Petition No. 1221
Interrogatories
Set One
April 14, 2016
Windham Solar LLC (WS) Responses April 28, 2016

General Questions

1. Windham Solar LLC (WS) included an abutters map under Exhibit D of its Petition (Petition) dated March 15, 2016 for the proposed project in Plainfield. Please submit a properly-labeled abutters map identifying each parcel owner, including but not limited to, the abutters listed in Exhibit D of the petition.
   A revised Map has been attached identifying parcels, and the associated owners. – Exhibit A

2. Where is the nearest off-site residence from the center of the eastern portion of the project? Provide the distance, direction, and address of such off-site residence. Where is the nearest-off-site residence from the center of the western portion of the project? Provide the distance, direction, and address of such off-site residence.
   The overall site plan has been revised to show dimensions from the homes to the closest modules to the facility and parcels are identified. – Exhibit B

Electrical / Energy Questions

3. The proposed project consists of two 1.0 megawatt (MW) and one 1.5 MW solar arrays totaling 3.5 MW. Is that 3.5 MW power output for the proposed solar project based on alternating current (AC)? If no, explain.
   Output to the grid is calculated in AC. The AC:DC ratio of the project is 1:1.17.

4. Indicate which solar arrays on the Overall Site Plan (Sheet 3 of 17) are the 1 MW arrays and which array is the 1.5 MW array.
   Boundaries have been added to the overall site plan, illustrating each array area. – Exhibit B

5. Page five of the Petition indicates that, "Each Facility will consist of approximately 3,395 solar modules (based on a module rating of 345 watts)." How many "Facilities" is the Petitioner referring to? In other words, how many multiples of 3,395 solar modules are proposed? Please provide the number of solar modules for the two 1.0 MW and one 1.5 MW arrays and for the entire proposed project.
   Boundaries have been added to the overall site plan illustrating each array area and total module count. – Exhibit B

6. Provide the total direct current (DC) power output in MW for the project based on the total number of modules and wattage of such modules.
   The Maximum DC power output for each project on the site is based on the use of a 345w module throughout the site:
   North Project = 4680 Modules x 345W Module = 1,614,000 Watts DC
   East Project = 3456 Modules x 345W Module = 1,192,320 Watts DC
   South Project = 4248 Modules x 345W Module = 1,465,560 Watts DC

   Each project may be reduced in overall DC by using a lower wattage module, or removal of modules due to shading, or interconnection limitations.

7. In general, in the case of fixed solar panels, does orienting your solar panels to the south provide a sort of balance (in terms of sun exposure) between the sun rising in the east and setting in the west and ultimately result in optimizing (or attempting to maximize) your total annual energy production (in kilowatt-hours) and your capacity factor?
   This statement is correct for the WS project. There are situations in some parts of the country where a more westerly orientation is preferred in order to maximize energy production during peak demand periods, but this is usually only considered in situations where the power purchaser pays a time-of-use rate that is higher during peak demand periods than what is paid during shoulder or off-peak periods.

8. On page 7 of the Petition, WS notes that, according to the 2012 Integrated Resources Plan (IRP), the capacity factor for PV solar (and thus the proposed project) is approximately 13 percent. Is that based on the DC or AC side of the proposed solar facility?
   The 13% capacity factor stated in the 2012 Integrated Resources Plan for Connecticut is based on the DC nameplate of a solar facility.

9. How many 1,000-kilowatt inverters would be installed?
   (2) 1,000 kW inverters and (1) 1500 kW inverter is planned to be installed, however, WS may elect to utilize a 60 kW string inverter design. In the case of a string inverter design, approximately 75 – 60 kW inverters would be installed throughout the projects.

10. Provide the specifications sheet for the inverters.
    Attached are two specifications of the PV inverters that are currently being considered for the project. - Exhibit C

11. Provide the specification sheet for the proposed solar photovoltaic modules/panels.
    Attached are two specification of the PV modules that are currently being considered for the project. – Exhibit D

12. What are the estimated heights of the transformers and inverters?
    The transformer is approximately 7' high. The 1,000 kW centralized inverter is approximately 7' high. The 60 kW string inverters would be mounted at a height of approximately 5' – 6' high and be located throughout the array field.A cut sheet of a typical inverter/transformer pad has been added (2-1000-kilowatt inverters and 1 2000KvA transformer) – Exhibit E

13. Does Eversource currently have three-phase overhead electrical distribution on Plainfield Pike Road (Route 14A)?
    Yes.

Construction Questions

14. Would the tree clearing be performed in stages (e.g. five acres at a time), or would the clearing all be performed together as one stage of construction? (Note: Connecticut Department of Energy and Environmental Protection "DEEP" General Permit for the Discharge of Stormwater and Dewatering Wastewasters Associated with Construction Activities states that, "Whenever possible, the site shall be phased to avoid the disturbance of over five acres at a time…")
    Tree clearing will be phased per the DEEP requirements, and the federal NPDES requirements.

15. Estimate the amounts of cut and fill in cubic yards.
    500 yards cut and 500 yards fill, no export or import of soil is anticipated.

16. Approximately how tall would the poles be for the video cameras and meteorological equipment noted on page 12 of the Petition?
    Video and meteorological poles at the central skid will be 12' to 15' high. Approximately 6-10 perimeter fence posts per project limits will be installed at 12' high and will have motion detecting video mounted to atop the higher fence posts. These locations will be based on the final footprint, and camera sight lines. The cameras are battery powered, and run on an internal wireless project network.

17. How would the H-beams (that support the racking system) be driven into the ground?
    The intent is that a majority of the H-beams will be driven pile. However, an alternative grouted foundation is also designed if subsurface boulders or ledge is encountered. All structural pile designs will be signed by a CT licensed Professional Engineer.

18. What are the estimated constructed hours (e.g. Monday through Friday 8 AM to 5 PM)?
    Local zoning code working hours will be adhered to which are as follows:

    Plainfield Zoning Code Section 12.32.7.d.:
    Hours of operation. Operating hours shall be between the hours of 7:00 AM and 7:00 PM in all but the Industrial District. The Commission may stipulate reasonable operating hours which may be more or less restrictive depending upon the nature of surrounding land uses.
    .

19. Approximately what size mesh does WS anticipate utilizing for the chain link fence? While 2-inch mesh is a common size, would WS consider utilizing a mesh size less than two inches as an anti-climbing measure? Would the fence have barbed wire?
    7' chain link would be preferred. The sites security system will identify intruders or a breach in the perimeter on the site. WS would consider a smaller mesh, if costs are similar. The majority of our sites do not have barb wire given our planned security measures, and barb wire is not intended for this project.

20. Did WS consider an overhead electrical connection as a way to minimize disturbance in the vicinity of wetlands? Provide the pros and cons of overhead versus underground electrical connections.
    An overhead alignment will be explored at the final design. If underground conduit is installed crossings of conveyances within the wetlands would be directionally bored, so existing hydraulic flow lines remain undisturbed. Our experience has shown if conduit is open trenched in areas that convey water, that it eventually erodes, and becomes a site maintenance and erosion issue.

Environmental Questions

21. Did the Petitioner attempt to minimize wetland crossings when designing the access drives to each of the three solar arrays? For example, for the center (or southwestern) solar array, could the access to that solar array be shifted to the northwest to reduce the 1,455 square feet of wetland impacts? (See Overall Site Plan – Sheet 3 of 17).
    The site visit, and updated wetland report, identifies a brook on the site that has constant flow, the crossing location has been abandoned and WS is exploring other options for accessing the central area of the site. Also the alignment of the access roads have been revised given the site visit to more upland locations and the overall project wetland impact has been reduced to 4660 sf. - Exhibit B

22. Has the Petitioner received a response from the Connecticut Department of Energy and Environmental Protection regarding the Natural Diversity Database to date? If yes, provide a copy of such correspondence. While DEEP reviews state-listed species, are any federally-listed species known in the vicinity of the proposed project? If yes, describe possible impacts to such species and mitigation measures.
    WS is still awaiting a response from DEEP on the project, our submission was made in November of 2105.

    A search of the Federal Endangered Species highlights the following Species Occurrence on the project:

    Animals
        Northern long-eared Bat (Myotis septentrionalis)
        Piping Plover (Charadrius melodus)
    Plants
        Sandplain gerardia (Agalinis acuta)
        Small Whorled pogonia (Isotria medeoloides)

    A wildlife biologist will be contacted to perform a site visit and determine if the site possesses the appropriate habitat for the above plants and animals. The biologist will determine if mitigation measures are necessary, and to what extent.

23. Is the total tree clearing area for the proposed project about 18.4 acres? If no, provide the total tree clearing area. Does this total also include the tree removal in wetland areas? Approximately how many acres of tree clearing in wetland areas are expected?

    The revised site plan has the following values:
    Total site clearing = 18.07 AC
    Clearing in wetland = 0.10 AC
    Clearing in wetland buffers = 3.6 AC

24. Provide the carbon debt payback period. Specifically, as an estimate, you may utilize the U.S. Environmental Protection Agency (EPA) number of 1.22 metric tons of carbon dioxide sequestered by one acre of average U.S. forest in one year. That number can be multiplied by the number of acres of trees to be cleared to estimate the annual loss of carbon dioxide sequestration in metric tons per year for the project. Then the total projected annual electrical production in kilowatt-hours for the solar facility can be multiplied by the EPA estimate of 6.89551×10^{-4} metric tons of carbon dioxide displaced per kilowatt-hour in order to provide the annual carbon dioxide emissions avoided by the operation of solar plant. Based on this or a different analysis, compute the number of months or years it would take to "break even" with carbon dioxide or when the carbon dioxide emissions reductions would equal the sequestration loss. (Data source: http://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references)
    WS is proposing to clear 18.1 acres as part of the construction of the facility. Based on the formula provided above, the loss of carbon dioxide sequestration would be 22.082 tons per year. The WS facility is expected to generate 5,434,065 kWh during its first year of operation, degrading by 0.5% per year thereafter. Based on the EPA estimates provided above, the WS facility would off-set 3,747 metric tons of carbon dioxide during its first year of operation or approximately 10.27 tons per day. Therefore, the sequestration loss from clearing the trees would be off-set by the solar facility in 2.15 days of operation in the first year.

25. On page 11 of the Petition, WS estimates 115,000 tons of CO_2 equivalent offset or eliminated during the 45-year life of the facility. How was the 115,000 tons computed?
    The carbon off-set estimates provided in the Petition for Declaratory Ruling were based off of an estimated carbon off-set rate of 1.645 lbs per kWh of generation. This figure was based on a generation mix of 50% coal (2.07 lbs per kWh) and 50% natural gas (1.22 lbs per kWh) (source: https://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11). Windham Solar is willing to accept the calculations provided by the EPA above.

26. Has the Petitioner received a response from the State Historic Preservation Office to date? If yes, provide a copy of such correspondence.
    An application was submitted to SHPO by WS in mid-February. WS is still awaiting a response from SHPO on the parcel.

27. Is the proposed project located within an aquifer protection area?
    No, an acquifer protection map has been attached. - Exhibit F

28. Is any of the proposed project located within a 100-year or 500-year flood zone? If yes, indicate which portion(s) of the project area are located within flood zones, and provide a Federal Emergency Management Agency flood zone map that includes the subject property.
Yes, a portion of the western site is Zone A, no modules are proposed in the area, and the mapping is not following existing topography. An Elevation of the Zone will be requested from FEMA to determine the flood elevation in the aera. A freeboard separation of 1 foot from that elevation will be incorporated to the design of all electrical generating equipment.

29. In Exhibit H of the Petition, it is stated that a stormwater pond would be necessary to control stormwater runoff. On the Overall Site Plan, indicate the location of the stormwater pond. Would construction of the stormwater pond be within wetlands? Is so, identify the square feet of disturbance and permits necessary for this action.
Ponding will be installed at a continuous elevation at the perimeter of the site footprint, and sized upon the contributing drainage area, construction will not occur within the wetlands, but potentially within the wetland buffer. Post construction hydraulic discharge from the site, will be less than pre construction values. Detailed hydrology, and grading design, will be an element of the project construction documents.

30. In Exhibit F of the Petition, by letter dated February 2, 2016, Highland Soils, LLC indicated that a more detailed wetland report would be prepared following another site visit. Does the Petitioner have an updated Wetlands Report at this time? If yes, provide a copy of such full report. Were any vernal pools located as a result of such site visit? Are any additional wetland and/or vernal pool protective measures proposed at this time? If no visit has been made, provide an estimated timeframe for the visit and updated report.
Updated Wetland report with vernal pool analysis is attached –Exhibit G.

31. If vernal pools are identified as result of a site visit, include the following. Describe the methodologies used to evaluate the vernal pools and include the date(s) of his studies. Specifically detail how the egg masses were counted, how many visits over what period of time were made, and indicate if any other techniques such as minnow trapping were used, if applicable.
Updated Wetland report with vernal pool analysis is attached –Exhibit G.

32. If vernal pools are identified as a result of a site visit, include the following. Analyze the vernal pools using the Calhoun and Klemens methodology. While forested habitat is preferable, open habitat may be used and also can serve as areas that animals move through. Open habitat also over time can improve by regrowth. It cannot be merely discounted as developed habitat as one can have areas that have houses and roads. An excellent example of how to correctly analyze a habitat that has various components is that for Council Docket 455 (Tab 14 of that application) which clearly shows the correct treatment of wooded, open and grassed areas, versus developed areas. Only the developed areas are considered to be lost habitat. This document, as a sample wetlands and vernal pool analysis, has been attached for your convenience. The map at the end of the document is a useful template or reference.
Updated Wetland report with vernal pool analysis is attached –Exhibit G.

33. Would WS comply with the recommendations on page 22 of the Phase I Environmental Site Assessment?
    WS doesn't intend on any additional investigation given the location of the foundation and that there is no proposed disturbance in the area.

34. Would the solar panels "heat" rainwater and potentially thermally pollute wetlands?
    No. There is no evidence that this occurs given the short duration that rainwater is on the panels, furthermore, the panels would be clouded during the time of rainfall, so surface temperatures of the panels would be less than on a sunny day.

35. Would the proposed project meet the applicable DEEP noise standards at the boundaries of the subject properties? (Sources of noise might include but not be limited to inverters, transformers, etc.)
    Yes.

Maintenance Questions

36. How would WS handle potential snow accumulation on the panels and its effects of blocking the sunlight?
    Snow soiling has been accounted for in our solar modeling, no cleaning of panels is contemplated.

37. Has WS done any analysis to determine structural limits of snow accumulation on the solar panels and steel support structures, assuming heavy, wet snow? What accumulation of snow could the structures handle? Would WS clear snow from the panels when it approached the limit?
    The project racking will be designed for the regions wind and snow loading, and will be stamped by a licensed structural engineer. No clearing of snow is contemplated.

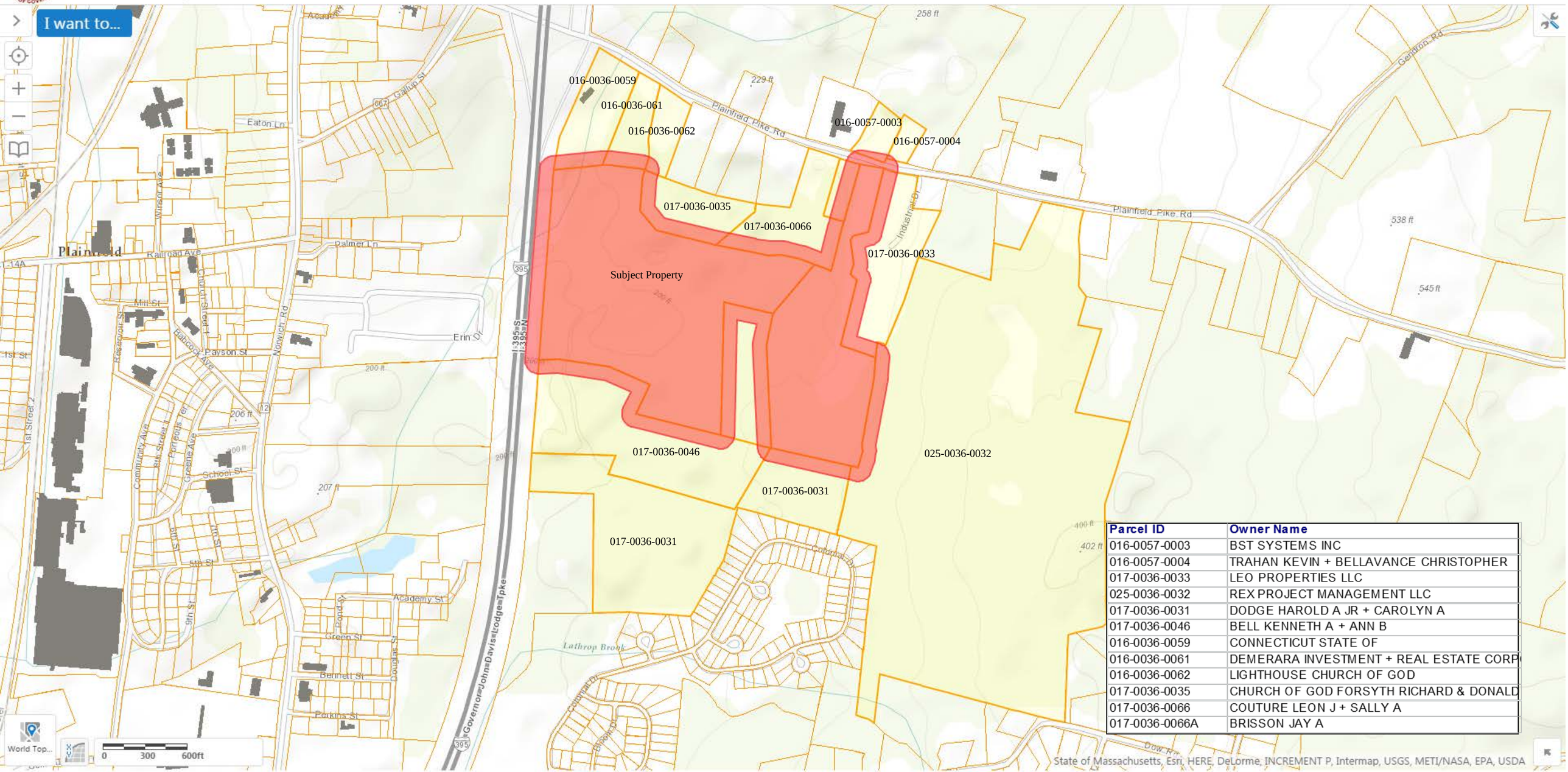
38. Would any mowing be required under or around the proposed solar panels/modules, and if so, approximately how often would mowing occur?

    Below is a typical operations and maintenance schedule, an operations and maintenance manual will be included in the projects final design.

    Monthly:
    Inspect the site vegetation growth, and establish a mowing schedule keeping vegetation between 6" and 18". Any growth above 18" begins shading lower elevation panels.
    Inspect the gravel roadways for washout locations or potential erosion issues, schedule maintenance as necessary
    Inspect the array field for any locations where excessive growth is identified, schedule maintenance as necessary

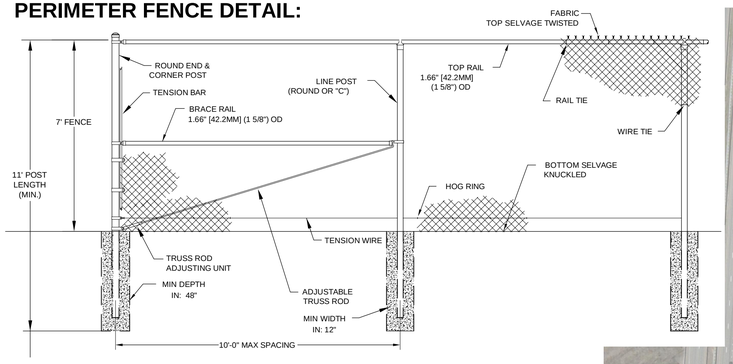
    Bi-Annually (April and October):
    Inspect vegetation during both the growing and non-growing seasons to ensure proper groundcover density.

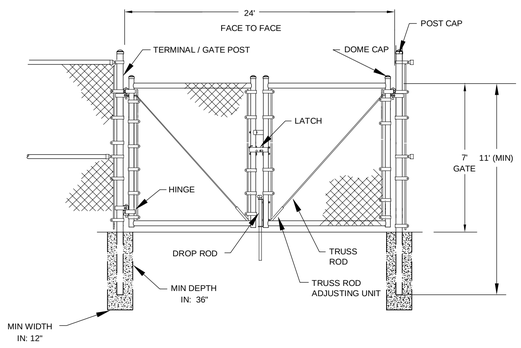
Identify stumps and areas within the array or at the perimeter, that have grown to create shading, schedule maintenance as necessary.
Replant bare areas or areas with sparse growth with the project specific seed mix.
Inspect perimeter landscaping screening, to ensure ongoing establishment of new plantings.



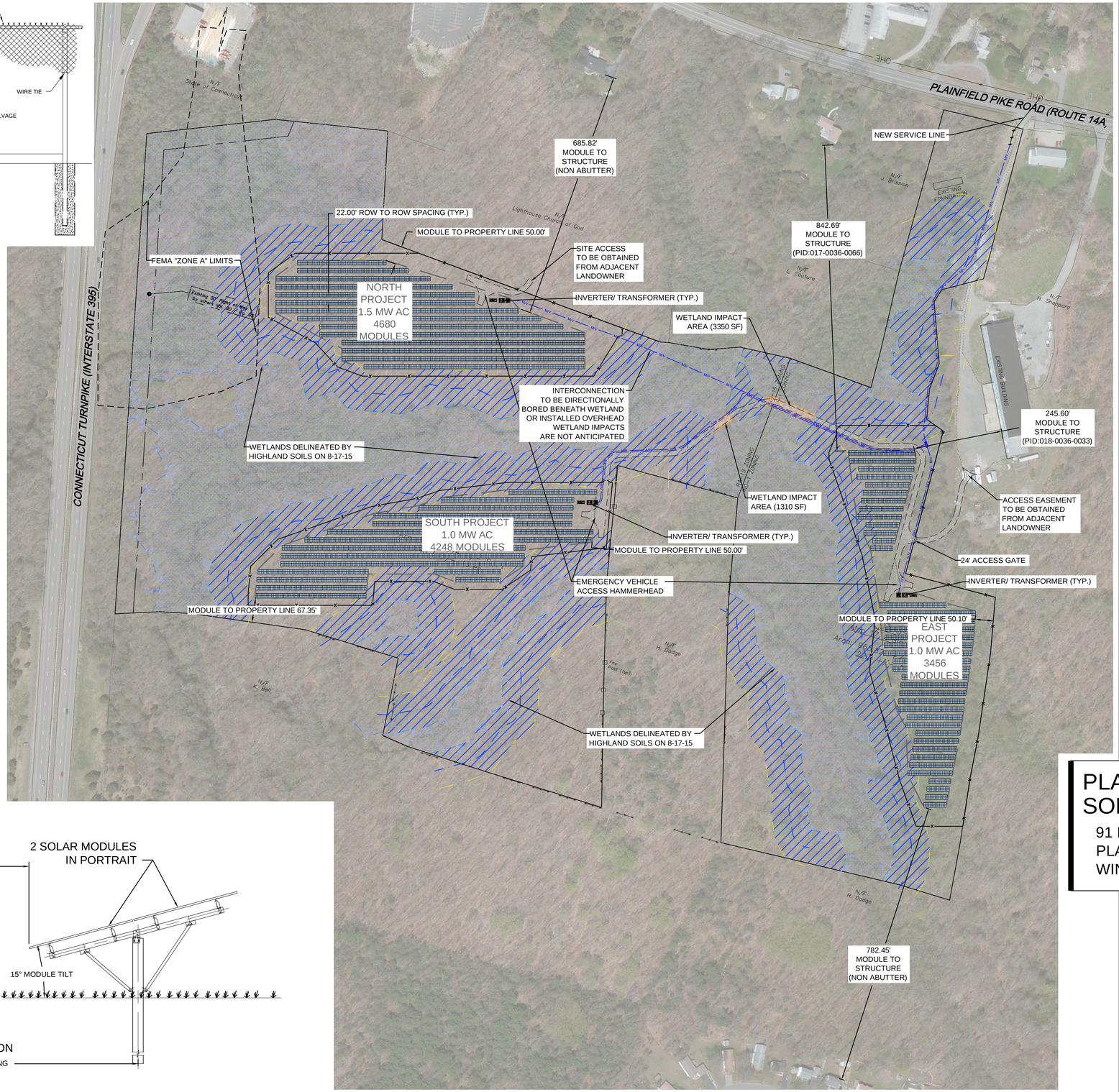
Parcel ID	Owner Name
016-0057-0003	BST SYSTEMS INC
016-0057-0004	TRAHAN KEVIN + BELLAVANCE CHRISTOPHER
017-0036-0033	LEO PROPERTIES LLC
025-0036-0032	REX PROJECT MANAGEMENT LLC
017-0036-0031	DODGE HAROLD A JR + CAROLYN A
017-0036-0046	BELL KENNETH A + ANN B
016-0036-0059	CONNECTICUT STATE OF
016-0036-0061	DEMERARA INVESTMENT + REAL ESTATE CORP
016-0036-0062	LIGHTHOUSE CHURCH OF GOD
017-0036-0035	CHURCH OF GOD FORSYTH RICHARD & DONALD
017-0036-0066	COUTURE LEON J + SALLY A
017-0036-0066A	BRISSON JAY A

PERIMETER FENCE DETAIL:





AERIAL SITE PLAN:



PROJECT AREAS & IMPACTS:

TOTAL SITE AREA = 67.2 ACRES

ARRAY FOOTPRINT= 16.9 ACRES (PROJECT FENCELINE LIMITS)

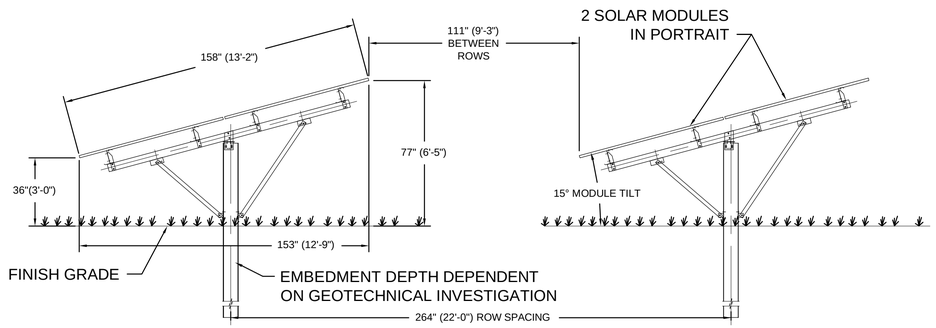
PROPOSED IMPERVIOUS:
GRAVEL ACCESS ROAD, STRUCTURAL POSTS & EQUIPMENT PADS = 1.18 ACRES

PROPOSED WETLAND IMPACTS:
0.24 ACRES FOR PROJECT ACCESS ROADWAYS
*ROADWAYS PROPOSED TO BE AT EXISTING GRADE IN WETLAND IMPACT AREAS TO MAINTAIN NATURAL DRAINAGE DIRECTIONS)

LEGEND:

- EXISTING PROPERTY LINE
- PROPOSED PROJECT FENCE
- PROPOSED GRAVEL ACCESS ROAD
- M/V — PROPOSED AC DISTRIBUTION
- 100' WETLAND BUFFER AREA
- WETLAND DELINEATION LINE
- 18 x 2 SOLAR MODULE BOCK

RACKING PROFILE DETAIL:



Westwood

Phone (480) 747-6558 6909 East Greenway Parkway, Suite 250
Fax (480) 376-8025 Scottsdale, AZ 85254
westwoodps.com

Westwood Professional Services, Inc.

Designed: ADC
Checked: SAW
Drawn: SJB
Record Drawing by/date:

Revisions:

#	DATE	DESCRIPTION
-	3/15/2016	CT SITING BOARD SUBMISSION
-	4/26/2016	CT SITING BOARD COMMENTS

Prepared for:

ecos ENERGY
222 SOUTH 9TH STREET
SUITE 1600
MINNEAPOLIS, MN 55402

PLAINFIELD PIKE SOLAR

91 PLAINFIELD PIKE RD
PLAINFIELD, CT 06374
WINDHAM COUNTY

OVERALL SITE PLAN

SITING BOARD REVIEW

DATE: 03/15/2016
SHEET: 3 of 17

NORTH AMERICA
OUTDOOR UTILITY SCALE
Solar Inverters

HEC-US

UTILITY SCALE SOLAR INVERTER

C US

EXTENDED MPPT
MPPt

AUTOMATIC REDUNDANT MODULAR MASTER SLAVE SYSTEM
ARM²S²

MULTIPLE MPPt
MPPt

REVOLUTIONAY COOLING

ADJUSTABLE POWER
DAY
NIGHT

OUTDOOR DURABILITY

INGRESS PROTECTION

HEC-US

The HEC-US central inverter is an industry leading modular system designed for outdoor use with a NEMA 3R Stainless Steel enclosure, pre-engineered DC Recombiner, AC output circuit breaker and built-in ARM^{2}S^2 revolutionary filter-less cooling system.

The HEC–US inverter is certified to UL-1741 and IEEE-1547 and designed for utility scale PV plants located in the most demanding environments. Power-Electronics inverters include proven dynamic grid support features that enhance grid quality and PV plant management.

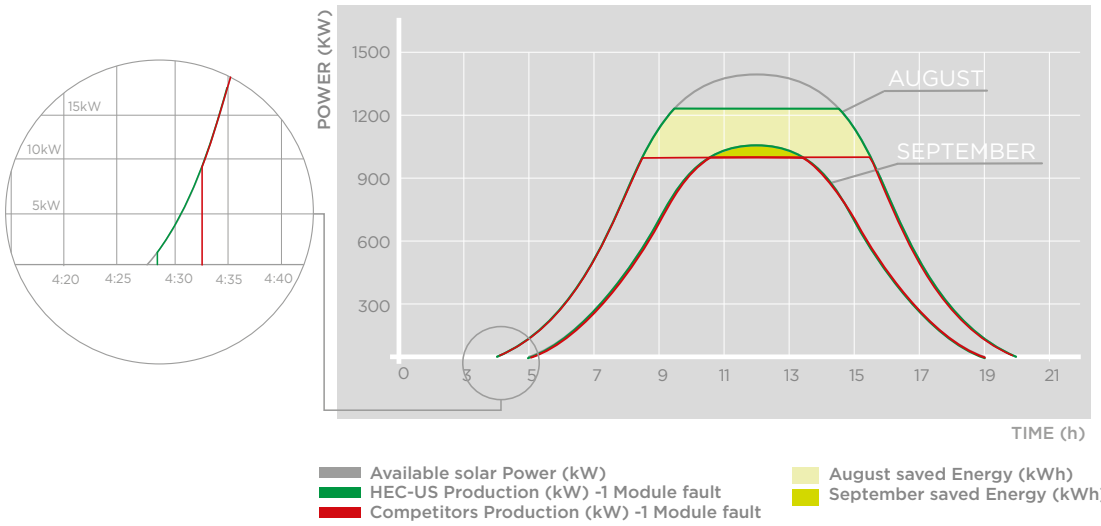
The HEC–US is available in a turnkey MW platform called the HEK Series. Delivered with factory tested Inverters, MV Pad-mounted transformer and auxiliary equipment, skid mounted solutions reduce installation and commissioning time and cost.

A MODULAR AND REDUNDANT SYSTEM MAXIMIZES UP-TIME AND PERFORMANCE

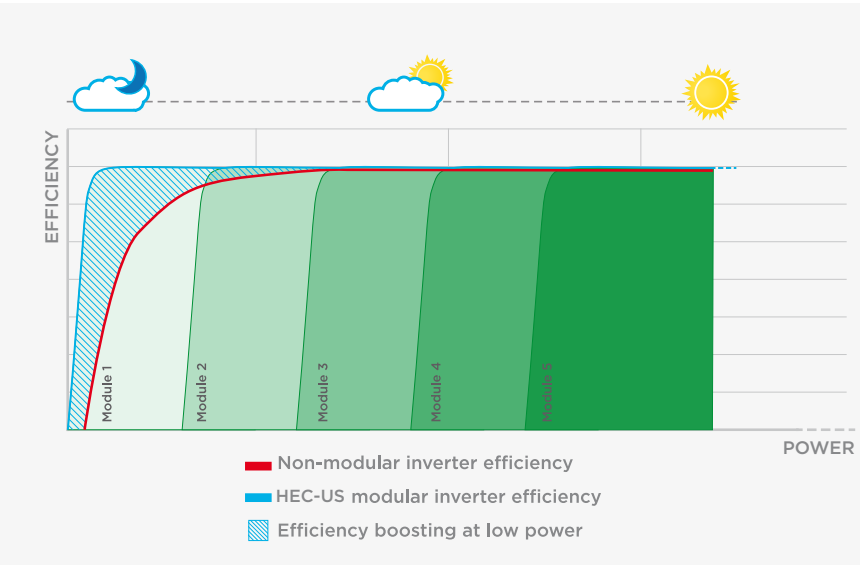
AUTOMATIC REDUNDANT MODULAR MASTER SLAVE SYSTEM

HEC-US topology combines the advantages of a central inverter with the availability of string inverters. HEC-US inverters are designed using 80 to 170 KVA independent modules. Each module is self-contained with its own control board, an independent power platform and its own cooling system, coupled together to common DC and AC buses. Each day, the HEC-US inverter wakes up with a single module power on-line. As the available PV power increases more modules are added to maintain peak inverter efficiency.

If there is a fault in one module, the faulted module is taken off-line and the output power is distributed evenly among the remaining system modules. All power modules work in parallel controlled by the master module. The master is the main governor of the system and is responsible for the MPPt tracking, synchronization sequence and overall protection. The automatic mode shifts the master module every night by comparing the register of energy production of all the modules in the system. The module with the least energy produced (kWh) will act as the master on the following day.



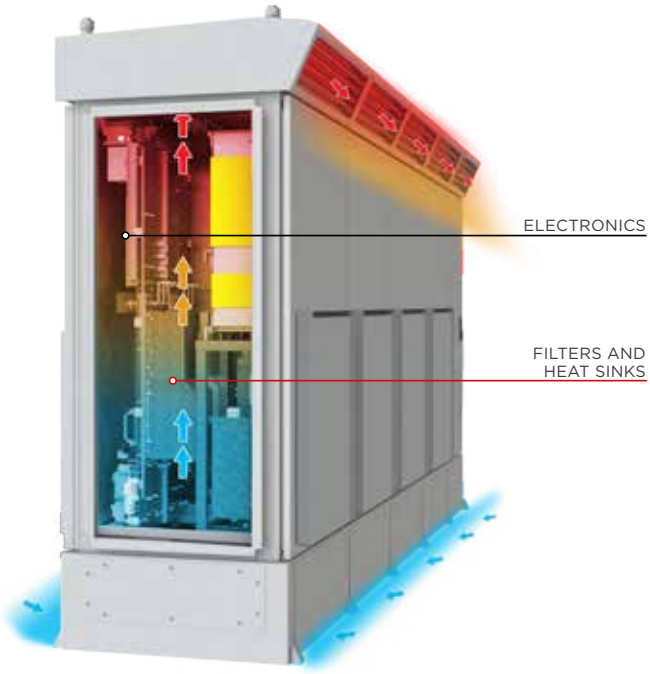
A modular inverter is more efficient than a central inverter. During low radiation conditions, a modular architecture uses the correct number of power modules to provide power while the central inverter must consume power internally to support the entire system. With lower losses, a modular inverter can begin to provide power earlier in the morning and stop later at the end of the day. As a result, throughout the entire service life of the PV plant, the HEC-US inverter generates higher yields than a central inverter with a higher reliability than string inverters.



REVOLUTIONARY COOLING SYSTEM

The design philosophy for the HEC-US inverters is to oversize sensitive components (like IGBTs & DC bus capacitors) and provide sufficient margin so the HEC-US can operate at 122F (50°C) with no power derating. Power-Electronics equipment is installed in mines, water treatment plants and concentrated solar power facilities in the most demanding locations in the world. Our expertise in harsh environments is the foundation for the perfect technical solution for our outdoor solar inverters.

The cooling systems on the HEC-US modules are divided into two main areas: the clean area (electronics) and the hot area (LC filters and heat sinks). The electronics are sealed in a NEMA 4 area and use a temperature control low flow cooling system that reduces filter maintenance. The hot area integrates independent speed controlled fans per each module that reduce stand-by consumption at low capacity, minimize audible noise and increase cooling capacity for PV installations located in hot environments or high altitudes.

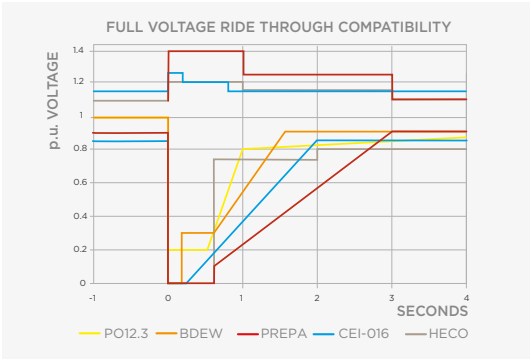


VAR AT NIGHT

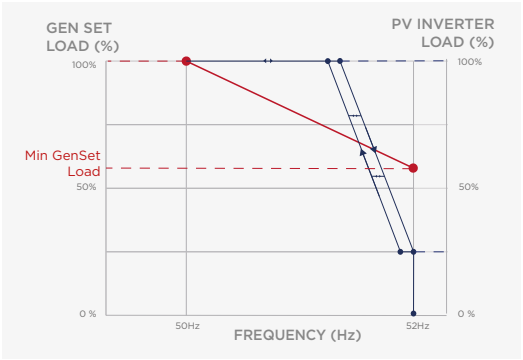
At night, the HEC-US inverter can shift to reactive power compensation mode. The inverter can respond to an external dynamic signal, a Power Plant Controller command or pre-set reactive power level (kVAr).

DYNAMIC GRID SUPPORT

HEC-US firmware includes the latest utility interactive features (LVRT, OVRT, FRS, FRT, Anti-islanding, active and reactive power curtailment...), and is compatible with all the specific requirements of the utilities.

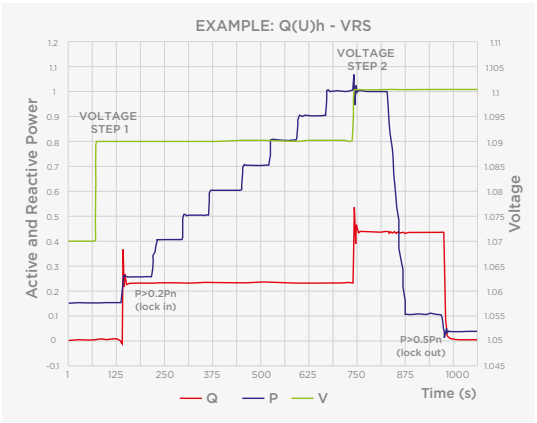


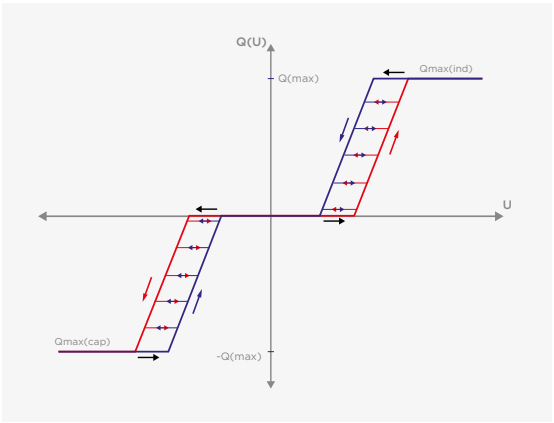
▲ **LVRT or ZVRT (Low Voltage Ride Through).** Inverters can withstand any voltage dip or profile required by the local utility. The inverter can immediately feed the fault with full reactive power, as long as the protection limits are not exceeded.

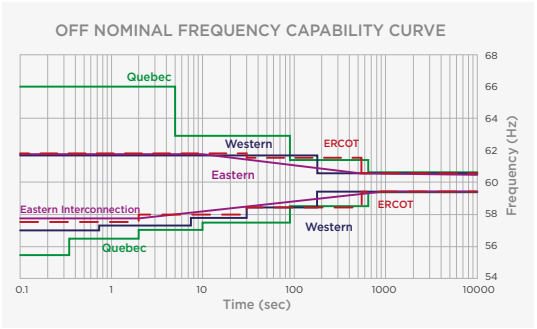


▲ **FRS: Frequency Regulation System.** Frequency droop algorithm curtails the active power along a preset characteristic curve supporting grid stabilization.

The advanced control allows the inverter to support the grid through reactive power injection or phase shift control by programming a wide range of fixed or dynamic power functions based on voltage and frequency inputs.







◀ **Frequency Ride Through:** Power Electronics inverters have flexible frequency protection settings and can be easily adjusted to comply with future requirements.

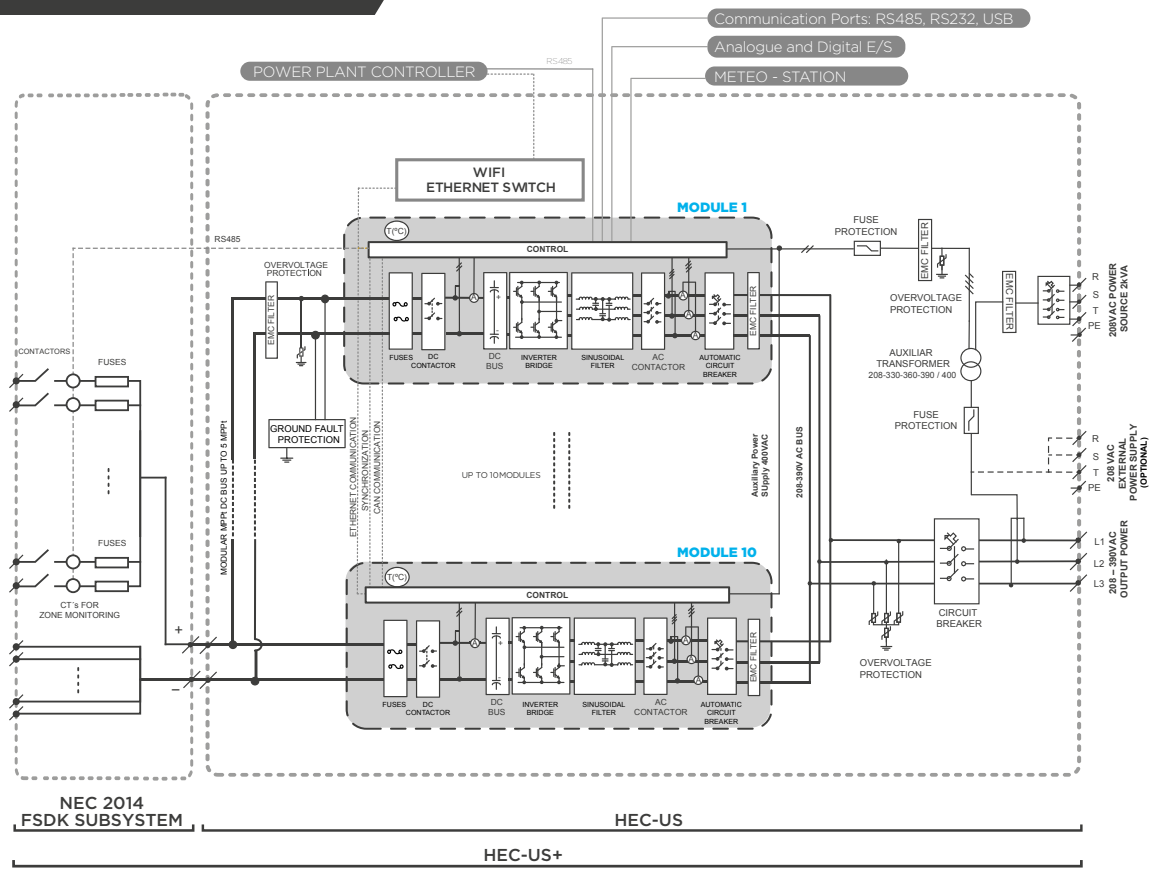
The HEC-US inverter has a unique anti-islanding protection that combines passive and active methods that eliminate nuisance tripping and reduce grid distortion. The inverter is certified to IEC 62116 and IEEE1547.

Power Electronics offers a **POWER PLANT CONTROLLER** that will allow both the PV plant operator and the utility to perform active and reactive power curtailment, voltage regulation and frequency regulation based on feedback from a power meter at the point of interconnection.

HEC-US

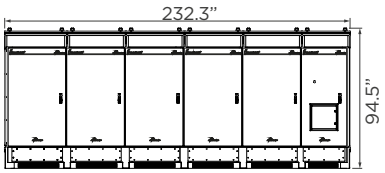
TECHNICAL CHARACTERISTICS

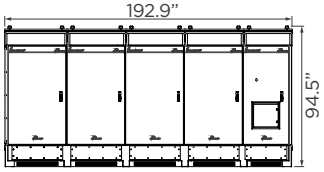
OPERATIONAL DIAGRAM

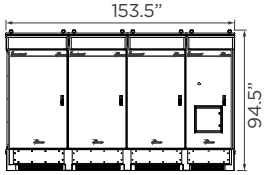


DIMENSIONS

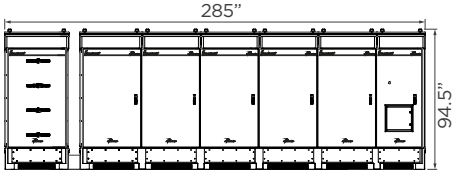
HEC-US

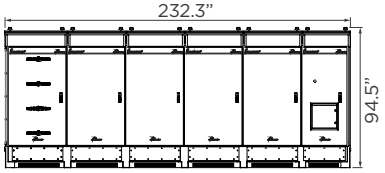


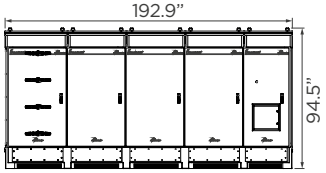




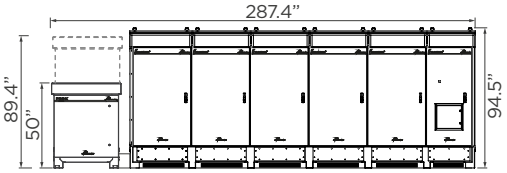
HEC-US+ NEC2011

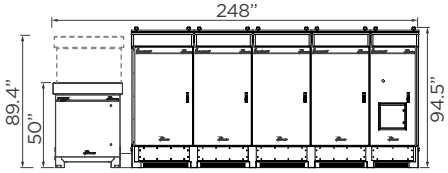


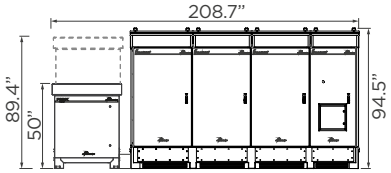




HEC-US+ NEC2014







NOTE Depth of all units is 40.12”.
Please consult hardware and installation manual for additional information on dimensions and weights.

HEC-US

TECHNICAL CHARACTERISTICS

		390VAC						
		FRAME 1	FRAME 2		FRAME 3		FRAME 4	
NUMBER OF MODULES		4	5	6	7	8	9	10
MODEL NUMBER		FS0600CU	FS0751CU	FS0900CU	FS1050CU	FS1250CU	FS1350CU	FS1500CU
OUTPUT	Maximum Power (kW/kVA) @PF=1; 50°C	680	850	1020	1190	1360	1530	1700
	Maximum Power (kW) @PF=0.9; 50°C	600	750	900	1050	1250	1350	1500
	Max. Output Current(A)	1007	1259	1510	1762	2014	2268	2520
	Operating Grid Voltage(VAC)	390Vac ±10%						
	Operating Range, Grid Frequency	60Hz (59.3Hz - 60.5Hz)						
	Power Factor [1]	0.9 leading... 0.9 lagging						
	Current Harmonic Distortion (THDi)	< 3% at nominal power						
INPUT	MPPt Window	552V - 900V						
	Maximum DC voltage	1000V						
	Rated DC current	1200A	1500A	1800A	2100A	2400A	2700A	3000A
	Maximum. short circuit DC current	1560A	1950A	2340	2730A	3120A	3510A	3900A
EFFICIENCY & AUX. SUPPLY	Max. Efficiency / CEC (η)	98.6% / 98.0%						
	Max. Standby Consumption (Pnight)	< approx. 40W/per module						
	Aux. Power Supply (208VAC)	6100VA	5300VA	4600VA	3800VA	3000VA	1800VA	1000VA
	Maximum Power Consumption (W)	1840W	2300W	2760W	3220W	3680W	4140W	4600W
ENVIRON-MENT	Degree of protection	NEMA 3R						
	Cooling system	Forced air intake through bottom and exhausted through upper exhaust hood						
	Permissible Ambient Temperature[2]	-22°F to +122°F / -30°C ...+50°C ; >50°C/ 122°F power derating						
	Relative Humidity	4% to 100%, Active heating and humidity control						
	Max. Altitude (above sea level)[2]	4000m; >1000m power derating 1% Sn (kVA) per 100m						
CONTROL INTERFACE	Interface	Alphanumeric display, ON-OFF Selector, ON/OFF pushbutton (Optional)						
	Communication	RS232 / RS485 / USB / Ethernet, (Modbus RTU Protocol, Modbus TCP/IP)						
	Analogue Inputs	1 programmable and differential inputs; (0-20mA or ± 10mV to ± 10V) and PT100						
	Digital Outputs	1 electrically-isolated programmable switched relays (250VAC, 8A or 30 VDC, 8A)						
PROTECTIONS	Ground Fault Protection	Floating PV array: Isolation Monitoring per MPP NEC2011 Grounded PV array: GFDI protection NEC2014 Grounded PV array: GFDI protection and isolation monitoring (requires 1 Digital Output)						
	NEC2011 Recombiner[3]	Max. 4x700A switches. Max. 32 inputs (70-200A fuse). Max. 28 (400A fuse) Max. 3x1250A switches. Max. 24 inputs (70-200A fuse). Max. 21 inputs (400A fuse)						
	NEC2014 Recombiner[3]	Max. 40 inputs (70-400A fuse)						
	Overvoltage Protection	DC and AC Inverter sides (Type 4) and Auxiliary Supply type 2 - Internal Standard						
CERTI-FICA-TIONS	Safety	UL 1741; CSA 22.2 No.107.1-01						
	Utility Interconnect	IEEE 1547						

NOTES [1] Power factor adjustable from pure leading to pure lagging.
[2] Below -20°C equipped with extended Active Heating + Heating Resistor. Other characteristics consult with Power Electronics.
[3] Check maximum shortcircuit DC current of the inverter to assure full recombiner compatibility.

HEC-US

TECHNICAL CHARACTERISTICS

		360VAC						
		FRAME 2			FRAME 3		FRAME 4	
NUMBER OF MODULES		5	6	6	7	8	9	10
MODEL NUMBER		FS0701CU	FS0752CU	FS0830CU	FS1003CU	FS1110CU	FS1251CU	FS1400CU
OUTPUT	Maximum Power (kW/kVA) @PF=1; 50°C	780	930	930	1100	1250	1400	1550
	Maximum Power (kW) @PF=0.9; 50°C	700	750	830	1000	1110	1250	1400
	Max. Output Current(A)	1251	1492	1492	1765	1989	2246	2486
	Operating Grid Voltage(VAC)	360Vac ±10%						
	Operating Range, Grid Frequency	60Hz (59.3Hz - 60.5Hz)						
	Power Factor[1]	0.9 leading... 0.9 lagging						
	Current Harmonic Distortion (THDi)	< 3% at nominal power						
INPUT	MPPt Window	510V - 900V						
	Maximum permissible DC voltage	1000V						
	Rated DC current	1500A	1800A	1800A	2100A	2400A	2700A	3000A
	Maximum short circuit DC current	1950A	2340	2340	2730A	3120A	3510A	3900A
EFFICIENCY & AUX. SUPPLY	Max. Efficiency / CEC (η)	98.6% / 98.0%						
	Max. Standby Consumption (Pnight)	< approx. 40W/per module						
	Aux. Power Supply (208VAC)	5300VA	4600VA	4600VA	3800VA	3000VA	1800VA	1000VA
	Maximum Power Consumption (W)	2300W	2760W	2760W	3220W	3680W	4140W	4600W

NOTES

[1] Power factor adjustable from pure leading to pure lagging.
[2] Below -20°C equipped with extended Active Heating + Heating Resistor. Other characteristics consult with Power Electronics.
[3] Check maximum shortcircuit DC current of the inverter to assure full recombiner compatibility.

SG 60KU-M

SUNGROW

www.sungrowpower.com

Efficient and flexible

- High flexibility for complex configurations due to 4 MPP trackers and a wide input voltage range
- High yields due to efficiency up to 98.9% and CEC efficiency of 98.5%
- Output power up to 66kVA / 66kW at power factor of 1
- Can be installed at any angle

Grid-friendly

- Active power continuously adjustable (0~100%)
- Fulfill a variety of reactive power adjustment requirments with power factor 0.8 overexited ~ 0.8 underexited
- Integrated LVRT and HVRT function
- Includes RS-485 and Ethernet interface, compatible with all common monitoring systems

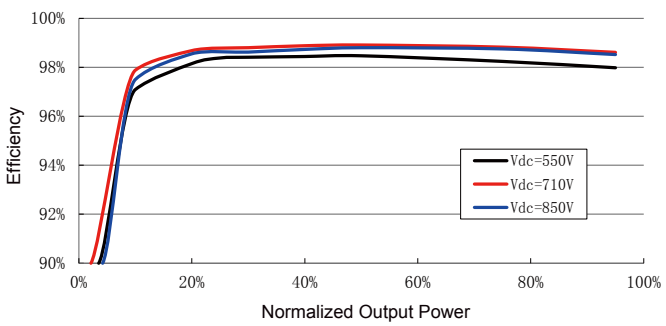
Intelligent design

- Integrated combiner box: 16 x Screw terminal pairs with DC string fuses (both positive and negative), Type II overvoltage protection(both DC and AC), DC and AC switch, more safety and lower the system cost
- Integrated string detection function and arc fault detection

Reliable

- Product certification: UL 1741, IEEE 1547, IEEE1547.1, CSA C22.2 107.1-01-2001, FCC Part 15 Sub-part B Class B Limits
- Manufacturer certification: ISO 9001, ISO 14001, OHSAS 18000

Efficiency Curve



Input Data

Max. PV input voltage	1000V
Startup voltage	300V
Stop Voltage	280V
MPP voltage range	300~950V
MPP voltage range for nominal power	550~850V / 513~850V
String Fuse	Positive and Negative
No. of MPPTs	4
Max. number of PV strings per MPPT	4
Max. PV input current	112A
Maximum DC short circuit current	200A
Max. current for input connector	12A
Max. Cable Size	10AWG, Cu or Al
Arc Flash Detection	Yes
DC Switch	Yes
Insulation Detection	Yes
DC Surge Arrestor	Type II DIN rail surge arreste

Output Data

Nominal AC output power	60000W / 56000W
Max AC output power (PF=1)	66000W
Max. AC output apparent power	66000VA
Max. AC output current	80A
Nominal AC voltage	3Ø/3W +Ground, 480Vac
AC voltage range	422~528Vac
Nominal grid frequency	60Hz
Grid frequency range	55~65Hz
THD	<3% (Nominal power)
DC current injection	<0.5%In
Power factor	>0.99@default value at nominal power, (adj. 0.8 eading ~ 0.8 lagging)
Max. Cable Size	70m², Cu or Al
AC Surge Arrestor	Type II DIN rail surge arreste (40kA)

Protection

Anti-islanding protection	Yes
Low Voltage Ride Through	Yes
DC reverse connection protection	Yes
AC short circuit protection	Yes
Leakage current protection	Yes
Overvoltage protection	Type II DIN rail surge arrester
AC switch	Yes

Mechanical Data

Dimensions (W*H*D)	665*915*276 mm	26.2*36*10.9inch
Mounting method	Wall bracket	
Weight	70kg	154lbs

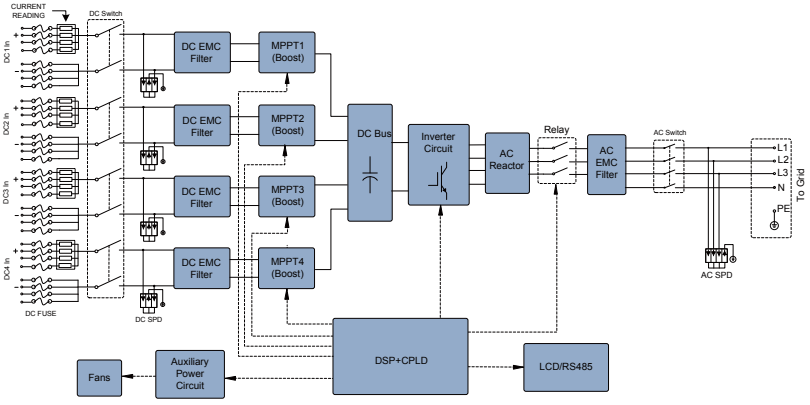
System Data

Max. efficiency	98.90%	
CEC efficiency	98.50%	
Isolation method	Transformerless	
Ingress protection rating	NEMA4X	
Tare Loss	<1W	
Operating ambient temperature range	-25~60℃ (>50℃ derating)	-13…+140℉ (>122℉ derating)
Allowable relative humidity range	0~100%	
Cooling method	Smart forced air cooling	
Max. operating altitude	4000m (>3000m derated)	13,000ft (>9,800ft derated)
Display	Graphic LCD	
Communication	RS485 / Ethernet	
DC connection type	Screw terminals	
AC connection type	Screw clamp terminal	
Certification	cCSAus	
Safety and EMC Standard	UL 1741, IEEE 1547, IEEE1547.1, CSA C22.2 107.1-01-2001, FCC Part 15 Sub-part B Class B Limits	

Communication

RS485	Standard
Ethernet	Standard
I/O dry contact	Standard
Protocol	Modbus

Circuit Diagram



Sunmodule®
SW 340-350 XL MONO

SOLARWORLD
REAL VALUE

TUV Power controlled:
Lowest measuring tolerance in industry

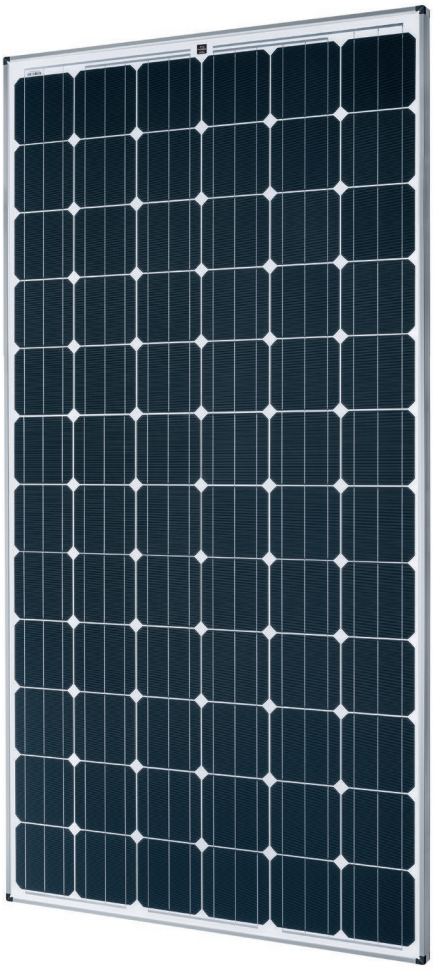
Every component is tested to meet
3 times IEC requirements

Designed to withstand heavy
accumulations of snow and ice

Sunmodule
Positive performance tolerance

25-year linear performance warranty
and 10-year product warranty

Glass with anti-reflective coating



World-class quality
Fully-automated production lines and seamless monitoring of the process and material ensure the quality that the company sets as its benchmark for its sites worldwide.

SolarWorld Plus-Sorting
Plus-Sorting guarantees highest system efficiency. SolarWorld only delivers modules that have greater than or equal to the nameplate rated power.

25-year linear performance guarantee and extension of product warranty to 10 years
SolarWorld guarantees a maximum performance digression of 0.7% p.a. in the course of 25 years, a significant added value compared to the two-phase warranties common in the industry, along with our industry-first 10-year product warranty.*

*in accordance with the applicable SolarWorld Limited Warranty at purchase.
www.solarworld.com/warranty

• Qualified, IEC 61215
• Safety tested, IEC 61730
• Blowing sand resistance, IEC 60068-2-68
• Ammonia resistance, IEC 62716
• Salt mist corrosion, IEC 61701
• Periodic inspection

• Periodic inspection
• Power controlled

UL 1703

ISO 9001
ISO 14001
Certified

Home Innovation
NGBS GREEN CERTIFIED

solarworld.com

Sunmodule®
SW 340-350 XL MONO

SOLARWORLD
REAL VALUE

PERFORMANCE UNDER STANDARD TEST CONDITIONS (STC)*

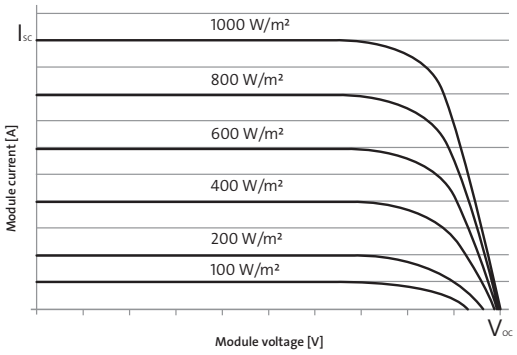
		SW 340	SW 345	SW 350
Maximum power	P_{max}	340 Wp	345 Wp	350 Wp
Open circuit voltage	V_{oc}	47.6 V	47.8 V	48.0 V
Maximum power point voltage	V_{mpp}	38.0 V	38.2 V	38.4 V
Short circuit current	I_{sc}	9.69 A	9.75 A	9.82 A
Maximum power point current	I_{mpp}	9.01 A	9.10 A	9.17 A
Module efficiency	η_m	17.04 %	17.29 %	17.54 %

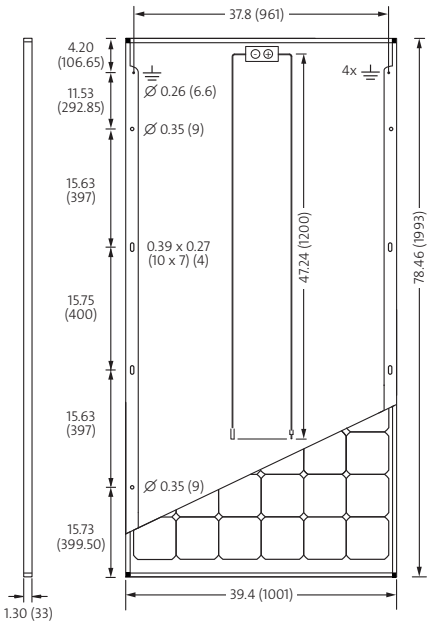
*STC: 1000W/m², 25°C, AM 1.5

PERFORMANCE AT 800 W/M², NOCT, AM 1.5

		SW 340	SW 345	SW 350
Maximum power	P_{max}	259.3 Wp	263.8 Wp	267.2 Wp
Open circuit voltage	V_{oc}	41.5 V	41.8 V	42.0 V
Maximum power point voltage	V_{mpp}	34.9 V	35.2 V	35.4 V
Short circuit current	I_{sc}	8.05 A	8.10 A	8.16 A
Maximum power point current	I_{mpp}	7.42 A	7.50 A	7.56 A

Minor reduction in efficiency under partial load conditions at 25° C: at 200 W/m², 100% of the STC efficiency (1000 W/m²) is achieved.





COMPONENT MATERIALS

Cells per module	72	*Front*	Low-iron tempered glass with ARC (EN 12150)
Cell type	Monocrystalline	*Frame*	Clear anodized aluminum
Cell dimensions	6.17 in x 6.17 in (156.75 x 156.75 mm)	*Weight*	47.6 lbs (21.6 kg)

THERMAL CHARACTERISTICS

NOCT	46 °C
TCI_{sc}	0.042 % / °C
TCV_{oc}	-0.304 % / °C
TCP_{mpp}	-0.43 % / °C
Operating temp	-40 to +85 °C

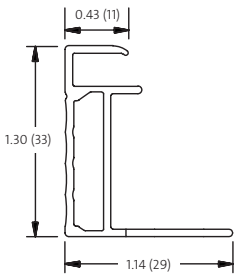
ADDITIONAL DATA

Power sorting	-0 Wp/+5 Wp
J-Box	IP65
Connector	PV wire per UL4703 with H4/UTX connectors
Module fire performance	(UL 1703) Type 1

PARAMETERS FOR OPTIMAL SYSTEM INTEGRATION

Maximum system voltage SC II / NEC		1000 V
Maximum reverse current		25 A
Number of bypass diodes		3
*Design loads**	*Two rail system*	113 psf downward, 64 psf upward
*Design loads**	*Edge mounting*	178 psf downward, 23 psf upward

* Please refer to the Sunmodule installation instructions for the details associated with these load cases.



- Compatible with both "Top-Down" and "Bottom" mounting methods
- ⏚ Grounding Locations:
  – 4 locations along the length of the module in the extended flange.

All units provided are imperial. SI units provided in parentheses.
SolarWorld AG reserves the right to make specification changes without notice.

THE TALLMAX MODULE

72 CELL
MULTICRYSTALLINE MODULE

305-320W
POWER OUTPUT RANGE

16.5%
MAXIMUM EFFICIENCY

0~+5W
POSITIVE POWER TOLERANCE

As a leading global manufacturer of next generation photovoltaic products, we believe close cooperation with our partners is critical to success. With local presence around the globe, Trina is able to provide exceptional service to each customer in each market and supplement our innovative, reliable products with the backing of Trina as a strong, bankable partner. We are committed to building strategic, mutually beneficial collaboration with installers, developers, distributors and other partners as the backbone of our shared success in driving Smart Energy Together.

Trina Solar Limited
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Trinasolar
Smart Energy Together

Ideal for large scale installations
- High powerful footprint reduces installation time and BOS costs
- 1000V UL/1000V IEC certified

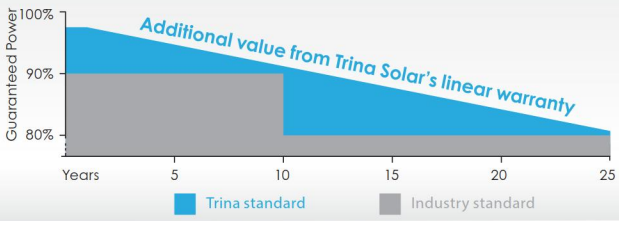
One of the industry's most trusted modules
- Field proven performance

Highly reliable due to stringent quality control
- Over 30 in-house tests (UV, TC, HF, and many more)
- In-house testing goes well beyond certification requirements
- PID resistant

Certified to withstand challenging environmental conditions
- 2400 Pa wind load
- 5400 Pa snow load
- 35 mm hail stones at 97 km/h

LINEAR PERFORMANCE WARRANTY

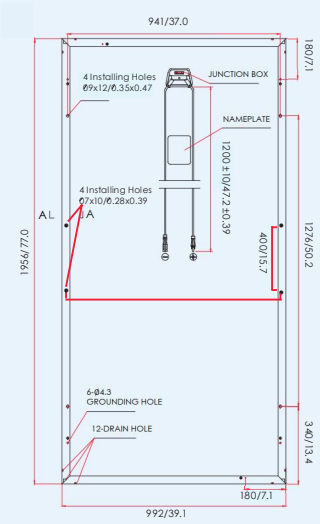
10 Year Product Warranty • 25 Year Linear Power Warranty



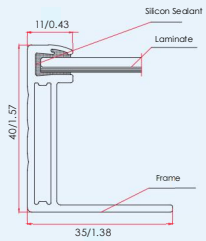
THE TALLMAX MODULE

TSM-PD14

DIMENSIONS OF PV MODULE
unit:mm/in

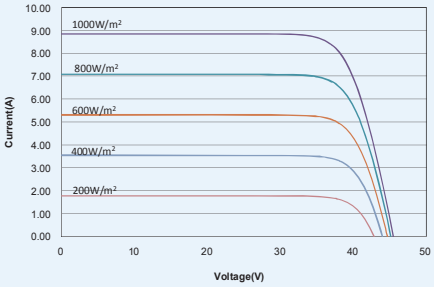


Back View



A-A

I-V CURVES OF PV MODULE(310W)



CERTIFICATION

ELECTRICAL DATA (STC)

Peak Power Watts-P_{MAX} (Wp)	305	310	315	320
Power Output Tolerance-P_{MAX} (W)	0 ~ +5			
Maximum Power Voltage-V_{MPP} (V)	36.6	37.0	37.1	37.1
Maximum Power Current-I_{MPP} (A)	8.33	8.38	8.51	8.63
Open Circuit Voltage-V_{OC} (V)	45.5	45.5	45.6	45.8
Short Circuit Current-I_{SC} (A)	8.81	8.85	9.00	9.10
Module Efficiency η_m (%)	15.7	16.0	16.2	16.5

STC: Irradiance 1000 W/m², Cell Temperature 25°C, Air Mass AM1.5.

ELECTRICAL DATA (NOCT)

Maximum Power-P_{MAX} (Wp)	227	230	234	238
Maximum Power Voltage-V_{MPP} (V)	34.0	34.3	34.3	34.4
Maximum Power Current-I_{MPP} (A)	6.68	6.72	6.83	6.91
Open Circuit Voltage-V_{OC} (V)	42.2	42.2	42.3	42.5
Short Circuit Current-I_{SC} (A)	7.11	7.15	7.27	7.35

NOCT: Irradiance at 800 W/m², Ambient Temperature 20°C, Wind Speed 1 m/s.

MECHANICAL DATA

Solar cells	Multicrystalline 156 × 156 mm (6 inches)
Cell orientation	72 cells (6 × 12)
Module dimensions	1956 × 992 × 40 mm(77.0 × 39.1 × 1.6 inches)
Weight	22.5 kg (50 lb)
Glass	3.2 mm,High Transmission, AR Coated Tempered Glass
Backsheet	White
Frame	Silver Anodized Aluminium Alloy
J-Box	IP 65 or IP 67 rated
Cables	Photovoltaic Technology cable 4.0mm² (0.006 inches²), 1200mm (47.2 inches)
Connector	UTX Amphenol
Fire Type	Type 1 or 2

TEMPERATURE RATINGS

Nominal Operating Cell Temperature (NOCT)	44°C (±2°C)
Temperature Coefficient of P_{MAX}	- 0.41%/°C
Temperature Coefficient of V_{OC}	- 0.32%/°C
Temperature Coefficient of I_{SC}	0.05%/°C

MAXIMUM RATINGS

Operational Temperature	-40~+85°C
Maximum System Voltage	1000VDC (IEC) 1000VDC(UL)
Max Series Fuse Rating	15A

WARRANTY

10 year Product Workmanship Warranty

25 year Linear Power Warranty

(Please refer to product warranty for details)

PACKAGING CONFIGURATION

Modules per box: 26 pieces

Modules per 40' container: 572 pieces

*The mechanical loading is dependent upon the mounting method. The mounting method described in the Installtion Manual section 6.1-C can pass 2400Pa wind load and 2400Pa snow load.

TSM EN 2016 A

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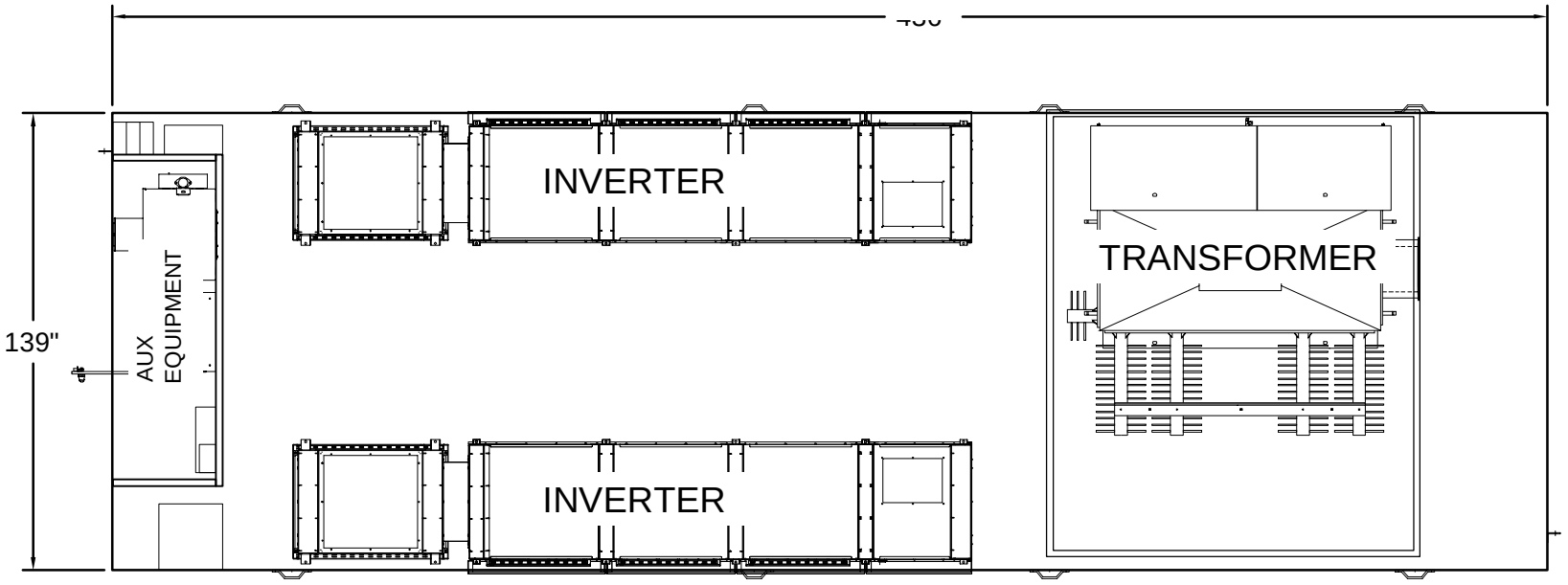
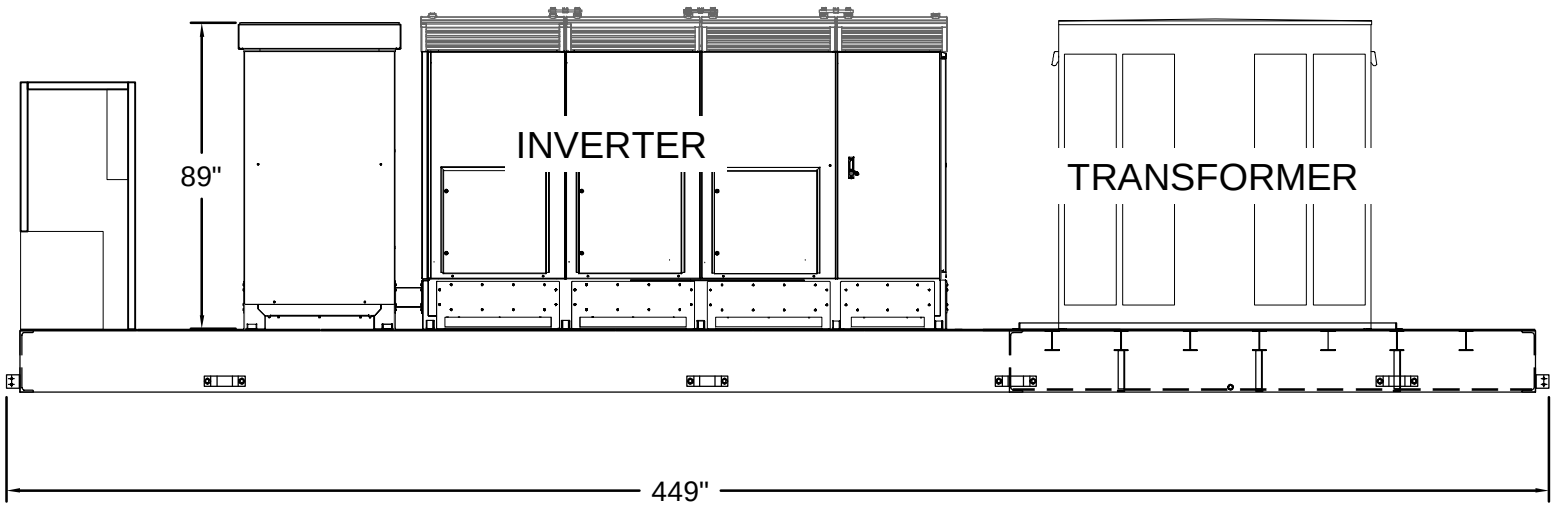
Smart Energy Together



PLAN VIEW



ELEVATION

INVERTER SKID PLAN AND PROFILE

AQUIFER PROTECTION AREAS

Plainfield, CT

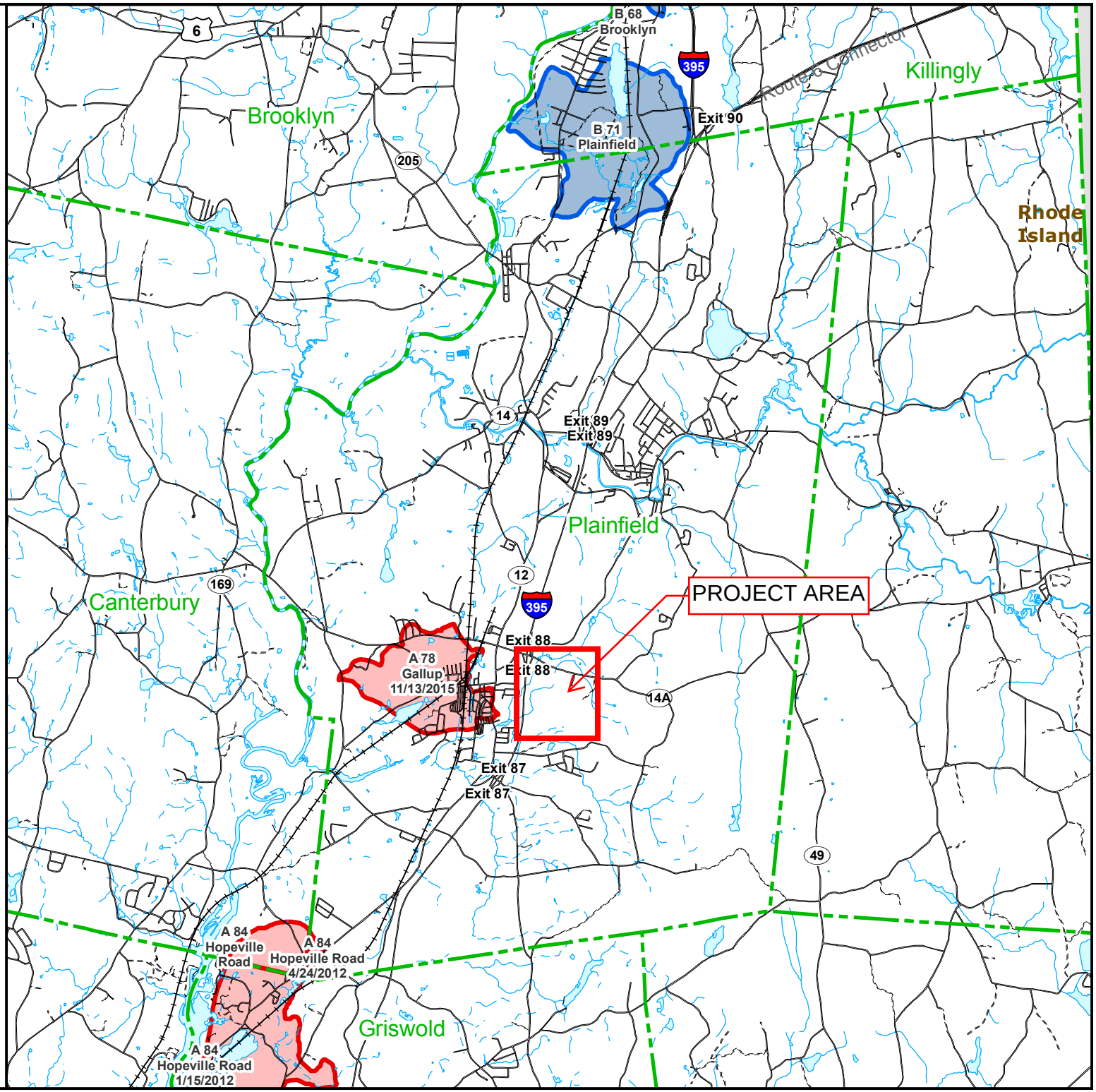
December 28, 2015

- Level A APA (Final Adopted)
- Level A APA (Final)
- Level B APA (Preliminary)
- Town Boundary

NOTE: The Aquifer Protection Areas were delineated through Connecitcut's Level A and Level B Mapping Processes. Aquifer Protection Areas are delineated for active public water supply wells in stratified drift that serve more than 1000 people, in accordance with Sections 22a-354c and 22a-354z of the Connecticut General Statutes. Level B Mapping delineates a preliminary aquifer protection area, providing an estimate of the land area from which the well draws its water. Level A Mapping delineates the final Aquifer Protection Area, which becomes the regulatory boundary for land use controls designed to protect the well from contamination. As Level A Mapping is completed for each well field and approved by DEEP, it replaces the Level B Mapping. Final Adopted Level A Areas are those where towns have land use regulations for them. Masschusetts and Rhode Island Wellhead Protection Areas may be shown for informational purposes.

QUESTIONS:
Bureau of Water Protection and Land Reuse
Planning and Standards Division
Phone: (860) 424-3020
www.ct.gov/deep/aquiferprotection

STATE OF CONNECTICUT
DEPARTMENT OF
ENERGY & ENVIRONMENTAL PROTECTION
79 Elm Street
Hartford, CT 06106-5127



HIGHLAND SOILS LLC

WETLAND REPORT

PLAINFIELD PIKE SOLAR FACILITY
91 PLAINFIELD PIKE
PLAINFIELD, CONNECTICUT

PREPARED FOR
ECOS ENERGY

BY
JOHN P. IANNI
PROFESSIONAL SOIL SCIENTIST

APRIL 27, 2016

P.O Box 337, Storrs, CT 06268 · 860-742-5868 · Highlandsoils@aol.com

INTRODUCTION

The project site contains just over 69 acres and is located on the south side of Plainfield Pike Road and westerly of Interstate 396 in Plainfield, CT. The site is currently wooded and slopes in a general east to west direction. In the fall of 2015 the inland wetland boundaries were field delineated and in March and April of 2016 additional site walks were conducted to collect information on the natural resources of the site.

The inland wetland delineation on the subject property was completed on August 30, 2015. The wetlands were field delineated in accordance with the standards of the National Cooperative Soil Survey and the definition of wetlands as found in the Connecticut General Statutes, Chapter 440, Section 22A-38. I have reviewed the prepared plans have found the representation of the field delineated wetlands to be substantially correct.

The eastern-most wetland line was flagged as part of the 2015 wetland survey, however, a previous wetland survey was conducted on the property and the eastern-most line is from the previous survey. Most of the previous flags were visible and the more recent line is in general agreement with the older line.

Additionally, the wetland boundaries also conform to the jurisdictional wetlands definition (Federal or Army Corps wetlands) as based on:

> Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

EXISTING CONDITIONS

The subject property is currently wooded with mixed hardwood species. A small logging operation has been ongoing on the property since the summer of 2015 and a selective harvest of hardwoods for firewood has removed most of the Ash trees and some Oaks. The operation was mainly concentrated in the eastern third of the site where the trees were cut and then skidded to a processing area on the adjacent property to the east. Small skid roads traverse the site, including wetland areas. However, minimal disturbance to the soils was observed in the spring of 2016.

As stated earlier, the site slopes from east to west and two watercourse systems traverse the site. The site contains a small area of sand and gravel dominated soils in the northeastern limits of the site, but glacial till dominates the soil resources.

The site consists of two parcels of land that are very distinguishable based on historic land uses, which have impacted the current vegetative communities. The eastern third of the site contains an understory dominated by Japanese barberry with Multiflora rose thickets. Older field areas also contain Multiflora rose and Honeysuckle, the species are indicative of a transition from agriculture to the present woodlands. The western third of the property contains a more mature Oak/Hickory growth with less of the invasive species. The understory is more open in the western portion of the property and the forest is more typical of areas that have not been used for agriculture in the recent past.

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WETLAND RESOURCES

The mapped wetlands comprise approximately a quarter of the site. Two perennial watercourses enter and exit the site, and although they combine offsite, they originate from different drainage areas. The main wetland feature on the site is a large system that is found in the eastern third of the site. Along the southeastern property line a small intermittent or seasonal watercourse enters the site and flows northerly toward the main body of the wetland. The watercourse hugs the western edge of the wetland before it exits and reenters from the abutting Dodge property. The eventual discharge is off the property along the southern property line. The watercourse channel is well defined through the upper portion of the wetlands where it is buffered by wide areas of poorly drained or wetland soils. After the watercourse renters the property it is in a well-defined but small channel with just a narrow strip of wetland soils along its edges. No evidence of overbank flow was noted along the lower channel, and surface flows appear diminished by the capacity of the main body of wetlands to store surface water after precipitation events.

The main body of the wetland is along the northern property line where a perennial watercourse also enters the property. The perennial watercourse enters the wetland system along the northern border near the northeastern corner of the abutting church property. Ground water seepage wetlands were noted to the east of the watercourses. The water course channel is well defined and recent overbank flows were noted. The ground surface is very stony and flat and the watercourse channel tends to flow along the western edge of the mapped wetlands. The vegetation begins to transition at this point and along with Red maple, Winterberry begins to appear in the understory. The ground cover includes Sphagnum moss, Skunk cabbage, False hellsbore, Sensitive fern and Blue flag iris. Japanese barberry is still present in this area. Surface water flow outside of the defined channel is diffuse and evidence of ponding after precipitation events is apparent in the main wetland body. A small upland island was mapped adjacent to the perennial watercourse.

The ground water seepage wetlands are wooded with Red maple as the dominant tree species. The understory reflects the agricultural history of the property and Multiflora rose is prevalent, but Japanese barberry dominates the wetland boundaries and drier portions of the wetland. Spicebush is also present but the barberry forms the majority of the understory. In the interior of the wetland where openings in the canopy allow for more light penetration, Soft rush and Woolgrass are found. Oaks, Hickory and Ash are also present in the wetland and are a reflection of the seasonally fluctuating water table within the wetlands.

The wetland system narrows as the topographic gradient increases. The next few hundred feet of wetlands are characterized by the perennial watercourse and a small buffer of wetland soils. The vegetation also transitions to a more mature mixed hardwood system. The channel size decreases as the topographic gradient increases and overbank flows are not as apparent.

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The wetland system flows westerly to a large flat area where flows are dissipated and the channel size decreases and turns to the south before discharging off the property in the southwestern portion of the property. At the property line, an existing stone wall acts as a small constriction in the system and overbank flows are apparent.

A separate wetland system was observed along the northwestern corner of the property. It should be noted that although the hydrology of this wetland system is separate from the main body of wetlands, there is a connection between the two wetlands that results in a continuous wetland mapping between the two areas. The two systems do not have a surface flow connection, and a distinct drainage divide was noted between the systems. This wetland is associated with a perennial watercourse that enters the subject property from the State Department of Transportation property located in the northwestern corner of the site. The wetland associated with the watercourse is a Red maple/Highbush blueberry, Sweet pepperbush plant community with very poorly drained soils that are saturated to the surface for most of the year.

The final wetland is an isolated area of poorly drained soils located along the southern property line. This wetland system has a seasonally high water table but is not associated with any surface water or surface flows. The vegetation consists of mixed hardwoods that include Red maple, White oak and Shagbark hickory. American beech is in the understory and the wetland is supported by shallow ground water flows.

VERNAL POOL HABITAT

On March 30, 2016 a survey for breeding amphibians was conducted on the property. Skies were mostly cloudy in the morning with clearing skies in the afternoon. Temperatures ranged from the upper 40's F to the upper 50's by late afternoon. Three areas of breeding amphibians were found within the mapped wetlands.

A second survey was conducted on April 13, 2016. Temperatures were around 55 degrees F and skies were sunny.

It should be noted that Vernal Pool Assessments (Assessment Sheets attached) were conducted in accordance with the methodology contained in the following publication, hereafter referred to as the BDP (Best Development Practices):

> *Calhoun, A. J. K. and M. W. Klemens. 2002. Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.*

Area #1 is located in a small area of standing surface water adjacent to wetland flag #23. The area of surface water was approximately 10 feet by 20 feet and up to a foot in depth. The area is adjacent to diffuse surface flows within the mapped wetlands but the hydrology appears to be supported by shallow ground water flows. Eleven Wood frog egg masses were noted in a

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cluster along the edge of the pool. A single Spotted salamander egg mass was also seen in the second survey. A small area of shallow standing water was noted just north of the breeding area; this area does not contain wetland soils and no breeding activity was noted.

The second area of breeding amphibians was found in the center of the southeastern wetland finger and is located equidistant from wetland flags #136 and #C39. The breeding pool is an older man-made excavation adjacent to the seasonal watercourse. The pool is approximately 15 feet in diameter and up to two feet deep. It is clearly man-made and the spoils are located along all the edges. The spoils separate the surface flow of the intermittent watercourse from the ground water-fed breeding pool. In this breeding area 18 Spotted salamander egg masses and eleven Wood frog egg masses were noted.

The third breeding area is located approximately 100 feet to the south along the western edge of the mapped wetlands. A small depression with shallow ponding of less than one foot was noted and two Spotted salamander egg masses and four Wood frog egg masses were noted.

All three of the pools are rated as Tier I based on the Vernal Pool Assessment.

Individual Wood frog and Spotted salamander egg masses were scattered throughout the upper or eastern portion of the wetland and are associated with small micro-pools and shallow ponded areas created by previous logging activities.

WETLAND FUNCTIONS

The functions and values of the wetlands will be described in a qualitative manner modeled after the method used by the US Army Corps of Engineers. The information is from *The Highway Methodology Workbook Supplement*. This publication uses a descriptive approach to assessing functional values, versus the CT D.E.P. approach, which uses a quantitative or numerical approach to ranking wetland functions and values.

Ground Water Recharge/Discharge - This function considers the potential for a wetland to serve as a ground water recharge and/or discharge area. It refers to the fundamental interaction between wetlands and aquifers, regardless of the size or importance of either.

> Ground water seepage into the wetlands through shallow ground water flows occurs in the upper part of the wetland. Surface inputs in the form of watercourses are found in three locations and there are two discharge points at the property boundaries. The wetlands are underlain by a sandy and friable glacial till and there are signs of decreased surface flows in the wetlands. The wetlands are ground water discharge wetlands with a component of shallow ground water recharge in places. Ground water recharge and discharge are a primary function of the on-site wetlands.

Floodflow Alteration - This function considers the effectiveness of the wetland in reducing flood damage by water retention for prolonged periods following precipitation events and the gradual release of flood waters. It adds to the stability of the wetland ecological system or its buffering

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characteristics and provides social or economic value relative to erosion and/or flood prone areas.

Areas of the wetlands are flat and signs of overbank flows are present. Signs of variable water levels are also present and there is a constricted outlet to the main wetland on the property. Channel sizes vary within the wetlands with larger areas suitable for storage of excess storm flows. Poorly drained soils are located adjacent to the watercourses and are capable of storing water during precipitation events. This function occurs to a high degree in the upper and lower portion of the wetlands.

Fish and Shellfish Habitat - This function considers the effectiveness of seasonal or permanent watercourses associated with wetland in question for fish and shellfish habitat.

The watercourses associated with the wetlands are small and although they are persistent, perennial flows are limited to the wetland in the northwestern corner. This system has culverts at the inlet to the property and outlet. Significant barriers to fish movement are present. The main wetland system is associated with more seasonal flows and is not suitable for fish habitat. Stone walls and off-site culverts form significant barriers for fish movements. No evidence of fish was present but an extensive survey was not conducted. This is not a primary function of the on-site wetlands.

Sediment/Toxicant/Pathogen Retention - This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants or pathogens in runoff water from surrounding uplands, or upstream eroding wetland areas.

The potential for sediment sources exist in the watershed above this wetland. Although associated with watercourses, there are many indications of overbank flows during small storm events. The surface flows outside of the defined channels are diffuse and the micro-topography allows for sediment capture. Velocity decreases are apparent in the wetlands and the opportunity for sediment capture at constriction points is apparent. The wetlands lack a high degree of open water vegetation interspersion but sediment capture was apparent. This is a main function of the wetlands.

Nutrient Removal/Retention/Transformation - This function considers the effectiveness of the wetland as a trap for nutrients in runoff water from surrounding uplands or contiguous wetlands, and the ability of the wetlands to process these nutrients into other forms or trophic levels. One aspect of this function is to prevent ill effects of nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers or estuaries.

The ability for the wetlands to perform this function is limited by the watercourses that flow through the wetland. During normal flows the watercourse conveys flows through the wetland and there is little opportunity for nutrient capture and uptake. During storm flows, overbank flows saturate the surrounding wetlands and nutrient capture can occur. However, the lack of sufficient areas of open water and the lack of diversity and abundance of aquatic plants limits the function. The wetland system in the northwestern

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corner of the site has the ability to perform this function while the main wetland system does not. This is a primary function for small portions of the on-site wetlands.

Production Export - This function relates to the effectiveness of the wetland to produce food or usable products for human, or other living organisms.

Only the wetland system in the northwestern part of the property has enough qualifiers for this to be a consideration. This wetland has a dense shrub layer of berry-producing shrubs and the production of organic matter is high. The remaining wetland system has little potential for organic matter production and export due to its thin canopy of trees and sparse shrub layer other than Barberry. The potential for flushing of the wetlands is limited other than the northwestern system. This is not a principle function.

Sediment/Shoreline Stabilization - This function evaluates the effectiveness of a wetland to stabilize stream banks and shorelines against erosion.

The on-site wetlands are not associated with a pond, lake or other water body. The watercourse channels are stable and no unusual erosion was noted. The wetlands generally have very stony surfaces and topographic gradients are generally low. This is not a primary function.

Wildlife Habitat - This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and wetland edges. Both resident and/or migrating species are considered.

The wetlands are a single cover class and lack interspersion of other wetland types. Open water areas and marsh habitat are lacking. Density of vegetation is high in some areas but the wetlands generally have open understories. Aquatic vegetation and multiple cover classes are generally lacking. Interstate 395 is along the western border of the site and connectivity to other wetland areas is fragmented by the highway and other roads. Wildlife utilization of the site occurs but it is not a primary function of the wetlands.

Recreation – (Consumptive and Non-Consumptive) This value considers the suitability of the wetland and associated watercourses to provide recreational opportunities such as hiking, canoeing, boating, fishing, hunting and other active or passive recreational activities.

The wetlands are not associated with a river, stream, pond or other feature that would accommodate water-based recreation such as fishing, canoeing or boating. The water courses are not of sufficient size for swimming or other active recreation. The wetlands are not wildlife habitat wetlands and this function is not present on the site.

Educational/Scientific Value - This function considers the suitability of the wetland as an "outdoor classroom" or for scientific research.

The wetlands have low potential for this function. The site is not part of an educational site and lacks the diversity in wetland classes. The site is not readily accessible and has a

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high degree of invasive plants. No significant open water areas exist and the recent logging has resulted in a disturbed appearance. The site lacks significant cultural features and access to the site is not available. This is not a primary value.

Uniqueness/Heritage - This value considers the effectiveness of the wetland for special values such as archeological sites, rare and endangered species habitat or uniqueness for its location.

This value is not represented on the site. The wetlands are generally a single cover class and lack a pond site or other site features that enhance the potential for this value. There are no known archeological features, rare and endangered habitat or existing study sites within the wetlands. The wetlands have a high degree of invasive plants and views into the wetlands are limited. Of the 31 qualifiers for this value only a few are represented and they include a well vegetated stream corridor, and potential viewing locations and stone walls. This is not a primary value.

Visual Qualities/Aesthetics - This value relates to the visual qualities of the wetlands.

The wetlands lack the diversity in wetland types including shallow marshes and other low growing open type wetland systems. The site has extensive disturbances due to recent logging and the presence of large areas of invasive species detracts from this value. This is not a primary value.

Endangered Species Habitat – This value considers the suitability of the wetland to support threatened or endangered species.

A review of the Natural Diversity Data Base maintained by the State of Connecticut indicates no rare endangered or threatened species on or near the site. An inquiry has been made to the State for additional information and guidance.

WETLAND IMPACTS

Direct Wetland Impacts

Three areas of solar arrays are proposed for the site. Access to the southerly array requires a wetland crossing for an access drive. The drive will cross a relatively narrow area in the wetland and will utilize a small upland island in the middle of the wetland to minimize the footprint of the access drive. A low water crossing is proposed (as detailed on the plans). The crossing minimizes grading and reduces the footprint of the crossing to the maximum extent possible. The total direct wetland impact is 4,660 square feet and should be eligible for a Category 1 permit from the Army Corps of Engineers.

The area of the proposed crossing has been recently disturbed and has been used as a logging road for a harvest operation from the fall of 2015. The wetland in the area of the crossing has a seasonally high water table but is very dry in the summer months. An intermittent watercourse is associated with the wetland but only flows during the wet periods in the spring and fall.

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The original proposal was to have an access road along the northerly property line with a spur to access the southerly array. After a more detailed investigation of the crossing an alternative is being explored that would access the northerly array through an abutting property. This alternative access would greatly reduce the initially proposed direct wetland impacts.

Indirect Wetland Impacts

The project has been designed so that all of the solar arrays are outside of wetlands. Minor clearing along the one hundred foot upland review area is proposed and the perimeter fence is within the upland review area. All disturbed areas will be seeded and stabilized with vegetation and long-term impacts have been minimized.

It is recommended that the wetland crossing be conducted during the dry season when ground water levels are low and surface flows are minimal. Additionally, it is recommended that site work be minimized in the early spring during the migration and breeding season for the obligate amphibian species. This could be accomplished by avoiding site work near the vernal pools from March through June. Silt fence exclusion barriers can be used to minimize impact to the amphibian populations during that period.

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Plainfield Pike Pool #1 - Wetland Flag #23

VERNAL POOL ASSESSMENT SHEET

A. Biological Value of the Vernal Pool

(1) Are there *any* state-listed species (Endangered, Threatened, or Special Concern) present or breeding in the pool?
Yes_____ No__X__

(2) Are there two or more vernal pool indicator species breeding (i.e., evidence of egg masses, spermatophores [sperm packets], mating, larvae) in the pool?
Yes__X__ No_____

(3) Are there 25 or more egg masses (regardless of species) present in the pool by the conclusion of the breeding season?
Yes_____ No__X__

B. Condition of the Critical Terrestrial Habitat

(1) Is at least 75% of the vernal pool envelope (100 feet from pool) undeveloped?
Yes__X__ No_____

(2) Is at least 50% of the critical terrestrial habitat (100-750 feet) undeveloped?
Yes__X__ No_____

NOTE: For these purposes, "undeveloped" means open land largely free of roads, structures, and other infrastructure. It can be forested, partially forested, or open agricultural land.

Cumulative Assessment

Number of questions answered YES in category A	Number of questions answered YES in category B	Tier Rating
(1-3)	(2)	(Tier I)
1-3	1	Tier II
0	1-2	Tier III
1-3	0	Tier III

CAUTION *This rating system is designed strictly as a planning tool, not as an official assessment tool.* It will enable you to determine the relative ecological value of pools within your community. A Tier I rating—which will most likely apply to only a minority of sites—denotes exemplary pools; Management Recommendations should be applied at these sites. For pools rated as Tier II; proceed with care; you need more information! Tier II pools will probably constitute the majority of your vernal pool resources; Management Recommendations should be applied at these sites to the maximum extent practicable. Tier II pools might also be likely candidates for restoration efforts (e.g., reforestation of the critical terrestrial habitat).

Plainfield Pike Pool #2 East of Wetland Flag #134

VERNAL POOL ASSESSMENT SHEET

A. Biological Value of the Vernal Pool

(1) Are there *any* state-listed species (Endangered, Threatened, or Special Concern) present or breeding in the pool?
Yes_____ No X

(2) Are there two or more vernal pool indicator species breeding (i.e., evidence of egg masses, spermatophores [sperm packets], mating, larvae) in the pool?
Yes X No_____

(3) Are there 25 or more egg masses (regardless of species) present in the pool by the conclusion of the breeding season?
Yes X No_____

B. Condition of the Critical Terrestrial Habitat

(1) Is at least 75% of the vernal pool envelope (100 feet from pool) undeveloped?
Yes X No_____

(2) Is at least 50% of the critical terrestrial habitat (100-750 feet) undeveloped?
Yes X No_____

NOTE: For these purposes, "undeveloped" means open land largely free of roads, structures, and other infrastructure. It can be forested, partially forested, or open agricultural land.

Cumulative Assessment

Number of questions answered YES in category A	Number of questions answered YES in category B	Tier Rating
(1-3)	(2)	(Tier I)
1-3	1	Tier II
0	1-2	Tier III
1-3	0	Tier III

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Plainfield Pike Pool #3 Wetland Flag # 136

VERNAL POOL ASSESSMENT SHEET

A. Biological Value of the Vernal Pool

(1) Are there *any* state-listed species (Endangered, Threatened, or Special Concern) present or breeding in the pool?
Yes_____ No__X__

(2) Are there two or more vernal pool indicator species breeding (i.e., evidence of egg masses, spermatophores [sperm packets], mating, larvae) in the pool?
Yes__X__ No_____

(3) Are there 25 or more egg masses (regardless of species) present in the pool by the conclusion of the breeding season?
Yes_____ No__X__

B. Condition of the Critical Terrestrial Habitat

(1) Is at least 75% of the vernal pool envelope (100 feet from pool) undeveloped?
Yes__X__ No_____

(2) Is at least 50% of the critical terrestrial habitat (100-750 feet) undeveloped?
Yes__X__ No_____

NOTE: For these purposes, "undeveloped" means open land largely free of roads, structures, and other infrastructure. It can be forested, partially forested, or open agricultural land.

Cumulative Assessment

Number of questions answered YES in category A	Number of questions answered YES in category B	Tier Rating
(1-3)	(2)	(Tier I)
1-3	1	Tier II
0	1-2	Tier III
1-3	0	Tier III

CAUTION *This rating system is designed strictly as a planning tool, not as an official assessment tool.* It will enable you to determine the relative ecological value of pools within your community. A Tier I rating—which will most likely apply to only a minority of sites—denotes exemplary pools; Management Recommendations should be applied at these sites. For pools rated as Tier II, proceed with care; you need more information! Tier II pools will probably constitute the majority of your vernal pool resources; Management Recommendations should be applied at these sites to the maximum extent practicable. Tier II pools might also be likely candidates for restoration efforts (e.g., reforestation of the critical terrestrial habitat).