RESPONSES OF WINDHAM SOLAR, LLC
TO
CONNECTICUT SITING COUNCIL INTERROGATORIES - SET ONE

On December 30th, 2020, the Connecticut Siting Council ("Council") issued Interrogatories, Set One to Windham Solar, LLC ("Petitioner" or "Windham"), relating to Petition No. 1222A. The Petitioner provides the following responses.

Project Development

1. Referencing the Motion to Reopen received on October 22, 2020, please identify the changed conditions associated with the development of the 2 megawatt (MW) alternating current (AC) Future Projects (Future Projects).
   RE:
   The Connecticut Light and Power Company d/b/a Eversource electrical line upgrades to the site have allowed for additional generation capacity. Windham solar has obtained additional LREC/ZREC contracts for the site. Windham solar is currently forecasting constructing these facilities in Q3 of 2021.

2. Windham Solar, LLC (WS) noted that the Future Projects were denied by the Council. However, attached Sheet No. 4 dated June 15, 2018 indicates three 1 MW AC Future Projects array areas. Please provide a corrected Sheet No. 4 with array labeling consistent with Sheet No. 15 – Landscaping Plan.
   RE:
   A revised overall site plan ***(Exhibit A- Site Plan)*** has been attached illustrating the currently constructed facilities and the intended solar layouts for the remainder of the site, including the future project area, and the individual project footprints.

3. Referencing attached Sheet No. 4 dated June 15, 2018, to the east of the access drive, WS depicts the 6 MW AC of solar arrays already approved by the Council. On August 16, 2019, the Council approved the Development and Management (D&M) Plan for the clearing of the 6 MW approved array area and construction of 4 MW of the approved arrays.
   What is the current status of the construction of the 4 MW of arrays?
   RE:
   The 6MW approved array area has been cleared, stormwater basins have been graded and the entire site has been seeded for groundcover establishment. The (2) 2MW solar arrays were completed in and energized in August/September of 2020. The facilities are identified in the overall site plan ***(Exhibit A- Site Plan)*** as Sydney and Dickenson solar.

   Indicate when WS plans to submit an additional D&M Plan for the remaining approved 2 MW array.
   RE:
   Future D&M plans will be submitted upon the decision of the approval of the additional 2MW. If the additional area is approved, the project footprint represented in the overall site plan would be the basis of the next D&M Plan.

4. Referencing page 16 of the original Petition dated March 15, 2016, WS noted that it would participate in the state's LREC/ZREC Program. What is the status of such participation, and would the Future Projects be included?
RE:
All the solar facilities for the site, including the Future Projects have been awarded LREC/ZREC contracts.

5. Does WS have a contract (i.e. power purchase agreement) to sell the electricity and renewable energy certificates (RECs) it expects to generate from the Future Projects?
RE:
Yes.

If so, to which public utility?
RE:
The projects have been awarded REC contracts with The Connecticut Light and Power Company d/b/a Eversource. The energy from the projects will either be sold either to Eversource or to a municipality under the Virtual Net Metering (VNM) program and/or as wholesale supply under the Standard Service and Supplier of Last Resort Service.

If the electricity is to be sold to more than one public utility, provide the percentage to be sold to each public utility.
RE:
WS does not plan for the electricity to be sold to more than one public utility.

6. What authority approves the power purchase agreement (PPA) for the Future Projects?
RE:
PURA if the off-taker is Eversource. The municipality if it is pursuant to a VNM agreement.

Has a PPA with an electric distribution company been executed?
RE:
The PPA with Eversource is awaiting approval from PURA.

If so, at what alternating current megawatt output?
RE:
The AC output for the future project area would total 2MW. So the site will ultimately have (2) 1MW Projects and (3) 2MW projects.

If not, when would the PPA be finalized?
RE:
N/A

7. What is the length of the power purchase agreement (PPA)?
RE:
It is anticipated that the energy will be sold under (i) a 7-year PPA with Eversource or (ii) under a 20-year VNM contract with a local municipality if additional VNM capacity is authorized by the Legislature.

Are there provisions for any extension of time in the PPA?
RE:
Yes, but that is not the case for the ZREC/LREC contracts.

Is there an option to renew?
RE:
Until the final off-taker is determined, the answer to this question is unknown.

8. Is the alternating current megawatt capacity of the facility fixed at a certain amount per the PPA?
RE:
It is fixed based upon the LREC/ZREC contracts.

Is there an option within the PPA to allow for changes in the total output of the facility based on unforeseen circumstances?
RE:
There is in the case of the PPA with Eversource. Until the final off-taker is determined in the case of VNM, the answer to this question is unknown in the case of a VNM PPA.

9. If the PPA expires and is not renewed and the solar facility has not reached the end of its lifespan, will WS decommission the facility or seek other revenue mechanisms for the power produced by the facility?
RE:
It is likely that WS would sell power on the wholesale market or under another PPA depending upon what the legal and market framework supports at that time.

10. Would WS participate in the ISO-NE Forward Capacity Auction for the proposed 2 MW Future Projects (Future Projects)?
RE:
There are currently no plans to participate in the Forward Capacity Market for this site. By far the most beneficial outcome for ratepayers for projects under 5MWs is for such projects to maintain their status as "load reducers" in ISO-NE, which if properly treated by the EDCs would result in lower capacity requirements, lower capacity costs, and lower regional network service costs.

If yes, which auction(s) and capacity commitment period(s)?
RE:
N/A

Proposed Site

11. In the lease agreement with the landowner PLH, LLC, are there any provisions related to decommissioning or site restoration at the end of the project's useful life?
RE:
No.

If so, please describe and/or provide any such provisions.
RE:
N/A.

12. Would all components of the solar photovoltaic panels be recyclable?
RE:

End of life modules are typically handled by specific module manufacturers recycling programs or module recycling companies; current technology allows for high recycling efficiency of solar PV modules. Basic information on Recycling can be found in the link below:
(https://www.greenmatch.co.uk/blog/2017/10/the-opportunities-of-solar-panel-recycling)

Could components of panels be reused to make photovoltaic cells or whole panels be used to make new solar panels at the end of the life of this project?
RE:
Current recycling technologies can reuse modules, recycle wafers, and repurpose raw materials for other goods. WS is unsure of recycling technologies and costs at the end of life of these systems and how these modules will be specifically recycled at that time.

Could the solar panels and/or associated components be repurposed for a different use or product?
RE:
A majority of the modules are glass plastic and aluminum, all raw materials that are traditionally recycled for any use.

13. Provide the distance, direction and address of the nearest property line and nearest off-site residence from the solar field perimeter fence for the Future Projects.
RE:
Address: 19 West Fisk Road, Hampton, CT 06247
Distance: 320'

Energy Output

14. What is the proposed solar panel wattage in Watts direct current (W DC) for the Future Projects?
RE:
475W to 485W

Would it be the same as the already approved arrays?
RE:
No the modules installed with the approved arrays are 330W to 400W.

15. Have electrical loss assumptions been factored into the output of the facility?
RE:
Yes, Electrical losses are calculated throughout the design of each facility. Energy modeling, and total production of each facility, considers these electrical loss assumptions.

What is the total output (MW AC) at the point of interconnection taking into account all approved solar panels and the Future Project?
RE:
The total output of all the facilities will be 8MW AC. The facilities AC output is determined by the electrical transformer associated with each project. The transformer size sets the interconnection voltage and current output.

16. Would the power output of the solar panels decline as the panels age?
RE:
Yes.

If so, estimate the percent per year.
RE:
Solar Modules on average degrade approximately 0.5%-1% of their output per year.

17. If one section of the solar array experiences electrical problems causing the section to shut down, could other sections of the system still operate and transmit power to the grid?
RE:
The likely electrical design for the future systems will be a string inverter design, therefore each facility is broken into several smaller sections of generation and DC to AC conversion, therefore if an inverter or string is not producing power, the other elements of the system will still produce energy and continue to output to the grid.

Site Components and Solar Equipment

18. How many panels will each rack hold?
RE:
Solar modules are currently planned with 2 modules in portrait. The proposed solar racking is contiguous so each row differs in module quantity. Total module count is identified on the site plan for each facility.

19. Is the wiring from the panels to the inverters installed on the racking? If wiring is external, how would it be protected from potential damage from weather exposure, vegetation maintenance, or animals?
RE:
Yes, solar string wiring will be installed parallel with the array rows either affixed to the racking or installed in a cable tray. String wiring at the end rows will transition to underground conduit protecting it from vegetation maintenance and animals. All wiring is UV protected. This is a typical method for solar facility wiring install and meets all applicable electrical codes.

20. What is the proposed aisle width (or spacing from panel edge to panel edge) for the Future Projects?
RE:
Approximately 11.5', with the module selection represented in the site plan.

What is the minimum aisle width at which the solar panel rows could be installed?
RE:
The row spacing design for the effective impervious calculation assumed a narrow 7.7' row spacing, therefore anything wider decreases effective impervious, and creates a more conservative stormwater basin design.

How does this aisle width compare with the approved solar arrays?
RE:
Aisle width for the solar array constructed with the approved D&M Plan was 10.8'.

Interconnection

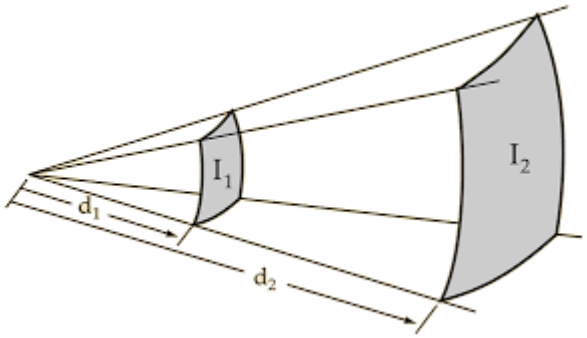
21. Provide an update on any system impact studies and indicate if the electrical distribution system can support the full megawatt output of the approved project plus the Future Projects (e.g. 8 MW AC).
RE:
On August 21st, 2019, Eversource prepared an updated distribution impact study, thus maximizing the output from the site across the existing feeder to 7MW AC. The impact study is attached as ***(Exhibit B – Impact Study)***. WS is still working with Eversource on additional capacity/distribution options. If the existing feeder is ultimately limited to 7MW AC, WS would

explore battery storage, or other methods of project oversizing, such as increasing the projects AC/DC ratio, to account for the full module footprint represented in the site plan.

Public Safety

22. Would the Future Projects comply with the National Electrical Code, the National Electrical Safety Code and any applicable National Fire Protection Association (NFPA) codes and standards, including, but not limited to, NFPA Code Section 11.12.3?
RE:
Yes. WS will construct the facilities to all applicable local and national codes.

23. Would the proposed Future Projects meet the applicable DEEP noise standards at the property boundaries?
RE:
Sec 22a-69-3.5 Requires Class A Receptors to have less than 55dBA at day and 45 dBA at night. Inverters and equipment will be centrally located on the site. String inverters and transformers emit 60dBA at 3 meters from the source. Noise levels change with distance per the inverse square law, see the image and equation below:



$$\frac{I_2}{I_1} = [\frac{d_1}{d_2}]^2$$

Therefore, the reduction of 60dBA at 3 meters (9.8 feet) from the source, to the maximum 55dBA in the daytime is approximately 5 meters (16.4 feet) from the source. All noise emitting equipment on site, is further than (16.4 feet) from the property line. Nighttime audible noise would only be the transformer and ancillary monitoring equipment such as routers, computers and battery backup devices. At 16.8m (55.1feet) from the source in the evening audible noise would be at or below 45dBA. All equipment that would be energized during the evening is also further than 16.8m (55.1 feet) from the property line.

24. Please respond to the comments of the Connecticut Airport Authority dated December 16, 2020.
RE:
A glare study was developed in association with the proposed facility expansion ***(Exhibit C – Glare Study)***. The study utilized a 2-mile flight path from the Windham Airport in the general direction of the proposed facility. The analysis of the flight path as it related to the proposed expansion indicated no glare concerns.

Petition 1222 was approved by the CSC without this information. A D&M plan associated with the Petition 1222 was approved on August 15, 2019 without this information. Approximately 5MW DC of solar modules have been installed on the site since February 2020 approximately 11 months since the issuance of the comments from the Connecticut Airport Authority. The currently installed modules on the site are also just off the centerline to the approach of Runway 27 at the Windham Airport. At this time, there have not been any glare complaints from the facility that WS is aware of. Ground mounted solar PV is designed to absorb sunlight, rather than reflect it, thus minimizing the potential impacts of glare. Per the *FAA Technical Guidance for Evaluating Selected Solar Technologies on Airports, November 2010 (updated April 2018).* Section 1.3.4. states that solar PV is compatible with airport land and is the best opportunity for airports to install solar energy versus other solar energy producing systems. Solar installations are presently operating at a number of airports across the country, including megawatt-sized solar facilities covering multiple acres.
https://www.faa.gov/airports/environmental/policy_guidance/media/FAA-Airport-Solar-Guide-2018.pdf

WS believes that there is no safety issue for arriving pilots associated with the existing or future phase facilities.

25. Would the Future Projects require a review/determination from the FAA regarding any potential hazard to air navigation?
RE:
WS does not believe so.

Environmental

26. Provide the total tree clearing area that would be required for the Future Projects development area.
RE:
5.3 Acres

27. Under Connecticut General Statutes §16-50k, "Core forest" means unfragmented forest land that is three hundred feet or greater from the boundary between forest land and non forest land, as determined by the Commissioner of Energy and Environmental Protection." Would any tree clearing associated with the development of the proposed Future Projects occur within core forest?
RE:
Yes.

If so, how many acres?
RE:
The future 2MW will clear approximately 5.2 additional acres of small core forest.

How would tree clearing affect the acreage of core forest and core forest edge?
RE:
Approximately 27.1 acres of small core forest and 5.2 acres of edge core forest have been cleared for the 6MW approved array area. An additional 0.3 acres of edge core forest will also be cleared with the future 2MW.

Provide an aerial photograph that depicts pre- and post-construction acreage of core and edge forest.
RE:
Attached as is a map that represents the isolated small core forest, edge core forest and the associated clearing areas and percentages. ***(Exhibit D – Core Forest)***

28. Does the proposed Future Projects development area contain any Connecticut Prime Farmland Soils?

    RE:

    There are no prime farmland soils for the Future Projects. An Agg Soil exhibit was originally submitted with the Interrogatory Response 3 for the 1222 application.

    If so, how many acres of Prime Farmland Soils would be impacted by the proposed Futures Projects?

    RE:

    N/A

29. Are there any wells on the site or in the vicinity of the Future Projects site?

    RE:

    No.

    If so, how would WS protect the wells and/or water quality from construction impacts?

    RE:

    N/A.

30. Would any fuels be stored on site during construction of the Future Projects?

    RE:

    Fuel for construction equipment may be stored on site, depending on the selected contractor, and their preferred method for refueling equipment.

    If so, provide Spill Prevention, Control and Countermeasure Plan.

    RE:

    A site specific spill prevention, control, and countermeasure (SPCC) plan is required for a site if there is 1,320 gallons or more in aggregate above ground storage. Connecticut does not have standards beyond the federal requirements for (SPCC) plans. The Petitioner does not plan on storing greater than 1,320 gallons in site, therefore a site specific SPCC is not necessary. The SWPCP that was submitted to and approved by DEEP address procedures required for spill containment and prevention.

31. Provide the pre-construction and post-construction percent development areas for the 100-foot to 750-foot Critical Terrestrial Habitat Areas for Vernal Pool #1 and Vernal Pool #2 which are identified on Sheet No. 15.

    RE:

    (Exhibit E – Vernal Pool Calculations) outlines the Vernal Pool Envelopes and Critical Terrestrial habitat areas associated with Vernal Pools #1 and #2. Impact calculations have been provided for the existing facility, and the additional impacts have been calculated for the future 2MW area.

    It should be noted that the reduction of CTH is based on considering solar panel array areas as "developed" land, which is unsuitable for amphibians. However, these areas will not be maintained as a typical lawn, which is excluded by the BDP as suitable habitat. They will be seeded to low, grasses suitable for grazing. Therefore, these areas will not prohibit movement of vernal pool amphibians as they move between habitats or disperse, as would a manicured lawn.

32. Would the proposed Future Projects be consistent with the 2015 U.S. Army Corps of Engineers Vernal Pool Best Management Practices?

    RE:

Yes.

33. What is the length of the posts and to what depth would the posts be driven into the ground to provide structural stability?
RE:
The posts for the solar racking will likely be ground screws, due to the rocky subsurface of the site. Ground screws for the approved facility are approximately 73" in depth.

Are any impacts to groundwater quality anticipated?
RE:
No. Post depth is too shallow to affect groundwater.

If so, how would the Petitioner manage and/or mitigate these impacts?
RE:
N/A

34. Please submit photographic site documentation with notations linked to the site plans or a detailed aerial image that identify locations of site-specific and representative site features for the Future Projects area. The submission should include photographs of the site from public road(s) or publicly accessible area(s) as well as Site-specific locations depicting site features including, but not necessarily limited to, the following locations as applicable:

For each photo, please indicate the photo viewpoint direction and stake or flag the locations of site-specific and representative site features. Site-specific and representative site features include, but are not limited to, as applicable:

1. wetlands, watercourses and vernal pools;
2. forest/forest edge areas;
3. agricultural soil areas;
4. sloping terrain;
5. proposed stormwater control features;
6. nearest residences;
7. Site access and interior access road(s);
8. utility pads/electrical interconnection(s);
9. clearing limits/property lines;
10. mitigation areas; and
11. any other noteworthy features relative to the Project.

A photolog graphic must accompany the submission, using a site plan or a detailed aerial image, depicting each numbered photograph for reference. For each photo, indicate the photo location number and viewpoint direction, and clearly identify the locations of site-specific and representative site features show (e.g., physical staking/flagging or other means of marking the subject area).

The submission shall be delivered electronically in a legible portable document format (PDF) with a maximum file size of <20MB. If necessary, multiple files may be submitted and clearly marked in terms of sequence.
RE:
Attached as ***(Exhibit F – Photo Exhibits)*** is a file that represents current site photos, and areas around the future development projects.

Facility Construction

35. With regard to earthwork required to develop the Future Projects portion of the site, provide the following:

a) Will the site be graded? If so, in what areas?
RE:
Grading areas are represented in ***(Exhibit F – Photo Exhibits)***. These grading areas are also associated with the approved SWPCP. Only the basins in the future project areas will require mass grading. Cut material from the basins will remain on site.

b) What is the desired slope within the solar array areas?
RE:
Slopes in the Future Project location average 6% to 12%, a fill area is represented in Exhibit F to balance earthwork material on site and improve slopes for the solar racking installation.

c) Could the solar field areas be installed with minimal alteration to existing slopes?
RE:
It is always WS intention to perform the least amount of grading and alteration to existing slopes on site with minimal import or export of soil.

d) If minimal alteration of slopes are proposed, can existing vegetation be maintained to provide ground cover during construction?
RE:
Given that the site was originally forested, after tree removal existing vegetation is minimal, the approved SWPCP outlines temporary and permanent seeding requirements to ensure slope stability, and those practices will continue for the Future Phase.

e) Estimate the amounts of cut and fill in cubic yards for any additional access road(s)
RE:

Earthwork Quantity	**Cut**	**Fill**
Stormwater Basin South	2325	0
Stormwater Basin North	2821	0
Access Roadway	0	2185
Array Footprint Grading	0	2961
NET	5146	5146

f) Estimate the amounts of cut and fill in cubic yards for solar field grading.
RE:
Approximately 3,000 yards will be graded within the solar facility area from the stormwater basin excavations.

g) If there is excess cut, will this material be removed from the site property or deposited on the site property?
RE:
Any excess cut will remain on site.

36. Would topsoil be stripped from the site prior to grading?
RE:

Yes. In all grading operations topsoil will be stripped, stockpiled and respread, basins and areas requiring topsoil will receive a minimum of 4" of soil, to ensure proper growth of groundcover.

If so, would the topsoil be spread over the disturbed areas once grading is complete?
RE:
Yes.

If not, how would growth of new vegetation/grasses be promoted within the graded areas if nutrient rich soils are not present?
RE:
N/A

37. For the future project would the posts (that support the racking system) be driven into the ground using the same methods as for the approved arrays? Explain. In the event that ledge is encountered, what methods would be utilized for installation?
RE:
Yes. As mentioned previously, the site will use ground screws, which were installed in the area of the approved arrays. Ground Screws can penetrate ledge and rocks, so installation refusals are minimized.

38. Would a seasonal restriction (i.e. outside of June/July) for clearing of the Future Projects area be implemented to protect the northern long-eared bat?
RE:
Yes. The applicant would prefer to clear prior to June of 2021, to ensure a seamless construction of the Future facility during the Summer/Fall of 2021.

Exhibit A

Site Plan

FISK ROAD

331.51'

SYDNEY POINT OF INTERCONNECTION

DICKINSON POINT OF INTERCONNECTION

MC HENRY / WASHINGTON / YANTIC POINT OF INTERCONNECTION

SYDNEY SOLAR EQUIPMENT

SYDNEY SOLAR
6000 (400W) Modules
2.00 MW AC
2.40 MW DC
TILT = 25°

YANTIC SOLAR EQUIPMENT

YANTIC SOLAR
5256 (475W) Modules
2.0 MW AC
2.49 MW DC
TILT = 25°

WASHINGTON SOLAR EQUIPMENT

WASHINGTON SOLAR
2880 (475W) Modules
1.00 MW AC
1.37 MW DC
TILT = 25°

DICKINSON SOLAR EQUIPMENT

MC HENRY SOLAR EQUIPMENT

MC HENRY SOLAR
3724 (330W) Modules
0.99 MW AC
1.22 MW DC
TILT = 25°

DICKINSON SOLAR
6000 (400W) Modules
2.00 MW AC
2.40 MW DC
TILT = 25°

100' SIDE/REAR YARD SETBACK

50' SIDE/REAR YARD SETBACK

100' ADDITIONAL SETBACK

40' SIDE YARD SETBACK

CL&P EASEMENT

EDGE C.L.& P. EASEMENT

100' 0 100' 200'
SCALE: 1"=100'

PETITION 1222A
INTERROGATORIES SET 1

EXHIBIT A - SITE PLAN
1-25-21

Exhibit B

Impact Study

ECOS Fisk 7000 kW
25, 35, 45 West Fisk Road, Hampton, CT

CD00607

Ryan Avery

08/21/2019

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Abstract

This system impact study is to examine the maximum allowable solar generation on the 11F14 feeder. The maximum amount of generation that can be interconnected to the 11F14 feeder for the Fisk Road project was found to be 7MW. To interconnect 7MW the three single-phase line regulators would need to be upgraded to be rated for 200 amps per phase. The current single-phase 100 amp regulators can handle up to 3MW of generation before experiencing reverse power flow. When these regulators experience reverse power flow more than 1 amp the regulators will buck or boost to maximum tap positions causing extremely high voltage or extremely low voltage. However, if the regulator control boxes are upgraded and settings changed to bias co-generation mode, the system can handle up to 5.5 MW of generation with the existing 100 amp regulators. Field verification would be necessary to determine existing control boxes; if they are not Cooper CL-7 each phase control box would need to be upgraded to accommodate Cooper's new setting for reverse power flow on highly penetration feeders. This installation is intended to export all of the solar production and does not contain any load behind the system. A full impact study is required as this project size does not qualify for the fast track process and it has been identified that transfer trip would be required. The study has determined the impacts on voltage, equipment ratings, and protection concerns, as well as any potential islanding concerns.

This study found that the voltages remained inside the acceptable voltage ranges as required by PURA, but the interaction with the three single-phase voltage regulators and the PV production was adversely affected. The voltage flicker of the system was found to be outside the acceptable ranges with 7MW and will require a ramp rate. The study has determined that there is a significant concern for the new generation's interaction with the existing synchronous machines installed on the circuit and the lack of daytime load. Direct transfer will be required to prevent any un-intentional islanding conditions and will also prevent generation from operating on alternative feeders during contingency events. If the customer desires; the utility may offer them a dynamic risk of islanding analysis that may waive the need for direct transfer trip. A site dedicated recloser will still be necessary to trip the DG offline during abnormal circuit reconfigurations. Any operation on alternate feeds will need to be analyzed on a case-by-case basis.

Introduction

This is a system impact study (SIS) that will investigate the impact of a 7MW PV system being interconnected to the 11F14 circuit via a three-phase line extension and overbuild of approximately 0.72 circuit miles down U.S. Route 6 in Hampton, CT. The scope of this study will look at the thermal limitations and voltage impacts during peak and light loading conditions. Voltage and VAR compensation equipment will be examined to see if proper functionality can be sustained with the increased generation on the circuit. The study will also examine the minimum loading of the circuit and the generation's interaction with any existing and queued DG facilities on the circuit, through May, 2019.

Project Location

The Fisk 7MW solar generation will be located at 25, 35, 45 Fisk Road in Hampton, CT. This project will be connected via new service via an aerial cable line extension from the Card St 11F14 feeder. The ECOS Fisk solar site is located approximately 10.61 circuit miles away from its bulk source. A backbone path representation of this distance can be found in the Appendix of this SIS, Figure 2.

System Configuration

The site is currently fed from the Brooklyn 30Y8 feeder; however, this substation cannot accept any reverse feed from this site. This is due to inadequate protection on the substation bus and transformer. To resolve this issue, the ECOS Fisk project will be interconnected to the 11F14 Card St 23kV feeder.

System Loading

The system loading at the 11F14 circuit breaker was measured to be a maximum of 15.5 MVA in August of 2018. The minimum was recorded at 6.2 MVA during the month of October.

Voltage Impact During Normal Operation

CT regulatory requirements require adherence to voltages at -5% to +5% PU. For this study, 'passing' will be considered if the voltage rise is less than 5% PU. The modeling software uses a nominal voltage of 120 as the output, so the voltages from the model will need to stay between 114 and 126 V. This portion of the study determines if the interconnection can maintain these requirements at peak and minimum loading conditions. The study looks at both peak and minimum loading during time in which the generator is in parallel with the Eversource system.

Peak Loading

At peak loading steady state conditions, with generation at a unity power factor and the customer generation connected, the system can sustain voltage within the PURA limitations. The system does not cause high voltage at the PCC or elsewhere along the circuit. The proposed project does cause minor power factor swings at the substation bus, as illustrated in Figure 2.

	Max Load(7MW)								
	Generation Off			Generation 95% - Hold Taps			Generation 100% - Steady State		
	A	B	C	A	B	C	A	B	C
	121.4	121.1	122.4	126	126.2	126.2	123.4	123	124.1
Card 11F	97.1	96.4	96.5	95.4	95.2	95.2	95.1	95	95

Figure 2: Three phase voltages and power factor during peak load at the PCC

Generation Off

During this simulation, all generators on the circuit, including the proposed generator, were turned off for the peak loading case. As shown in Figure 2, above, all voltages and power factor readings were within the PURA limitations.

Generation at 95%

Given that this project is a fluctuating resource, this load flow scenario was studied to determine the flicker risk. For PV installations, the Eversource standards allow for up to two percent flicker. To determine flicker, the circuit is run with all generation off. The taps on the regulators and the position of the switched capacitor banks are then locked. Generation is turned on to 95 percent. Under normal circuit configurations and having all capacitor banks in service, the maximum flicker occurred at 4.21%. Figure 3 below illustrates the flicker on all three phases during peak load.

Max Load(7MW)		
Flicker		
A	B	C
3.79%	4.21%	3.10%

Figure 3: Voltage flicker during peak load

Generation On

Under this simulation, all generators, including the proposed generator, were turned on. As shown in Figure 2, all voltages were within the PURA limitations. Power factor was also recorded at the substation and it was confirmed that the project does cause noticeable changes to power factor.

Minimum Loading

At minimum loading steady state conditions, with generation at a unity power factor and the customer generation connected, the system can sustain voltage within PURA limitations. The system does not cause high voltage at the PCC as well as elsewhere along the circuit and does not cause dramatic changes to substation power factor.

	Min Load(7MW)								
	Generation Off			Generation 95% - Hold Taps			Generation 100% - Steady State		
	A	B	C	A	B	C	A	B	C
	122.3	121.8	123	126.6	126	126.2	**124.5**	**124**	**124.1**
Card 11F	97.5	97.6	97.5	-3.5	60	32.6	-24.4	45	10.9

Figure 4: Three phase voltages and power factor during minimum load at the PCC

Generation Off

During this simulation, all generators on the circuit, including the proposed generator, were turned off for the peak loading case. As shown in Figure 4, above, all voltages were within the PURA limitations.

Generation at 95%

The same analysis for voltage flicker was studied during light load conditions. Figure 5 below illustrates the voltage flicker. Like peak loading, the 2% threshold is exceeded with the worst-case scenario at 3.52%.

Min Load(7MW)		
Flicker		
A	B	C
3.52%	**3.45%**	**2.60%**

Figure 5: Voltage flicker under light load conditions

Generation On

Under this simulation, all generators, including the proposed generator, were turned on. As shown in Figure 4, all voltages were within the PURA limitations. Power factor at the substation was also deemed acceptable.

Contingencies

Loss of 11F14 Source

The loss of normal source to the Fisk Solar site installation requires that the PV be offline. Any exceptions to this must first be run by Eversource DER Planning engineering and will be on a case-by-case basis. Under certain contingencies and loading of the circuits, the Fisk site may be allowed to operate at a limited output; if circuit conditions are favorable.

Regulators and Capacitors

The 11F14 circuit contains three capacitors. Of these capacitors, two are 600 kVAR and one 1800KVAR all of which are switched capacitors. All of the capacitors lie in the upstream zones.

The voltage impact study has identified that the current state of the circuit equipment can handle up to 3MW. However, by upgrading the settings of the regulators to bidirectional co-generation mode and updating the control box to a Cooper CL-7 box, a maximum of 5.5MW can be interconnected to 11F14 before the 100 amp regulator ratings are exceeded. Furthermore, by upgrading the three single phase regulators to be rated for 200 amps up to 7MW of generation can be interconnected before other in-line, backbone devices reach their limit along the circuit. Line regulators will cycle as many as 14 taps depending on the phase during peak loading when the new solar facility goes from no output to full output. Rapid tap change operation will be mitigated by implementing a ramp rate to the generator when it is coming back online due to varied resource availability. This will prevent drastic up and down swings in output.

System Upgrades and Service

Impact study costs include system improvements required due to system voltage, transfer trip, and system requirements for the generating sites in the scope of this study.

1. Three-phase line extension and overbuild configuration from the Card St 11F14 source to Fisk Road, approximately 0.72 circuit miles down U.S. Route 6 as seen in Figure 1 of the appendix.
2. New service with transformers to support DG
3. Primary metering, number to be determined by the number of PV ‘parcels’ specified by the developer to meet REC requirements
4. Three-phase SCADA recloser

5. Transfer trip from the 11F14-2 to the customer's site.
6. Updated settings and CL-7 control box if PV is over 3MW
7. Upgraded 200 amp per phase regulators if site is over 5.5MW

Protection Study

P&C concluded that the system needs additional effective grounding measures. When the project goes to construction a coordination study will be conducted. The customer is expected to follow the Eversource inverter and relay settings. The typical settings are shown below in Figures 6-7.

One major aspect related to protecting the proposed system and electric grid, is whether the system is effectively grounded. Below describes the four (4) main criteria looked at to ensure the system is effectively grounded. All four (4) criteria must pass to be deemed effectively grounded.

1. Is the DG less than one (1) megawatt (MW)? *NO
2. Does the proposed system pass the anti-islanding concern or in other words, does it pass the generation to load ratio requirement? *NO
3. Does the fault current at the point of common coupling (PCC) stay below a value that's greater than 10% of the existing value? *NO
4. Is the proposed area unknown to excessive fault currents? *YES

Since the system failed three (3) of the four (4) effective grounding conditions, the customer will be responsible to provide additional effective grounding on the 7 MW PV installation.

Redundant Relay Settings

27-1	UNDER VOLTAGE - FAST	(%) = 50
	Line to Line Voltage 480	(27-1) Volts = 240
	Line to Ground Voltage 277	(27-1) Volts = 139
	UV TIMER	(27-1) Seconds = 0.16
	UV TIMER	(27-1) Cycles = 10
27-2	UNDER VOLTAGE - SLOW	(%) = 88
	Line to Line Voltage 480	(27-2) Volts = 423
	Line to Ground Voltage 277	(27-2) Volts = 244
	UV TIMER	(27-2) Seconds = 2.0
	UV TIMER	(27-2) Cycles = 120
59-1	OVER VOLTAGE -FAST	(%) = 120
	Line to Line Voltage 480	(59-1) Volts = 576
	Line to Ground Voltage 277	(59-1) Volts = 333
	OV TIMER	(59-1) Seconds = 0.16
	OV TIMER	(59-1) Cycles = 10
59-2	OVER VOLTAGE - SLOW	(%) = 110
	Line to Line Voltage 480	(59-2) Volts = 528
	Line to Ground Voltage 277	(59-2) Volts = 305
	OV TIMER	(59-2) Seconds = 1.0
	OV TIMER	(59-2) Cycles = 60
81U - 1	UNDER FREQUENCY	(Hz) = 57
	UF TIMER	(81U-1) Seconds = 0.16
	UF TIMER	(81U-1) Cycles = 10
81O	OVER FREQUENCY	(Hz) = 60.5
	OF TIMER	(81O) Seconds = 0.16
	OF TIMER	(81O) Cycles = 10

Figure 6: Typical Eversource relay settings

Appendix C

C.1. Inverter voltage trip settings

Shall Trip Function	Required Settings	
	Voltage (p.u. of nominal voltage)	Clearing Time(s)
OV2	1.20	0.16
OV1	1.10	2.0
UV1	0.88	2.0
UV2	0.50	1.1

C.2. Inverter frequency trip settings

Shall Trip Function	Required Settings	
	Frequency (Hz)	Clearing Time(s)
OF2	62.0	0.16
OF1	61.2	300.0
UF1	58.5	300.0
UF2	56.5	0.16

C.3. Inverter Voltage Ride-through Capability and Operational Requirements

Voltage Range (p.u.)	Operating Mode/ Response	Minimum Ride-through Time(s) (design criteria)	Maximum Response Time(s) (design criteria)
V > 1.20	Cease to Energize	N/A	0.16
1.175<V≤1.20	Permissive Operation	0.2	N/A
1.15<V≤1.175	Permissive Operation	0.5	N/A
1.10<V≤1.15	Permissive Operation	1	N/A
0.88≤V≤1.10	Continuous Operation	infinite	N/A
0.65≤V<0.88	Mandatory Operation	Linear slope of 8.7 s/1 p.u. voltage starting at 3 s @ 0.65 p.u.: $T_{VRT} = 3\,s + \frac{8.7}{1\,p.u.}(V - 0.65\,p.u.)$	N/A
0.45≤V<0.65	Permissive Operation[12]	0.32	N/A
0.30≤V<0.45	Permissive Operation	0.16	N/A
V<0.30	Cease to Energize	N/A	0.16

C.4. Inverter frequency ride-thru capability

Frequency Range (Hz)	Operating Mode	Minimum Time(s) (Design Criteria)
f > 62.0	No ride-through requirements apply to this range	
61.2<f≤61.8	Mandatory Operation	299
58.8≤f≤61.2	Continuous Operation	Infinite
57.0≤f≤58.8	Mandatory Operation	299
f<57.0	No ride-through requirements apply to this range	

C.5. Grid support utility interactive inverter function status

Function	Default Activation State
SPF, Specified Power Factor	Off
Q(V), Volt-Var Function with Watt or Var Priority	Off Default value: 2% of maximum current output per second
SS, Soft-Start Ramp Rate	On
FW, Freq-Watt Function OFF	Off

Figure 7: Smart inverter settings excerpt from Appendix C of Exhibit B – Generator Interconnection Technical Requirements (April 30th, 2018)

Conclusions

The impact study has determined that the installation of a maximum of 7MW of PV at the Fisk Road solar site will be able to maintain voltage within regulatory limits with a ramp rate. The 7MW will require upgrades to the regulators to support 200 amps per phase. The current 100 amp regulators can support up to 3MW of generation without upgrading the settings and regulator control box and 5.5MW by updating the regulator settings and control box. During contingencies when the normal source to the Fisk Road solar site from the 11F14 to the PV site is out of service the system will be required to be offline via a DSCADA recloser to prevent operation on the alternate circuit. Operation on the alternate feed will need to be vetted out to Eversource DER Planning Engineering and will be on a case-by-case basis dependent on circuit loading, configuration, and other circuit parameters. The customer will also be required to pay for transfer trip, a line extension from the 11F14 circuit, and a new service with DSCADA controlled recloser and primary metering.

Appendices

Appendix A:

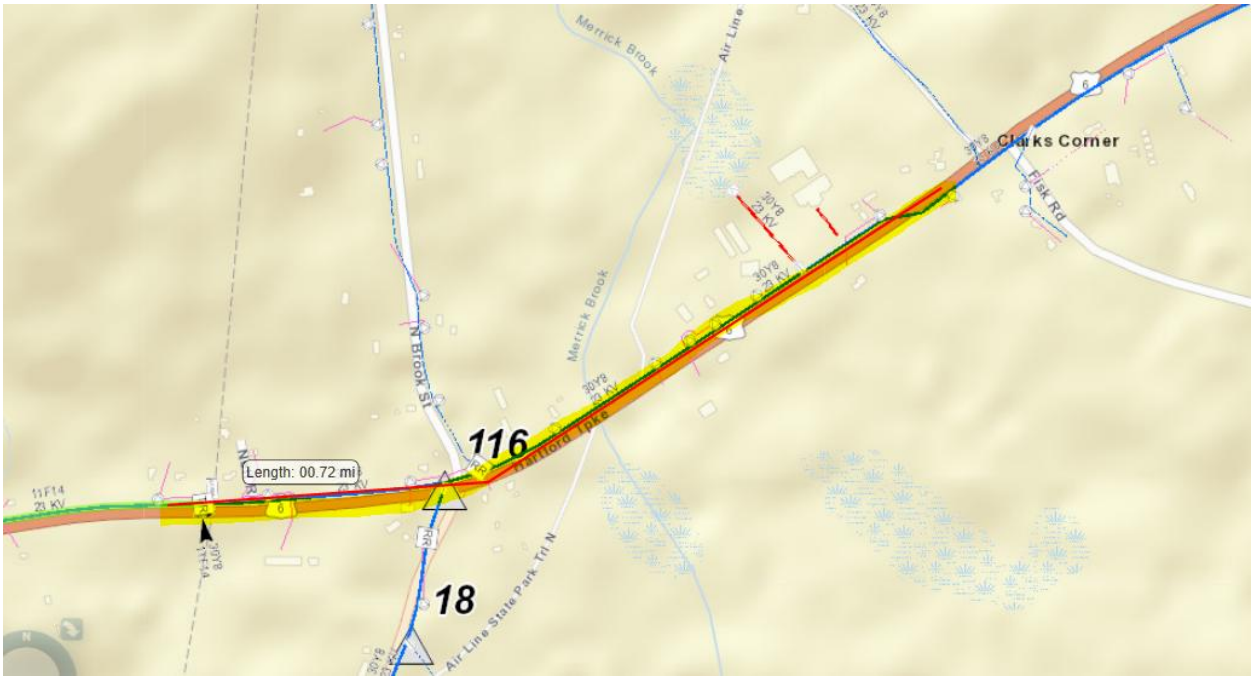


Figure 1: Three phase line extension from the ECOs Fisk site to the Card St 11F14 tie point

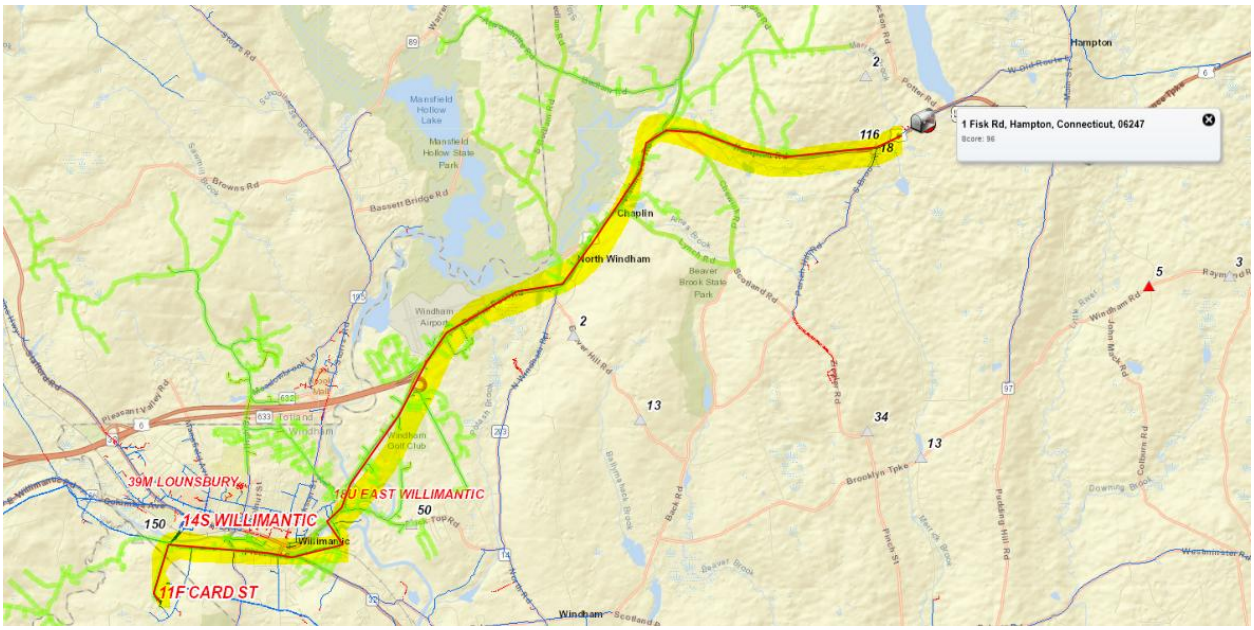


Figure 2: Backbone circuit path from Card St substation via Card St 11F14 feeder

Exhibit C

Glare Study

FORGESOLAR GLARE ANALYSIS

Project: **Fisk Street, Hampton, CT**
2MW solar

Site configuration: **Fisk Street**
Analysis conducted by Rodney Galton (rodney.galton@ecosrenewable.com) at 17:38 on 22 Jan, 2021.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 48447.8710

PV Array(s)

Name: PV array 1
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	41.769780	-72.082459	685.06	2.00	687.06
2	41.768508	-72.082169	661.02	2.00	663.02
3	41.768188	-72.081611	663.92	2.00	665.93
4	41.768196	-72.081322	658.63	2.00	660.63
5	41.769836	-72.081300	704.92	2.00	706.92
6	41.769860	-72.081558	703.41	2.00	705.41
7	41.770100	-72.081568	707.92	2.00	709.92
8	41.770616	-72.082099	711.36	2.00	713.36
9	41.770588	-72.083006	689.42	2.00	691.42

Flight Path Receptor(s)

Name: FP 1
Description:
Threshold height: 50 ft
Direction: 250.7°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	41.746439	-72.170694	237.54	50.00	287.54
Two-mile	41.756014	-72.134086	402.00	439.00	841.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	25.0	180.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP 1	0	0

Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	0	0

Flight Path: FP 1

0 minutes of yellow glare
0 minutes of green glare

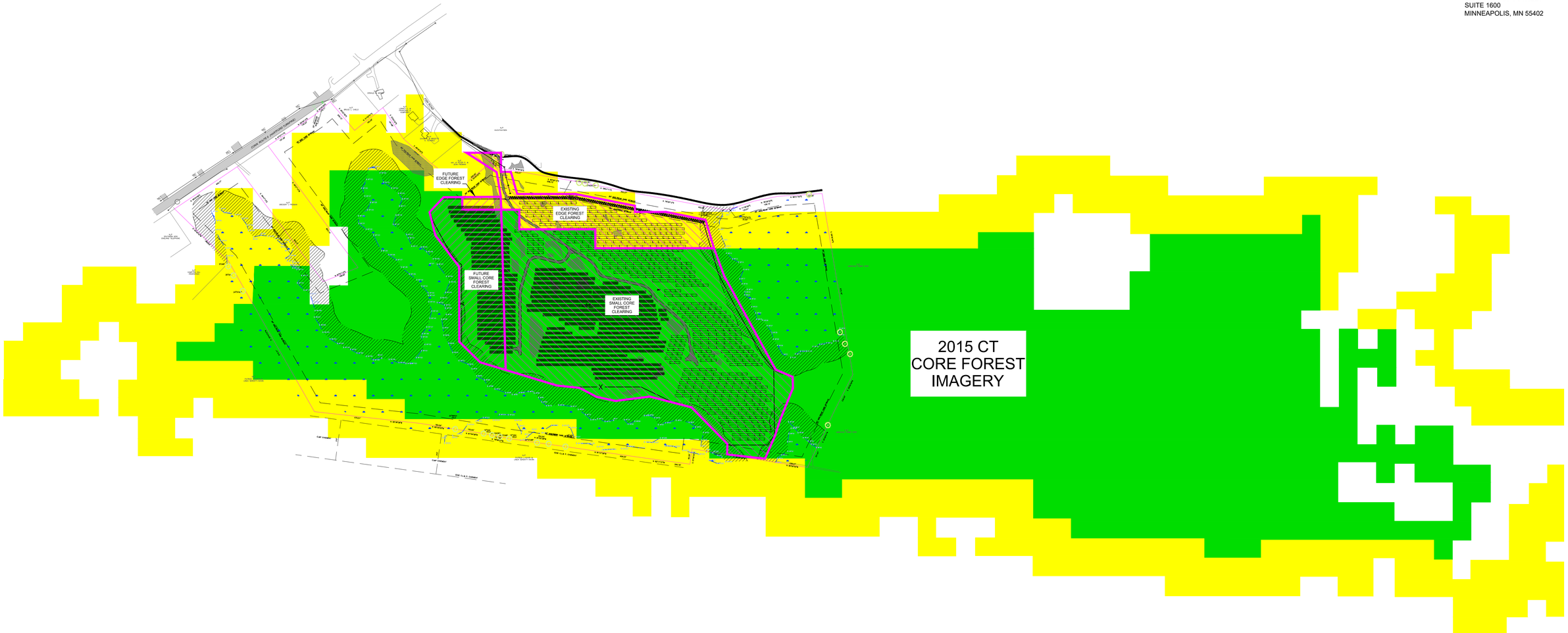
Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Exhibit D

Core Forest

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



	Total	EXISTING CLEARING		FUTURE CLEARING		TOTAL
	AC	AC	%	AC	%	%
Edge Forest	124.69	5.2	4.17%	0.3	0.24%	4.4%
Small Core Forest	167	27.1	16.23%	5.2	3.11%	19.3%

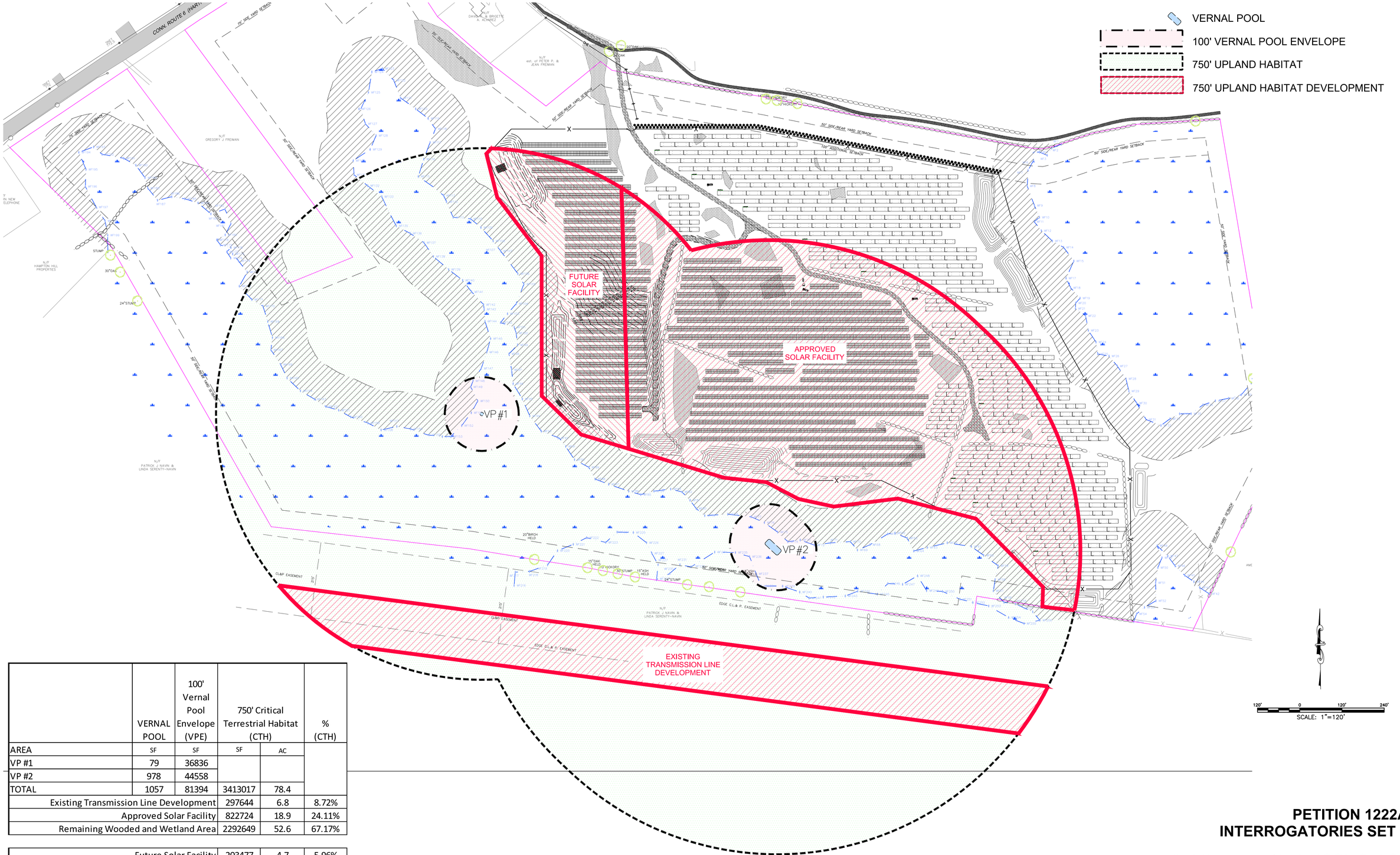
250' 0 250' 500'
SCALE: 1"=250'

PETITION 1222A
INTERROGATORIES SET 1

EXHIBIT D - CORE FOREST
1-27-21

Exhibit E

Vernal Pool Calculations



	VERNAL POOL	100' Vernal Pool Envelope (VPE)	750' Critical Terrestrial Habitat (CTH)		% (CTH)
AREA	SF	SF	SF	AC	
VP #1	79	36836			
VP #2	978	44558			
TOTAL	1057	81394	3413017	78.4	
Existing Transmission Line Development			297644	6.8	8.72%
Approved Solar Facility			822724	18.9	24.11%
Remaining Wooded and Wetland Area			2292649	52.6	67.17%

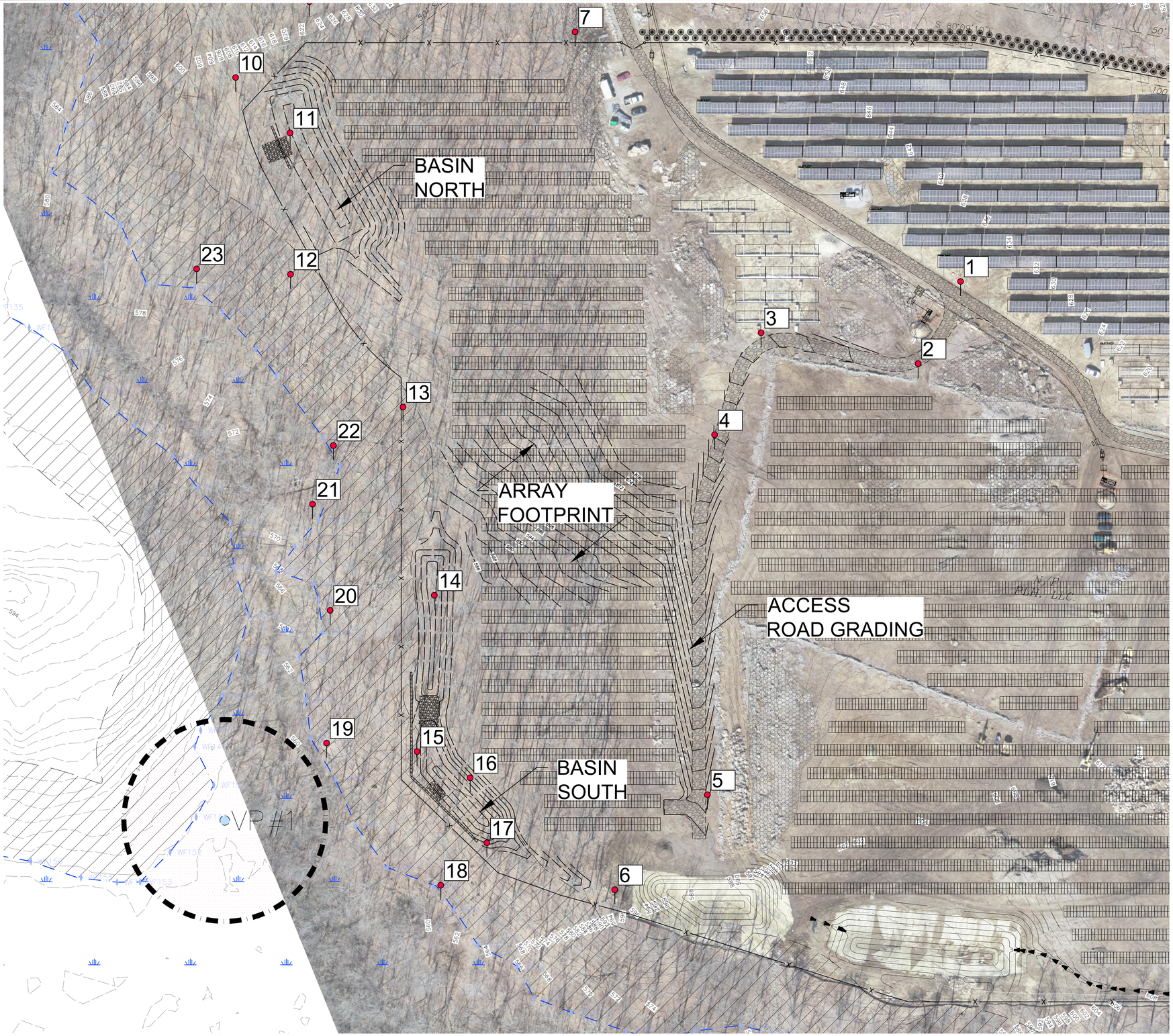
Future Solar Facility	203477	4.7	5.96%
Remaining Wooded and Wetland Area	2089172	48.0	61.21%

PETITION 1222A
INTERROGATORIES SET 1

EXHIBIT E - VERNAL POOL CALCS
1-25-21

Exhibit F

Photo Exhibits



Earthwork Quantitiy	Cut	Fill
Stormwater Basin South	2325	0
Stormwater Basin North	2821	0
Access Roadway	0	2185
Array Footprint Grading	0	2961
NET	5146	5146

60' 0 60' 120'
SCALE: 1"=60'

PETITION 1222A
INTERROGATORIES SET 1

EXHIBIT F - PHOTO EXHIBIT
1-25-21

PLACEMARK 1

EAST VIEW

SOUTH VIEW

WEST VIEW

NORTH VIEW

PLACEMARK 2

PLACEMARK 3


NORTH VIEW


WEST VIEW


EAST VIEW


SOUTH VIEW

PLACEMARK 4

WEST VIEW

NORTH VIEW

SOUTH VIEW

EAST VIEW

PLACEMARK 5

PLACEMARK 6

PLACEMARK 7


WEST VIEW


NORTH VIEW


SOUTH VIEW


EAST VIEW

PLACEMARK 8

PLACEMARK 9


NORTH VIEW


WEST VIEW


EAST VIEW


SOUTH VIEW

PLACEMARK 10


EAST VIEW


SOUTH VIEW


WEST VIEW


NORTH VIEW

PLACEMARK 11

PLACEMARK 12

PLACEMARK 13


SOUTH VIEW


EAST VIEW


NORTH VIEW


WEST VIEW

PLACEMARK 14

PLACEMARK 15


WEST VIEW


NORTH VIEW


SOUTH VIEW


EAST VIEW

PLACEMARK 16

PLACEMARK 17

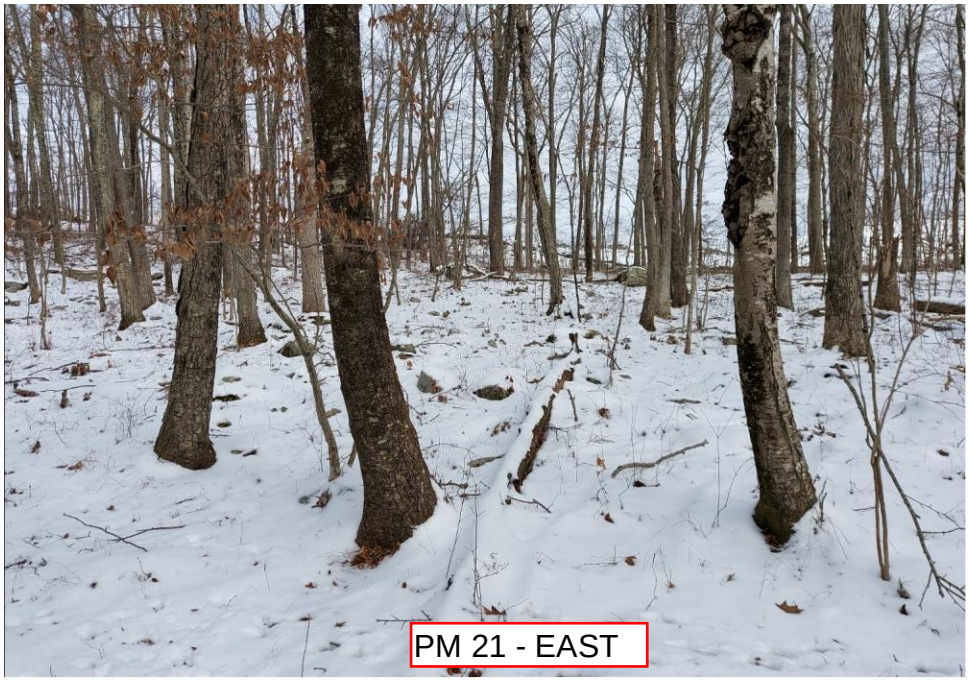

SOUTH VIEW


EAST VIEW


NORTH VIEW


WEST VIEW

PM 19 - EAST



PM 21 - EAST

PM 18 - NORTH

PM 20 - EAST


PM 22 - EAST


PM 23 - EAST