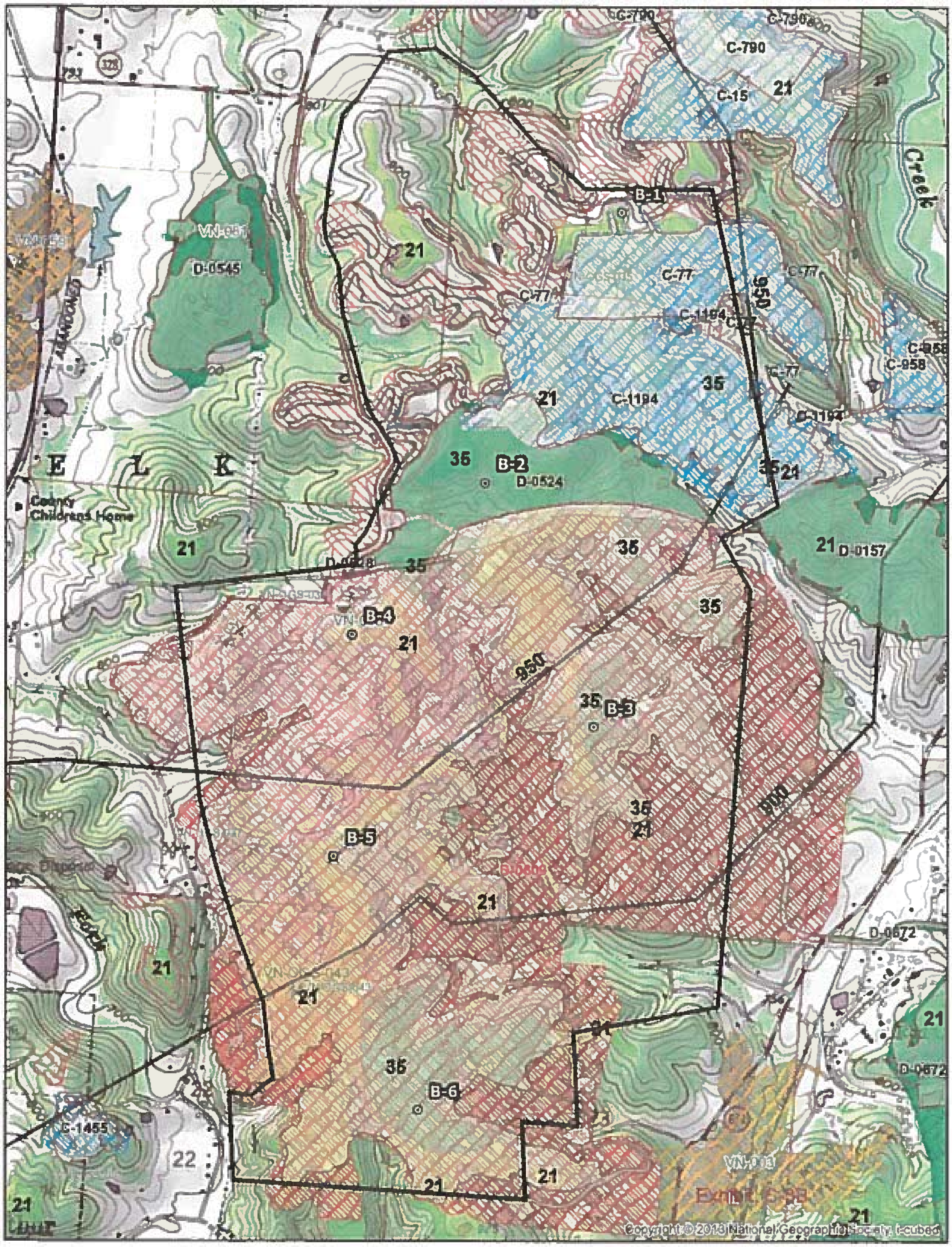
N

0 0.3 0.6 1.2 mi
0 0.5 1 2 km

1:36,112

Exhibit: C-3A

Ohio Dept. of Natural Resources


C-790
C-15
21
Creek
B-1
D-0545
21
C-77
950
C-1194
35
C-958
21
C-1194
E L K
County Childrens Home
35
B-2
D-0524
21
35
21
D-0157
35
B-4
21
950
35
B-3
35
21
900
B-5
21
D-0672
21
21
21
D-0672
35
B-6
C-1455
22
21
21
21
21
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Vinton Solar Energy LLC
Case No. 17-774-EL-BGN
Supplement to Application
August 15, 2017

Attachment 3b

Thermal Resistivity Test Results

by Terracon Consultants, Inc.
June 1, 2017

Christine M.T. Pirik (0029759)
(Counsel of Record)
William V. Vorys (0093479)
Dickinson Wright PLLC
150 East Gay Street, Suite 2400
Columbus, Ohio 43215
Phone: (614) 591-5461
Email: cpirik@dickinsonwright.com
wvorys@dickinsonwright.com

Attorneys for Vinton Solar Energy LLC

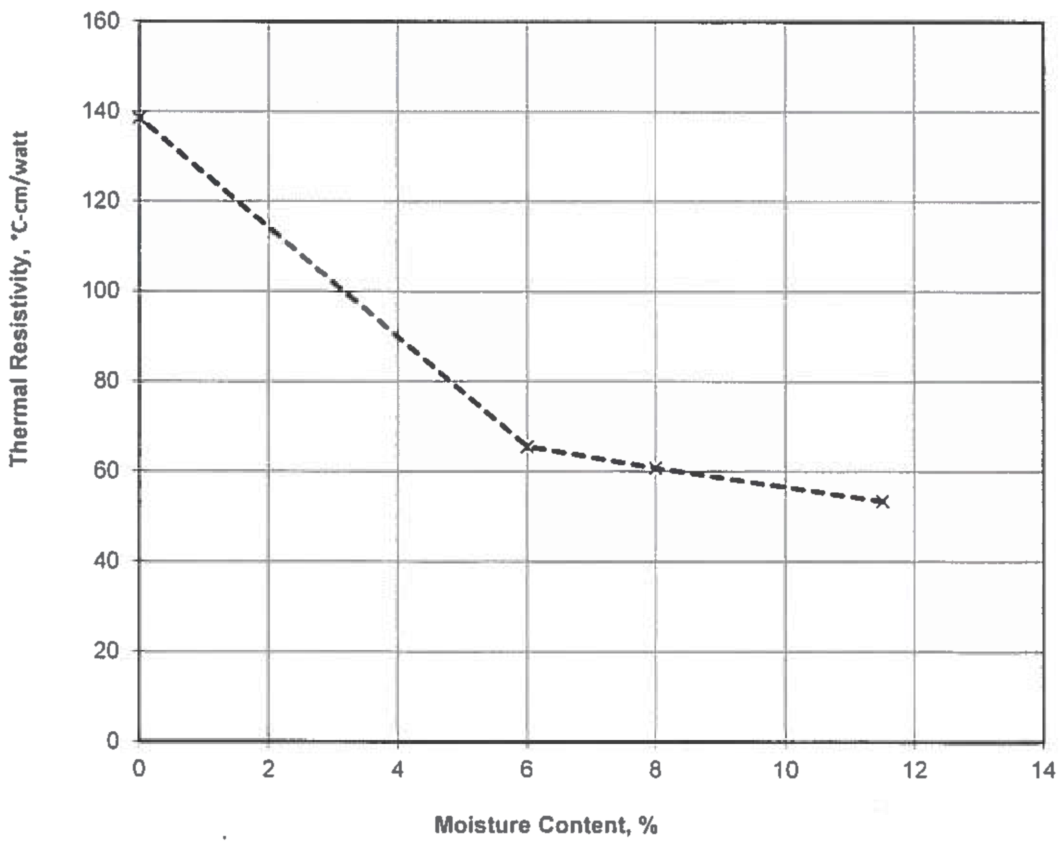
Project Name: Vinton Solar Power Facility
Project Number: N4175101

Thermal Resistivity Test Results

Moisture Content (%)	Thermal Resistivity (°C-cm/watt)	Temperature (°C)
11.5	53	18.9
8.0	61	20.8
6.0	65	20.3
0.0	139	25.2

Sample ID: B-1, 0.9-5 feet
Soil Type: Light Brown Sand
Standard/Modified Proctor: ASTM D 1557-A
Max Dry Density, pcf: 125.2
Optimum Moisture Content, %: 10.7
Target % Compaction: 85
Sample Dry Density, pcf: 105
Sample % Compaction: 84

Thermal Resistivity Dry-Out Curve



Date: 6/27/2017	Run By: TKS	Reviewed By: RB

Terracon

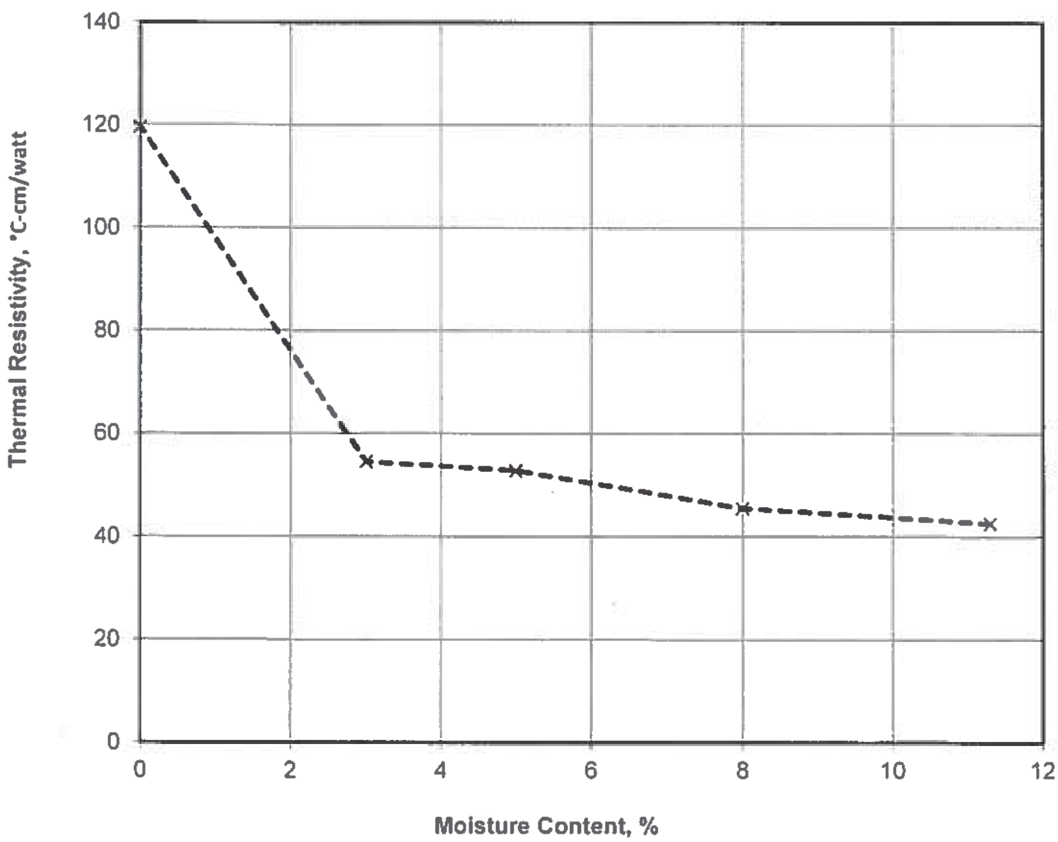
Project Name: Vinton Solar Power Facility
Project Number: N4175101

Thermal Resistivity Test Results

Sample ID: B-2, 0.9-5 feet
Soil Type: Tan Brown Sand w/Clay
Standard/Modified Proctor: ASTM D 1557-A
Max Dry Density, pcf: 126.5
Optimum Moisture Content, %: 9.8
Target % Compaction: 85
Sample Dry Density, pcf: 107
Sample % Compaction: 84

Moisture Content (%)	Thermal Resistivity (°C-cm/watt)	Temperature (°C)
11.3	43	19.0
8.0	45	20.8
5.0	53	20.2
3.0	54	20.2
0.0	120	24.5

Thermal Resistivity Dry-Out Curve



Date: 6/27/2017	Run By: TKS	Reviewed By: RB

Terracon

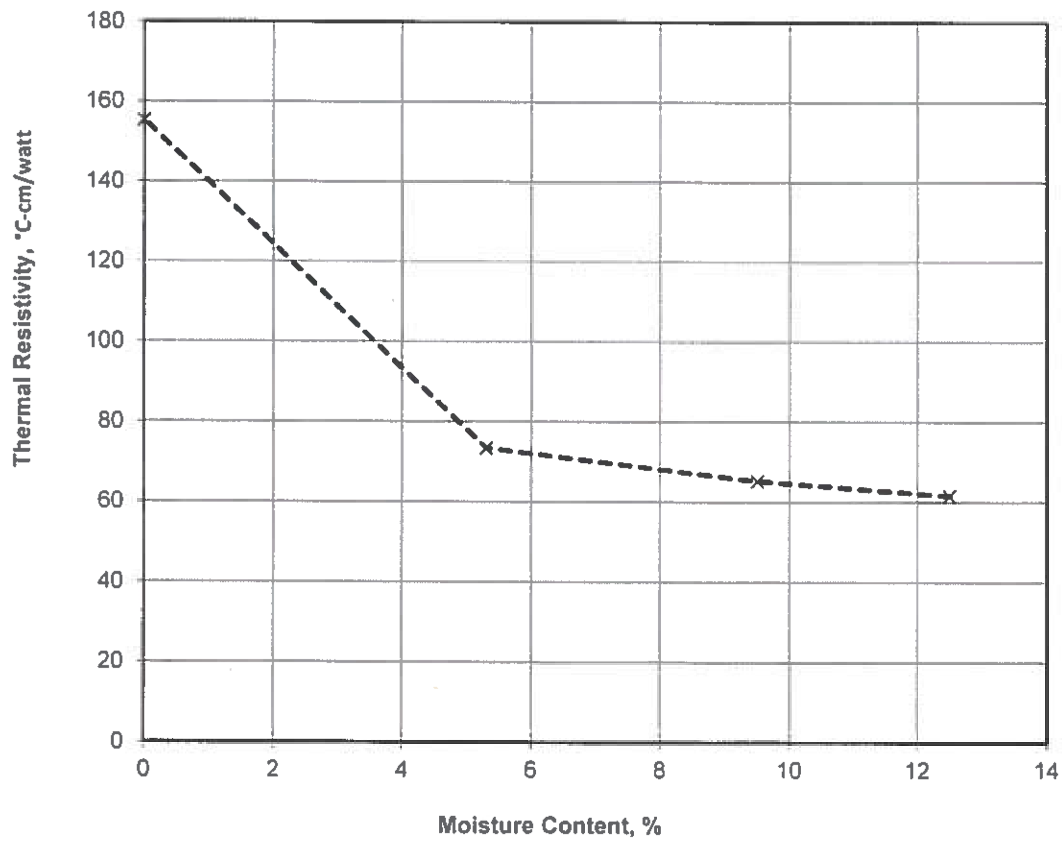
Project Name: Vinton Solar Power Facility
Project Number: N4175101

Thermal Resistivity Test Results

Moisture Content (%)	Thermal Resistivity (°C-cm/watt)	Temperature (°C)
12.5	62	19.2
9.5	65	20.6
5.3	73	20.1
0.0	155	23.4

Sample ID: B-5, 0.9-5 feet
Soil Type: Gray Clay
Standard/Modified Proctor: ASTM D 1557-A
Max Dry Density, pcf: 120.9
Optimum Moisture Content, %: 12.0
Target % Compaction: 85
Sample Dry Density, pcf: 103
Sample % Compaction: 85

Thermal Resistivity Dry-Out Curve



Date: 6/27/2017	Run By: TKS	Reviewed By: RB

Terracon

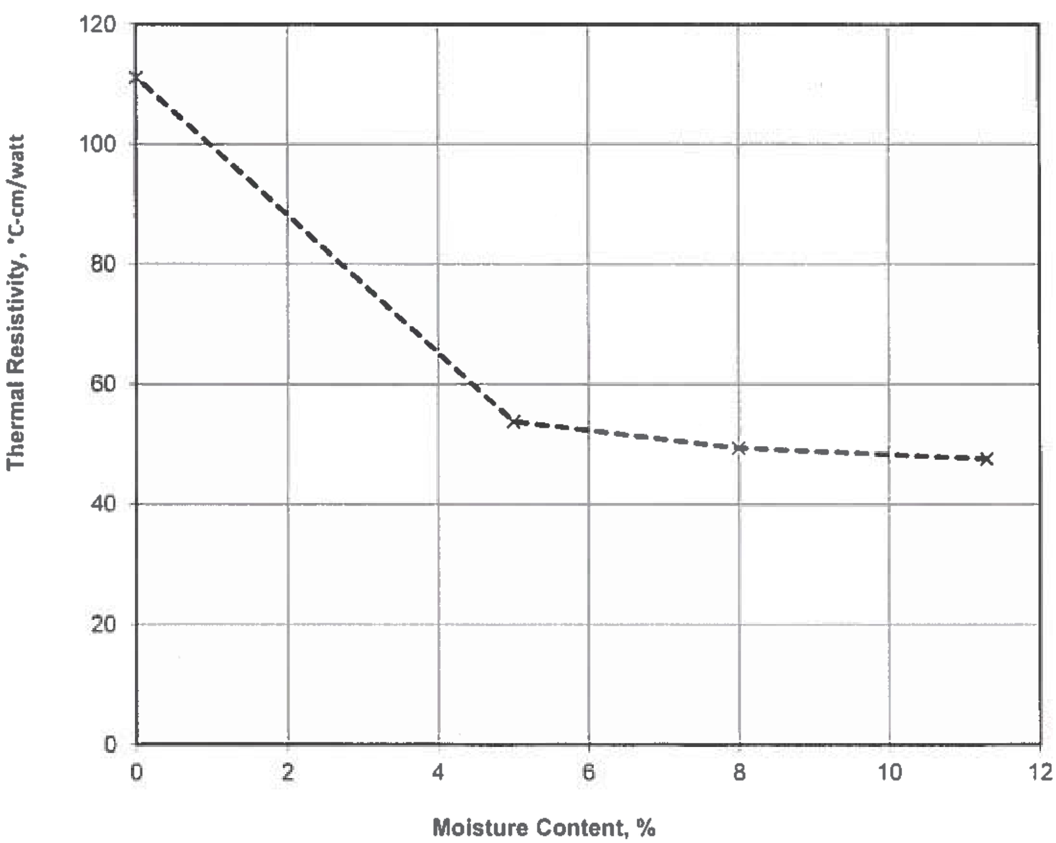
Project Name: Vinton Solar Power Facility
Project Number: N4175101

Thermal Resistivity Test Results

Sample ID: B-6, 0.9-5 feet
Soil Type: Gray Clay
Standard/Modified Proctor: ASTM D 698-A
Max Dry Density, pcf: 124.6
Optimum Moisture Content, %: 10.6
Target % Compaction: 95
Sample Dry Density, pcf: 118
Sample % Compaction: 94

Moisture Content (%)	Thermal Resistivity (°C-cm/watt)	Temperature (°C)
11.3	48	19.1
8.0	49	20.7
5.0	54	20.2
0.0	111	24.5

Thermal Resistivity Dry-Out Curve



Date: 6/27/2017	Run By: TKS	Reviewed By: RB

Terracon

Vinton Solar Energy LLC
Case No. 17-774-EL-BGN
Supplement to Application
August 15, 2017

Attachment 4

Figure 08-5.1

Land Use Map
July 12, 2017

Christine M.T. Pirik (0029759)
(Counsel of Record)
William V. Vorys (0093479)
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Columbus, Ohio 43215
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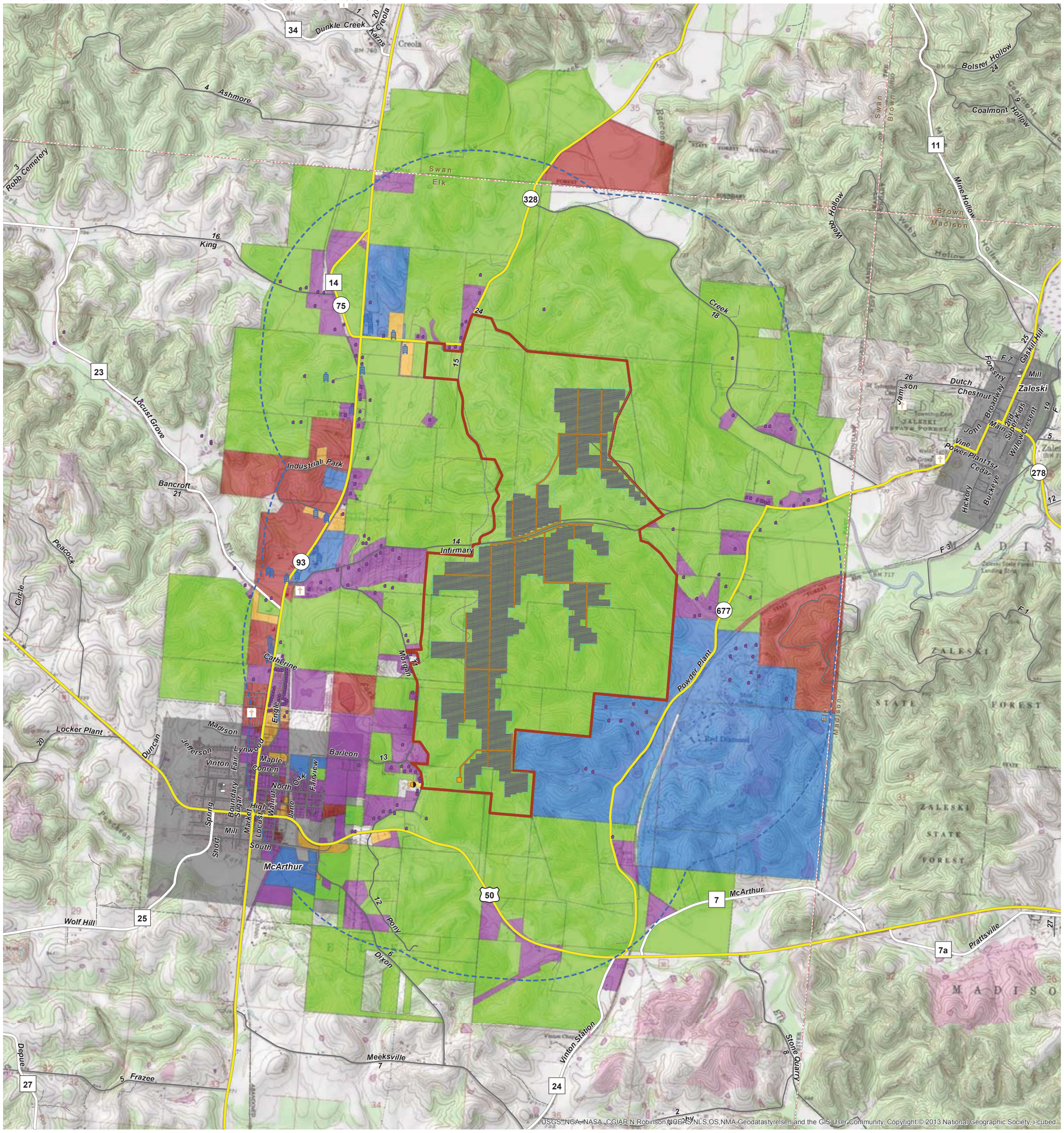
Attorneys for Vinton Solar Energy LLC



Legend

- POI
- Inverter
- substation
- Residence
- Commercial Building
- School
- Church
- Cemetery
- Modules
- Fence
- Access Road

Road Classification

- US/State Route
- County Road
- Local Road
- Dirt/Unpaved Road

Land Use

- Residential
- Agriculture
- Commercial
- Industrial
- Utility and Railroad
- Exempt
- Proposed Project Boundary

1,500 0 1,500
Feet
1:24,000

Land Use Map

Vinton Solar Energy Center, Vinton County, Ohio

Rev. 00
July 12, 2017

Invenergy