June 10, 2020

Mr. Ralph Palumbo
Revity Energy
117 Metro Center Boulevard, Suite 1007
Warwick, RI 02886
Sent via email to: Ralph@RevityEnergy.com

RE: Environmental Impact Statement 2nd Update
A Proposed Solar Farm Development
Frontier Road (AP: 7, Lots: 62, 62A and 63)
Hopkinton, Rhode Island
SAGE Project No. M896

Dear Mr. Palumbo:

The Environmental Impact Statement (EIS) dated January 31, 2020 was prepared while details for the site design were in progress. As such, subsequent reviews of the EIS have occurred to evaluate if any changes to the project plans have impacted the findings in the EIS. The first review, dated April 17, 2020, found the only necessary update was to the pre-construction noise assessment. This letter evaluates if any updates to the EIS are necessary based on modifications to the site plan and/or new findings since the April 17, 2020 review.

Attachment A provides the current site plan, this site plan is an update to Sheet 8 that was submitted by DiPrete Engineering (DiPrete) to Crossman Engineering on May 21, 2020. The changes to this site plan from what was submitted by DiPrete on May 21, 2020 is the addition of notes referencing statements from the EIS. The Site Layout Notes section in the "Overall Site Layout Plan" now includes a note for the potential need for sound barriers for the SG 250HX inverters (Note 11) and the requirement for equipment pads with transformer(s) to have secondary containment (Note 12). In addition, the location of where the sound barriers may be necessary and where secondary containment is needed are denoted on the site plan.

DiPrete conducted a geotechnical investigation on May 14, 2020 for areas of the site that are marked for regrading to relatively large cuts (e.g. 10 feet). **Attachment B** provides the Soil Erosion and Sediment Control Site Plan which shows the two test holes where relatively large grading cuts are proposed, test hole 20-10 and test hole 20-6. The proposed grading for the area where test hole 20-10 is located is estimated to be 7.25 feet, the results of the geotechnical investigation indicates that groundwater was not found until 8.5 feet. Thus, the large grading in this area would not be impactful to the groundwater. The proposed grading for the area where test hole 20-6 is located is estimated to be 10.7 feet, the geotechnical investigation found that groundwater is deeper than 9 feet. The geotechnical investigation in this area did not evaluate to the total depth of grading, however through evaluation of the soils in the

area it was found to be predominately manmade undulations that were most likely created for the golf course operations. As such it is not expected to be an issue to groundwater. Note that the only area where dense fill was not found was in the southern side of the steep slope. On this southern side, rock/ledge was hit about 2 feet down (refer to test hole 20-7), however there was no indication groundwater in that specific area. DiPrete believes that this could be an isolated area, as the other test holes along the ridge found no ledge/rock along with no groundwater table. The area where ledge/rock was hit, along with any other areas that may be discovered during construction, may result in modification during construction. These findings further support the statement in the EIS that groundwater would not be impacted during construction of the site, as it is not expected that the groundwater table will be impacted during construction grading process. If groundwater is found during construction, modifications to the construction plans will occur. The Stormwater Management Report prepared by DiPrete provides additional details of this geotechnical investigation.

The 3 parcels, where the proposed solar farm will be developed on Frontier Road, are unchanged and consist of Assessor's Plat 7 Lots 62, 62A and 63 as stated in the EIS. The discussions and conclusions regarding potential environmental impacts are unchanged by the solar panel layout modification, as the overall domain of development has not been altered. **Attachment C** provides a copy of the April 17, 2020 review of the original EIS and the original EIS (dated January 31, 2020).

Should you have any questions or concerns, please do not hesitate to contact me.

Sincerely,
SAGE Environmental, Inc.

Nicole Mulanaphy, P.E.
Senior Project Manager

Attachments:

Attachment A: Updated DiPrete Engineering Site Plan
Attachment B: DiPrete Engineering Soil Erosion and Sediment Control Site Plan
Attachment C: EIS Update/Review (dated April 17, 2020) and Original EIS (dated January 31, 2020)

Attachment A: Updated Site Plan

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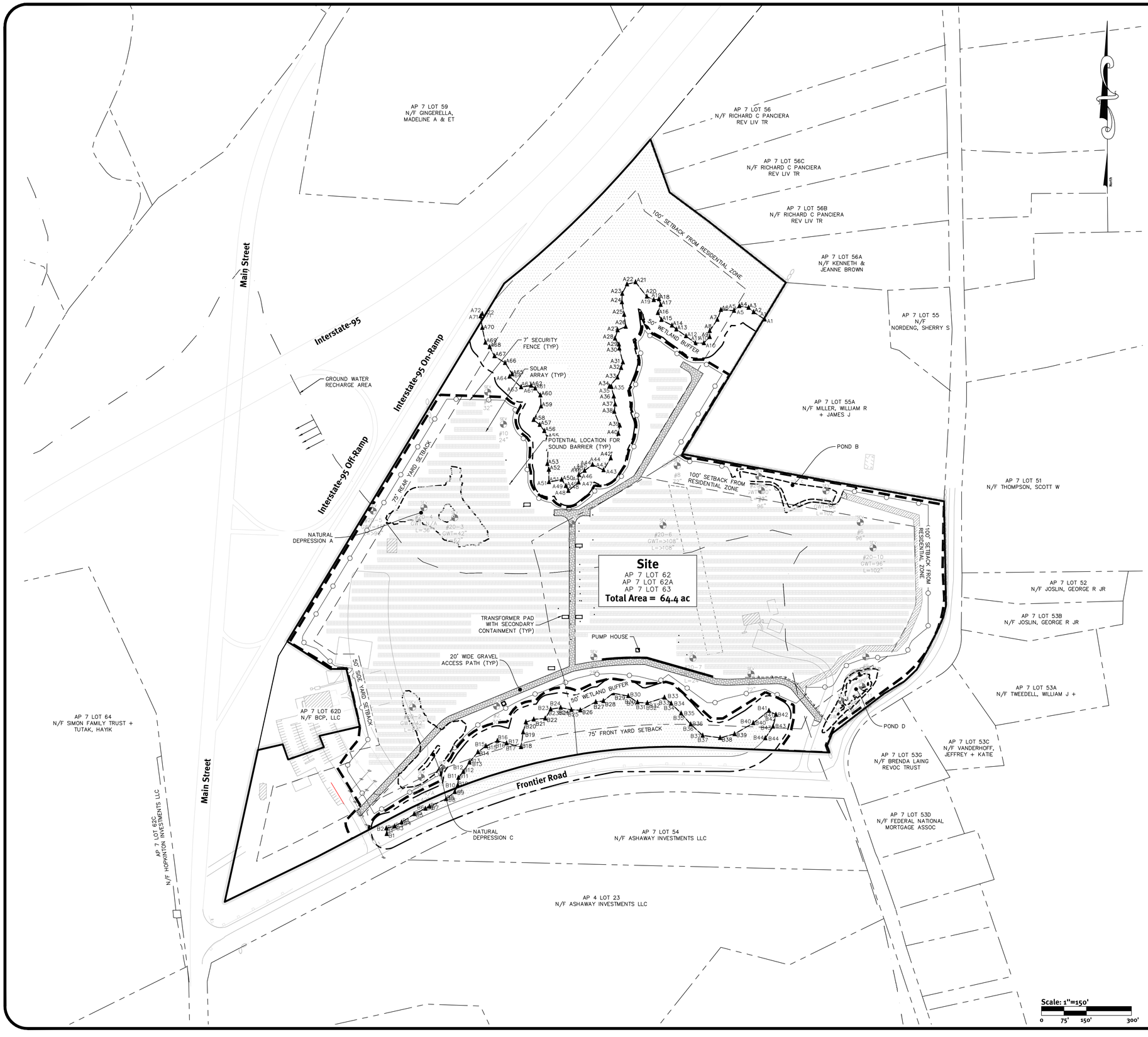


Site Layout Notes:

1. NO NEW WELLS OR OWTS PROPOSED. THE SOLAR SITE IS NOT PROPOSED TO BE SERVICED BY PUBLIC WATER OR SEWER.
2. ALL ELECTRICAL CONNECTIONS AND DISTRIBUTION LINES WITHIN THE FACILITY SHALL BE UNDERGROUND. ELECTRICAL EQUIPMENT BETWEEN THE FACILITY AND THE UTILITY CONNECTION MAY BE ABOVE GROUND IF REQUIRED BY THE UTILITY.
3. NO NEW LIGHTING INSTALLATIONS ARE PROPOSED.
4. PROPOSED SIGNAGE IS LIMITED TO SECURITY SIGNS (OR SIMILAR), OWNER IDENTIFICATION, AND 24-HOUR EMERGENCY CONTACT INFORMATION. TO BE INSTALLED ON THE FACILITY PERIMETER FENCING.
5. PROJECT WORK WILL BE UNDERTAKEN IN ONE PHASE, INCLUDING ALL ASSOCIATED SESC IMPLEMENTATION.
6. 20' MINIMUM SEPARATION IS REQUIRED BETWEEN THE SOLAR ARRAY AND PERIMETER FENCE.
7. CONSTRUCTION STAGING AREA TO INCLUDE CONCRETE WASHOUT AREA AND VEHICLE FUELING/ STORAGE/ MAINTENANCE AREA.
8. GROUND MOUNTED SOLAR INSTALLATIONS SHALL NOT EXCEED 12 FEET IN HEIGHT.
9. SECURITY FENCE TO BE A MINIMUM OF 7 FEET IN HEIGHT.
10. UNLESS CALLED OUT TO REMAIN, EXISTING UTILITIES ARE TO BE REMOVED DURING CONSTRUCTION.
11. THE SG 250HX INVERTERS MAY REQUIRE A SOUND BARRIER WITH AN NRC>0.20 AND SURROUNDS THE SIDES OF THE INVERTER THAT FACE THE PROPERTY LINE. THE SPECIFIC LOCATION AND DESIGN OF THE SOUND BARRIER WILL BE DETERMINED FOLLOWING THE POST CONSTRUCTION ENVIRONMENTAL NOISE ASSESSMENT THAT IS CONDUCTED WITHIN 90 DAYS OF THE SOLAR FARM BECOMING OPERATIONAL.
12. EQUIPMENT PADS WITH TRANSFORMER(S) REQUIRE SECONDARY CONTAINMENT OF 125% OF THE TOTAL FLUID FROM THE TRANSFORMER(S) ON THE PAD. A GEOMEMBRANE LINER WITH OIL FILTRATION WALLS, SUCH AS THE C.I.AGENT (OR COMPARABLE), IS TO BE INSTALLED PRIOR TO THE CEMENT BEING POURED FOR THE EQUIPMENT PADS. THE EXACT LAYOUT OF THE SECONDARY CONTAINMENT WILL BE DETERMINED DURING THE CONSTRUCTION PHASE AND WILL BE DESIGNED TO CONTAIN 125% OF THE TOTAL TRANSFORMER OIL VOLUME.

Dimensional Regulations:

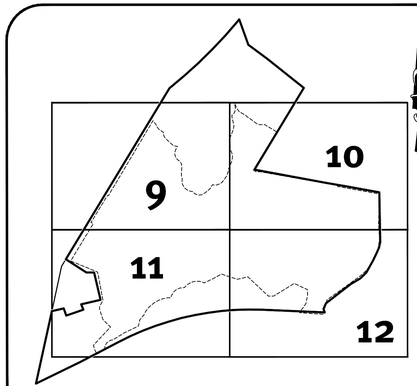
CURRENT ZONING:	MANUFACTURING
MINIMUM LOT AREA:	80,000 SF
MINIMUM FRONTAGE AND LOT WIDTH:	225'
MINIMUM FRONT AND CORNER SIDE YARD:	75'
MINIMUM SIDE YARD:	50'
MINIMUM REAR YARD:	75'

*100' MINIMUM SETBACK REQUIRED FROM RESIDENTIAL ZONES

Proposed Totals:

AREA WITHIN FENCE:	37.2 ACRES
AREA TO BE CLEARED:	7.8 ACRES
WOODLAND CLEARING AREA:	9.1 ACRES

11.309 MW DC and 9.250 MW AC Solar Farm



Key Map
SCALE 1"=500'

DiPrete Engineering
Two Stafford Court, Cranston, RI 02920
tel 401-943-1000 fax 401-464-6006 www.diprete-eng.com
Boston • Providence • Newport

This plan set must not be used for construction purposes unless stamped and signed by a Professional Engineer of DiPrete Engineering.

DiPrete Engineering only warrants plans on a DiPrete Engineering title block stamped by registered Professional Engineer of DiPrete Engineering does not warrant plans by any other party.

The contractor is responsible for all of the means, methods, safety precautions and requirements, and OSHA conformance in the implementation of this plan and design.

Existing utilities shown on this plan are approximate only. DiPrete Engineering assumes no responsibility for damages incurred due to locations of existing utilities. See 'Utility Note' on sheet 3.

No.	Date	Description	By:
5	06/04/2020	Cosocian Dev Review Comment Revisions	J.L.S.
4	05/29/2020	Updated Site Layout & Comment Revisions	J.L.S.
3	05/01/2020	Updated Abutters	K.A.R.
2	04/24/2020	Cosocian Dev Review Comment Revisions	J.L.S.
1	03/04/2020	RIEC Preliminary Determination Submission	J.L.S.
0	01/27/2020	RIEC Preliminary Determination Submission	J.L.S.

Drawn By: J.L.S. Checked By: D.R.N.

Overall Site Layout Plan

Frontier Road Solar

Assessor's Plat 7 Lots 62, 62A & 63
Hopkinton, Rhode Island

Prepared For
Revity Energy, LLC
117 Metro Center Blvd, Warwick, Rhode Island 02886

SHEET 8 OF 14

DE Job No: 2437-021 Copyright 2020 by DiPrete Engineering Associates, Inc.

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Attachment B: DiPrete Engineering Soil Erosion and Sediment Control Site Plan

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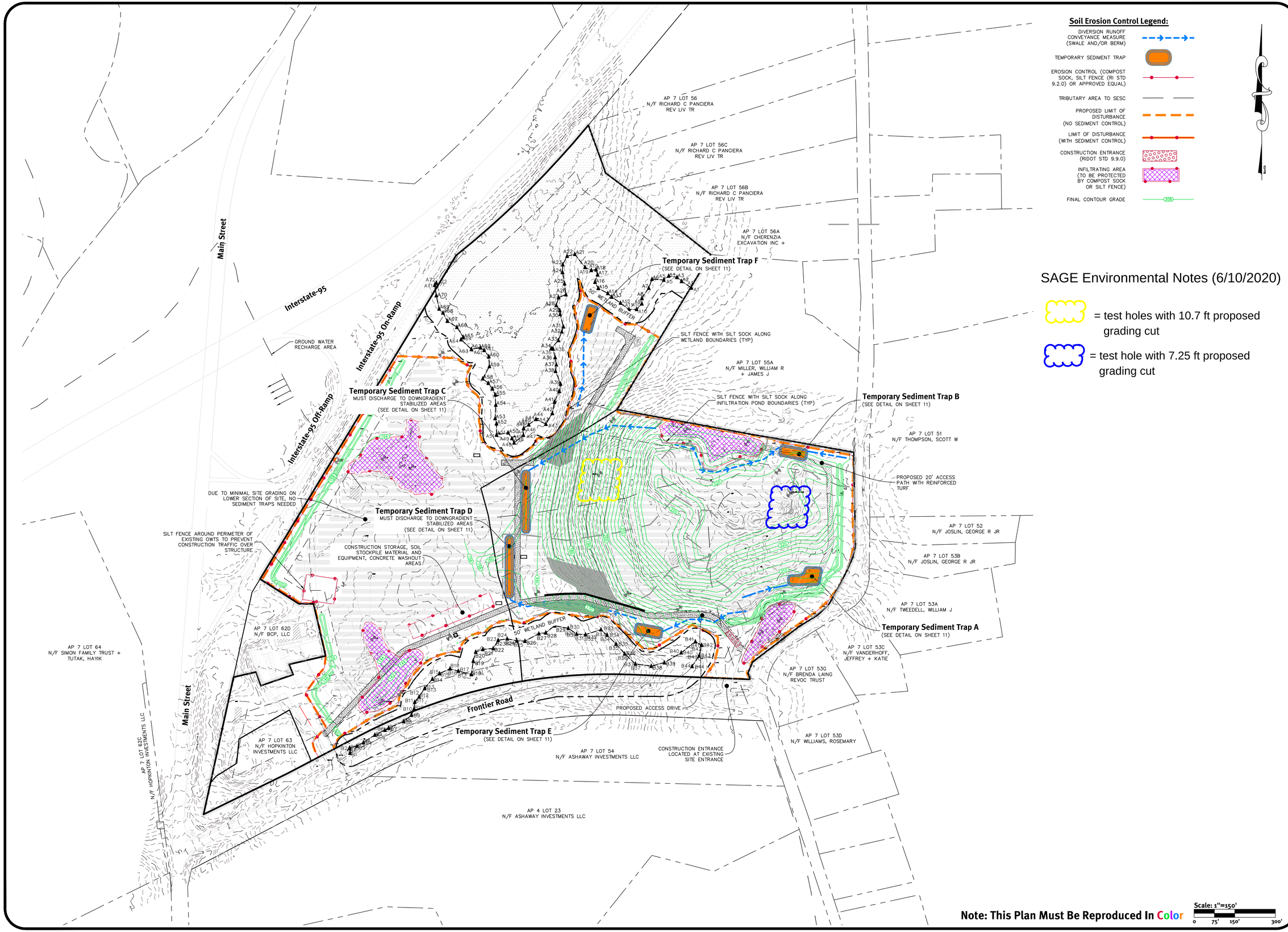

Note: This Plan Must Be Reproduced In Color

DiPrete Engineering
Two Stafford Court Cranston, RI 02920
tel 401-943-1000 fax 401-464-6066 www.diprete-eng.com
Boston • Providence • Newport

DANA R. NISBET
No. 11876
05/21/2020
REGISTERED PROFESSIONAL ENGINEER CIVIL

This plan set must not be used for construction purposes unless stamped 'Issued for Construction' and stamped by a registered Professional Engineer of DiPrete Engineering.

DiPrete Engineering only warrants plans on a DiPrete Engineering title block stamped by registered Professional Engineer of DiPrete Engineering. DiPrete Engineering does not certify plans by any other party.

The contractor is responsible for all of the means, methods, safety precautions and requirements, and OSHA conformance in the implementation of this plan and design.

Existing utilities shown on this plan are approximate only. DiPrete Engineering assumes no responsibility for the accuracy and/or completeness of locations of existing utilities. See 'Utility Note' on sheet 3.

No.	Date	Description	By:
4	05/21/2020	Cossatur Peer Review Comment Revisions	J.L.S.
3	05/01/2020	Updated Abutters	A.K.P.
2	03/24/2020	RIDEM Preliminary Comment Revisions	N.D.K.
1	03/13/2020	RIDEM Wetlands Peer Review Modifications	N.D.K.
0	01/27/2020	RIDEM Preliminary Determination Submission	J.L.S.

Drawn By: J.L.S. Checked By: D.R.N.

Overall SESC Plan

Frontier Road Solar

Assessor's Plat 7 Lots 62, 62A & 63
Hopkinton, Rhode Island

Prepared For:
Revity Energy, LLC
117 Metro Center Blvd, Warwick, Rhode Island 02886

DE Job No: 2437-021 Copyright 2020 by DiPrete Engineering Associates, Inc.

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Attachment C: EIS Update/Review (dated April 17, 2020)

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SAGE
ENVIRONMENTAL

April 17, 2020

Mr. Ralph Palumbo
Revity Energy
117 Metro Center Boulevard, Suite 1007
Warwick, RI 02886
Sent via email to: Ralph@RevityEnergy.com

RE: Environmental Impact Statement Update
A Proposed Solar Farm Development
Frontier Road (AP: 7, Lots: 62, 62A and 63)
Hopkinton, Rhode Island
SAGE Project No. M896

Dear Mr. Palumbo:

The Environmental Impact Statement (EIS) was prepared while details for the site design were in progress. As such, it is expected that details about the Site may be refined since the preparation of the EIS. **Attachment A** provides the updated site plan. The layout of the solar panels have changed slightly and there are less inverters (40 inverters vs. 60). This change required an update to the pre-construction noise assessment, the updated assessment is provided in **Attachment B**. The pre-construction noise assessment concludes that sound emitted from the proposed solar development is expected to be less than 40 dB at the property line.

The 3 parcels, where the proposed solar farm will be developed on Frontier Road, are unchanged and consist of Assessor's Plat 7 Lots 62, 62A and 63 as stated in the EIS. The discussions and conclusions regarding potential environmental impacts are unchanged by the solar panel layout modification, as the overall domain of development has not been altered. **Attachment C** provides a copy of the original EIS (dated January 31, 2020).

Should you have any questions or concerns, please do not hesitate to contact me.

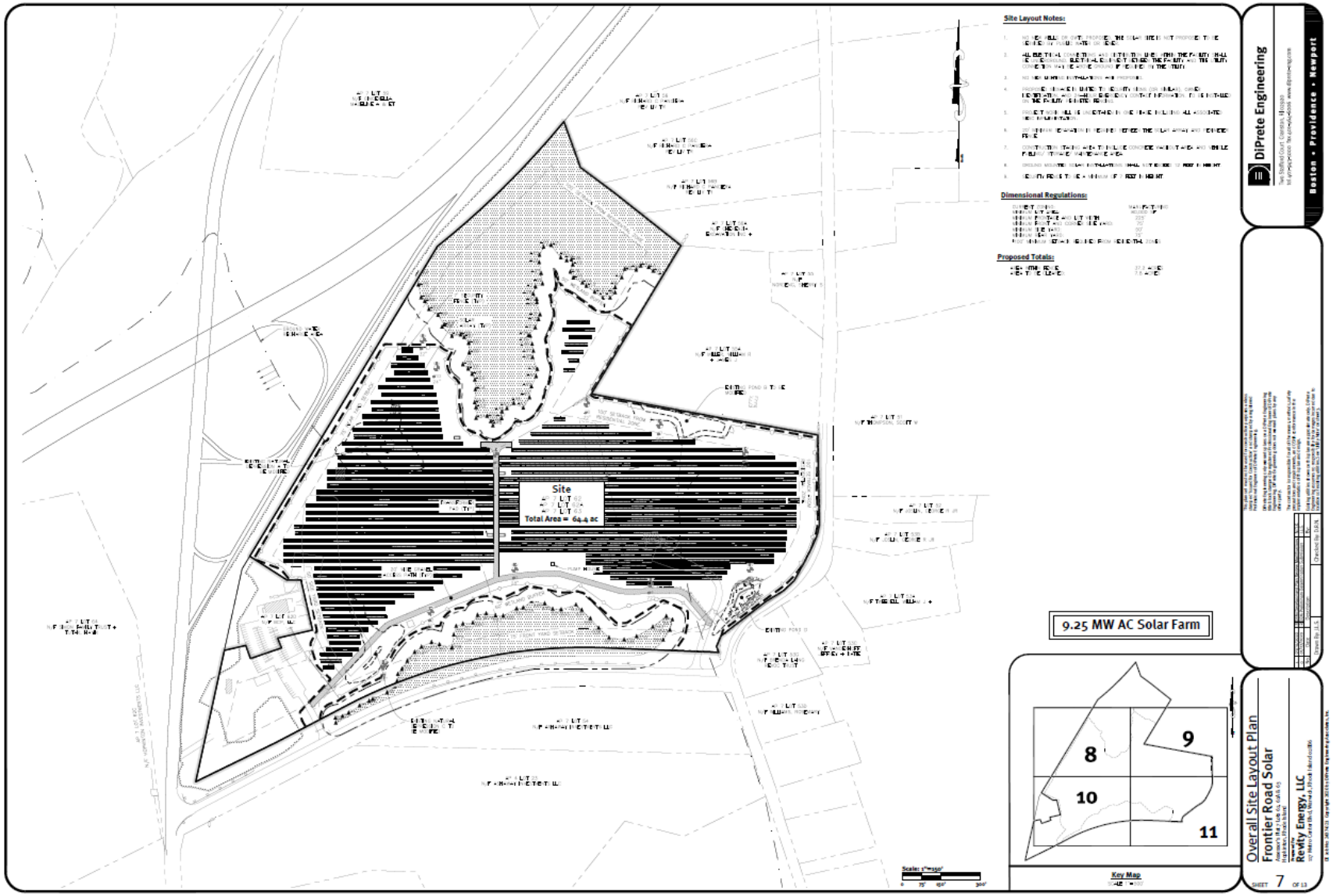
Sincerely,
SAGE Environmental, Inc.

Nicole Mulanaphy, P.E.
Senior Project Manager

Attachments:

Attachment A: Updated Site Plan
Attachment B: Updated Pre-Construction Noise Assessment
Attachment C: Original EIS (dated January 31, 2020)

Attachment A: Updated Site Plan



Attachment B: Updated Pre-Construction Noise Assessment

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SAGE
ENVIRONMENTAL

April 17, 2020

Mr. Ralph Palumbo
Revity Energy
117 Metro Center Boulevard, Suite 1007
Warwick, RI 02886
Sent via email to: Ralph@RevityEnergy.com

RE: Pre-Installation Noise Assessment (Updated)
A Proposed Solar Farm Development
Frontier Road (AP: 7, Lots: 62, 62A and 63)
Hopkinton, Rhode Island
SAGE Project No. M896

Dear Mr. Palumbo:

This correspondence presents the findings of an updated noise assessment for the proposed installation of a 9.25-megawatt (AC) solar development by Revity Energy, LLC in the Town of Hopkinton, Rhode Island referred to as Frontier Road Solar located at Assessor's Plat 7 Lots 62, 62A and 63. The pre-installation noise assessment estimates the sound emitted from 40 inverters and 5 transformers that are part of the proposed Frontier Road Solar development. The proposed project places one inverter at the end of each row (i.e. the end that is the most inward to the site), with the exception of one row that has two inverters. The transformers are located on equipment pads. **Attachment 1** provides a map displaying the location of the equipment pads and the closest distance (in feet) to the property line. **Attachment 2** provides the location of the inverters.

The Town of Hopkinton's Non-Residential Photovoltaic Solar Energy System Ordinance (dated January 22, 2019) states that noise levels from the Photovoltaic Solar Energy Systems (PSES) cannot exceed 40 dB at the property line. **Attachment 2** provides a map displaying the total sound emitted from each inverter and transformer (i.e. 45 sound emitting objects) for the Frontier Road solar development study area. To prevent sounds from exceeding 40 dB at any location along the property line a sound barrier is necessary for some of the inverters.

There are two types of inverters being used for this project, SG125HV and SG250HX both developed by Sungrow. The SG250HX is a larger inverter and produces more sound, there are 34 of these inverters used on site. Each of the SG250HX will be surrounded by a sound barrier to reduce the emitted sound. The selected sound barrier must have a Noise Reduction Coefficient (NRC) of 0.20 or greater.

The NRC measures the ability of material to adsorb sound. A material with an NRC of 0 will reflect all sound that hits it. A material with an NRC of 1.0 will theoretically absorb all sound that hits it. Note that NRC is a measurement of noise reduction within the human speech range; it is possible that a material

with a high NRC rating may actually be poor at absorbing music, mechanical equipment noise, or other very low or very high frequency sounds. It is important to verify with the manufacturer of the sound absorbing material that it is suitable for sound frequency emitted from the inverters.

Examples of a sound barrier that may be used for this project is a wooden fence (NRC=0.28[1]), acoustical curtain (NRC=0.65[2]), or a sound jacket/blanket (NRC=0.75[3]). The selected sound barrier will be chosen as the project progresses. The required specifications are such that the NRC > 0.20 and that the barrier surrounds the sides of the inverter that face the property line.

This assessment notes that sound emitted from the proposed project, with sound barrier (NRC=0.20) around the SG250HX inverters, does not exceed 40 dB at any location along the property line. The largest sound at the property line is 37.7 dB, which is comparable to a ambient wilderness/quiet suburban nighttime. The pink dashed line displayed in **Attachment 2** figure represents the 40 dB contour, meaning that any area past the dashed line would experience sounds emitted from the solar equipment that is below 40 dB.

Table 1 provides common noise sources and the associated decibel (dB) sound level, for example sounds below 40 dB would be comparable to ambient wilderness or a quiet suburban nighttime.

Table 1
Common Sounds with Associated Decibel (dB) Levels

Min (dB)	Max (dB)	Description
20	25	rustling leaves
25	30	quiet rural nighttime
30	35	whisper
35	40	ambient wilderness/quiet suburban nighttime
40	45	computer/quite urban nighttime
45	50	birds/light traffic
50	55	fan/campfire
55	60	refrigerator/dishwasher
60	65	typical conversation/ air conditioner
65	70	vacuum cleaner
70	75	busy traffic/noisy urban area
75	80	leaf blower/garbage disposal
80	85	kitchen blender
85	120	motorcycle/MRI machine

Source: Berger, Elliott H., Rick Neitzel, and Cynthia A. Kladden. Noise Navigator Sound Level Database. 3M Personal Safety Division, E•A•RCAL Laboratory, Univ. of Michigan, Dept. of Environmental Health Science, 26 June 2015. Version 1.8.
Fox, Sarinne. "Noise Level Chart." Noise Help. N.p., 2017. Web. 2018.

[1] Construction Materials – Types, Uses and Applications; Second Edition; Caleb Hornbostel; 1991; page 10 – Table A9
[2] https://www.tmsoundproofing.com/Sound-Curtain-Heavy-Duty-Permanent-Applications.html
[3] https://www.enoisecontrol.com/products/sound-blankets/

The sound calculations performed assume a "conservative" evaluation relative to noise propagation, such that the spread of sound was spread equally in all directions in a free field (i.e. no obstruction); with the exception of the SG250HX inverters. The SG250HX inverters sound is reduced based on NRC=0.20. It is likely that the combination of environmental (e.g. trees and shrubs) and site-specific features will serve to dampen additive noise levels.

Should you have any questions or concerns, please do not hesitate to contact me.

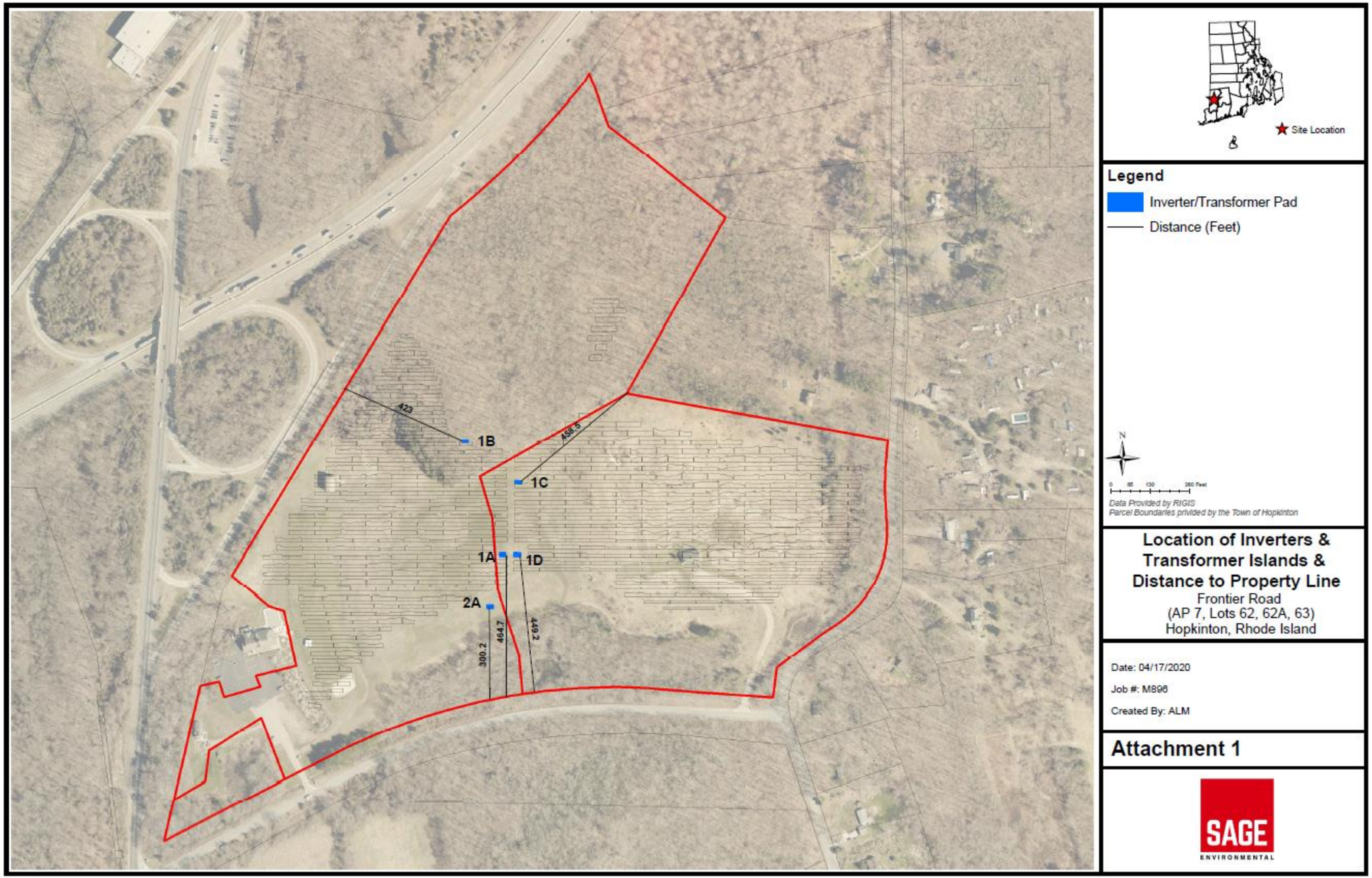
Sincerely,
SAGE Environmental, Inc.

Nicole Mulanaphy, P.E.
Senior Project Manager

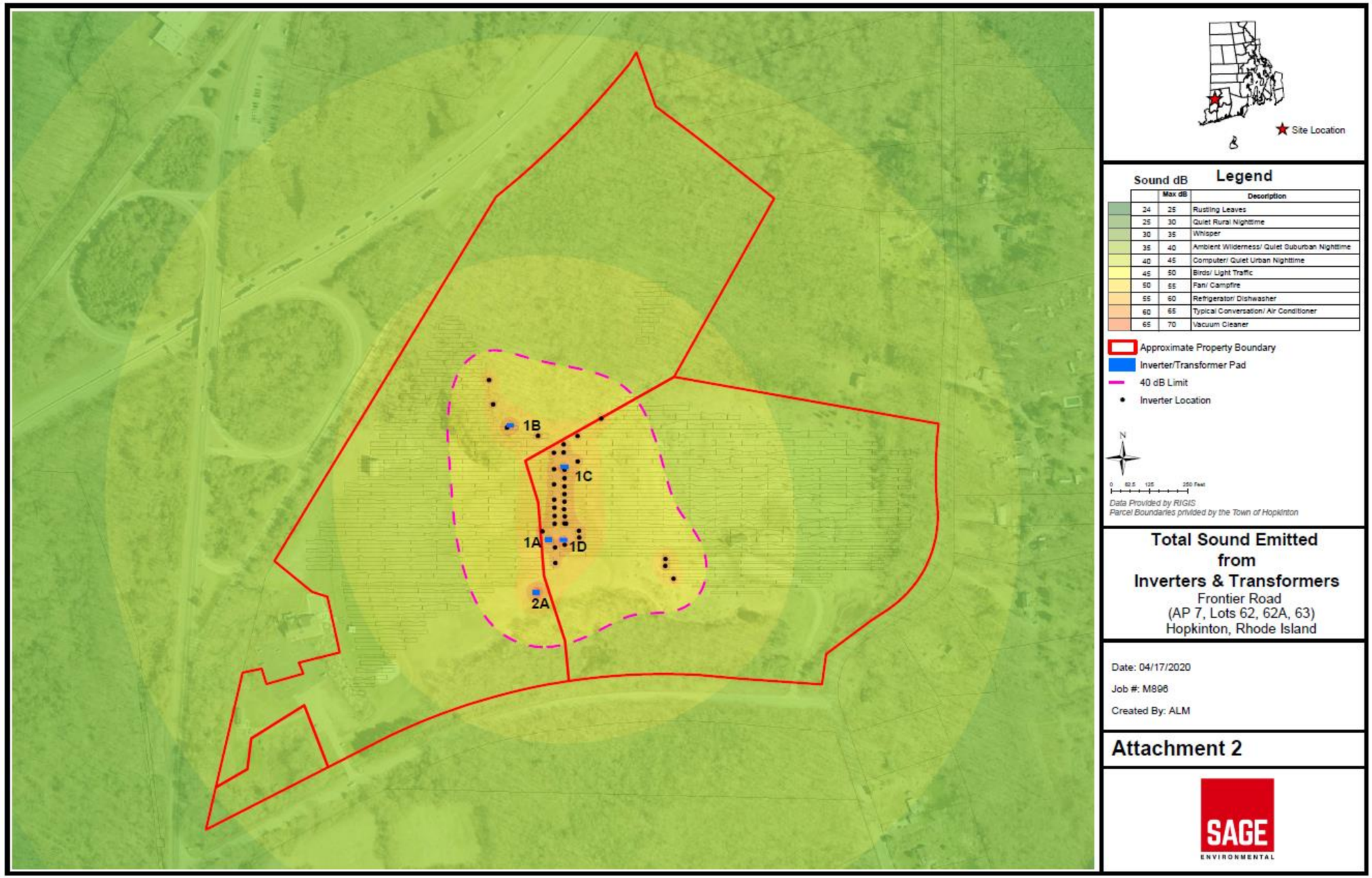
Attachments:

Attachment A: Location of Equipment Pads and Distance to Property Line
Attachment B: Total Sound Emitted from Each Inverter and Transformer
Attachment C: Solar Equipment Utilized for Project

Attachment 1: Location of Equipment Pads and Distance to Property Line



Attachment 3: Solar Equipment Utilized for Project



Attachment 3: Solar Equipment Utilized for Project

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SUNGROW

SG125HV NEW

String Inverter for 1500 Vdc Systems

High Yield

- Patented five-level topology, 98.8% CEC efficiency, 98.5% Euro efficiency
- Full power operation without derating up to 50 ℃

Easy O&M

- Virtual central inverter design concept enables easy O&M
- Compact design and light weight (68kg) for easy installation

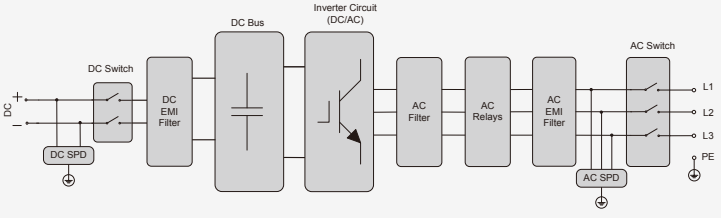
Higher ROI

- World's highest output string inverter at 125kW (1500Vdc/600Vac)
- 2 to 5 MW power block design for lower total installed costs
- DC/AC ratio up to 1.5

Grid Support

- Compliant with CEA, IEC 61727/62116
- Low/High voltage ride through (L/HVRT)
- Active & reactive power control, power ramp rate control

Circuit Diagram



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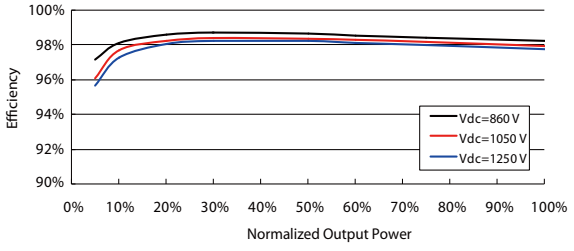
Input (DC)	SG125HV
Max. PV input voltage	1500 V
Min. PV input voltage / Startup input voltage	860 V / 860 V
Nominal input voltage	1050 V
MPP voltage range	860 - 1450 V
MPP voltage range for nominal power	860 - 1250 V
No. of independent MPP inputs	1
Max. number of PV strings per MPPT	1
Max. DC short circuit current	240 A
Output (AC)	
Nominal AC power (at 50 ˚C)	125000 W
Max. AC output at PF=1 (at 50 ˚C)	125000 W
Max. AC apparent power (at 50 ˚C)	125000 VA
Max. AC output current	120 A
Nominal AC voltage	3 / PE, 600 V
AC voltage range	480 - 690 V
Nominal grid frequency / Grid frequency range	50 Hz / 45 - 55 Hz, 60 Hz / 55 - 65 Hz
THD	< 3 % (at nominal power)
DC current injection	< 0.5 % In
Power factor at nominal powe / Adjustable power factor	> 0.99 / 0.8 leading - 0.8 lagging
Feed-in phases / Connection phases	3 / 3
Efficiency	
CEC efficiency / Euro efficiency	98.8 % / 98.5 %
Protection	
DC reverse connection protection	Yes
AC short-circuit protection	Yes
Leakage current protection	Yes
Grid monitoring	Yes
DC switch / AC switch	Yes / Yes
DC fuse	No
PV string current monitoring	No
Anti-PID function	Optional
Overvoltage protection	DC Type II / AC Type II
General Data	
Dimensions (W*H*D)	670*810*294 mm
Weight	68 kg (150 lbs)
Isolation method	Transformerless
Degree of protection	IP65
Night power consumption	< 2 W
Operating ambient temperature range	-25 to 60 ℃ (> 50 ℃ derating)
Allowable relative humidity range (non-condensing)	0 - 100 %
Cooling method	Smart forced air cooling
Max. operating altitude	4000 m (> 3000 m derating)
Display / Communication	LED / RS485, Bluetooth +APP
DC connection type	Screw Clamp terminal (Max. 120 mm²)
AC connection type	Screw Clamp terminal (Max. 120 mm²)
Compliance	CEA, IEC 62109, IEC 61727, IEC 62116, IEC 60068, IEC 61683, CE
Grid Support	LVRT, HVRT, active & reactive power control and power ramp rate control

Efficiency Curve



SG250HX-US New

Multi-MPPT String Inverter for 1500 Vdc System

SUNGROW
Clean power for all

HIGH YIELD

- 12 MPPTs with max. efficiency 99%
- Compatible with bifacial module
- Built-in Anti-PID and PID recovery function

SMART O&M

- Touch free commissioning and remote firmware upgrade
- Online IV curve scan and diagnosis*
- Fuse free design with smart string current monitoring

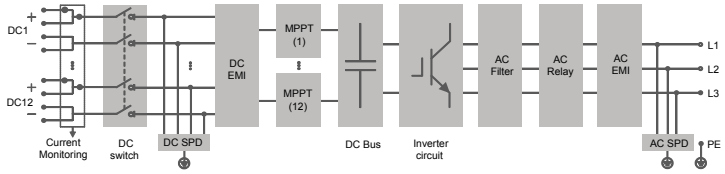
LOW COST

- Compatible with Al and Cu AC cables
- DC 2 in 1 connection enabled
- Power line communication (PLC)
- Reactive power at night function

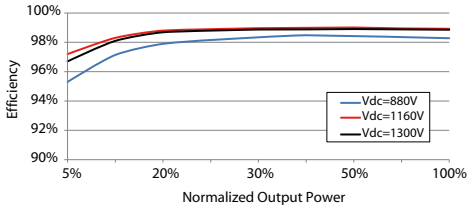
PROVEN SAFETY

- Integrated Arc fault circuit protection
- NEMA 4X protection and C5 anti-corrosion grade
- Type II SPD for both DC and AC

CIRCUIT DIAGRAM



EFFICIENCY CURVE



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Type designation	SG250HX-US
Input (DC)	
Max. PV input voltage	1500 V
Min. PV input voltage / Startup input voltage	600 V / 600 V
Nominal PV input voltage	1080 V
MPP voltage range	600 V – 1500 V
MPP voltage range for nominal power	860 V – 1300 V
No. of independent MPP inputs	12
Max. PV input current	26 A * 12
Max. current for input connector	30 A
Max. DC short-circuit current	50 A * 12
Output (AC)	
AC output power	250 kVA @ 30 ℃ / 225 kVA @40 ℃/200 KVA @50℃
Max. AC output current	180.5 A
Nominal AC voltage	3 / PE, 800 V
AC voltage range	680 – 880V
Nominal grid frequency / Grid frequency range	50 Hz / 45 – 55 Hz, 60 Hz / 55 – 65 Hz
THD	< 3 % (at nominal power)
DC current injection	< 0.5 % In
Power factor at nominal power / Adjustable power factor	> 0.99 / 0.8 leading – 0.8 lagging
Feed-in phases / connection phases	3 / 3
Efficiency	
Max. efficiency	99.0 %
CEC efficiency	98.5 %
Protection	
DC reverse connection protection	Yes
AC short circuit protection	Yes
Leakage current protection	Yes
Grid monitoring	Yes
Ground fault monitoring	Yes
DC switch	Yes
AC switch	No
Arc fault circuit interrupter (AFCI)	Yes
PV String current monitoring	Yes
Reactive powe at night function	Yes
PID protection	An-ti PID or PID recovery
Overvoltage protection	DC Type II and AC Type II
General Data	
Dimensions (W*H*D)	1051*660*363 mm (41.4''*26''*14.3'')
Weight	95kg (209.4 lbs)
Isolation method	Transformerless
Ingress protection rating	NEMA 4X
Night power consumption	< 2 W
Operating ambient temperature range	'-30 to 60 ℃ ('-22 to 140 ℉)
Allowable relative humidity range (non-condensing)	0 – 100 %
Cooling method	Smart forced air cooling
Max. operating altitude	4000 m (> 3000 m der ating) 13123 ft (> 9843 ft derating)
Display	LED, Bluetooth+APP
Communication	RS485 / PLC
DC connection type	Amphenol UTX (Max. 6 mm² 10AWG)
AC connection type	OT terminal (Max. 300 mm² 600 Kcmil)
Compliance	UL1741, UL1741SA, IEEE1547, IEEE1547.1, CSA C22.2 107.1-01-2001, FCC Part15 Sub-part B Class A Limits, California Rule 21,UL 1699B
Grid Support	Reactive power at night function, LVRT, HVRT,active & reactive power control and power ramp rate control, Volt/Watt, Frequency/Watt

*: Only compatible with Sungrow logger and iSolarCloud

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Three-phase pad-mounted compartmental type transformer

General

At Eaton, we are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality, most reliable transformers. Eaton's Cooper Power series Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. In order to drive this innovation, we have invested both time and money in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin. Such revolutionary products as distribution-class UltraSIL™ Polymer-Housed Evolution™ surge arresters and Envirotemp™ FR3™ fluid have been developed at our Franksville lab.

With transformer sizes ranging from 45 kVA to 12 MVA and high voltages ranging from 2400 V to 46 kV, Eaton has you covered. From fabrication of the tanks and cabinets to winding of the cores and coils, to production of arresters, switches, tap changers, expulsion fuses, current limit fuses, bushings (live and dead) and molded rubber goods, Eaton does it all. Eaton's Cooper Power series transformers are available with electrical grade mineral oil or Envirotemp™ FR3™ fluid, a less-flammable and bio-degradable fluid. Electrical codes recognize the advantages of using Envirotemp™ FR3™ fluid both indoors and outdoors for fire sensitive applications. The bio-based fluid meets Occupational Safety and Health Administration (OSHA) and Section 450.23 NEC Requirements.

EATON
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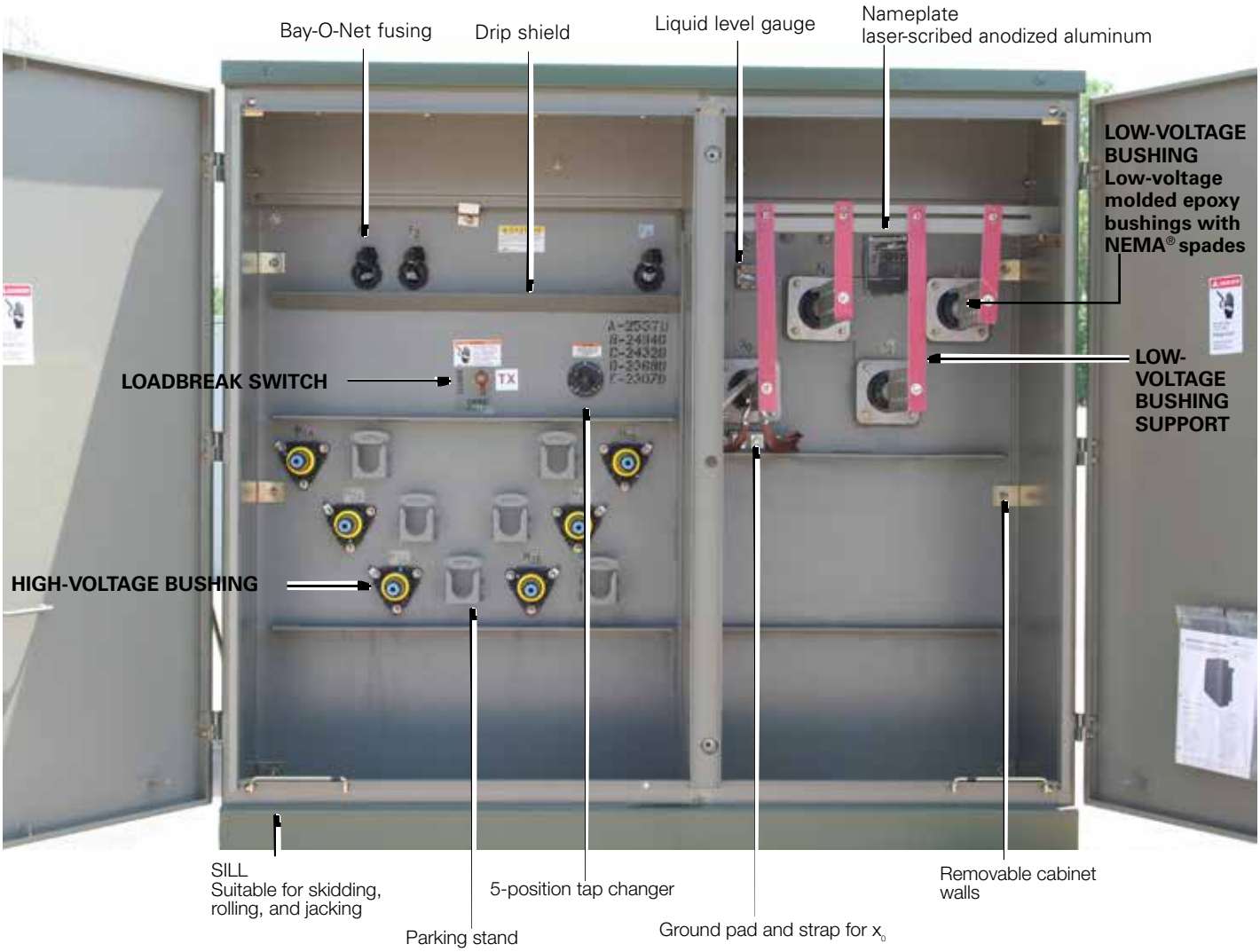

Figure 1. Three-phase pad-mounted compartmental type transformer.

Table 1. Product Scope

Type	Three Phase, 50 or 60 Hz, 65 °C Rise (55 °C, 55/65 °C), 65/75 °C, 75 °C
Fluid Type	Mineral oil or Envirotemp™ FR3™ fluid
Coil Configuration	2-winding or 4-winding or 3-winding (Low-High-Low), 3-winding (Low-Low-High)
Size	45 – 10,000 kVA
Primary Voltage	2,400 – 46,000 V
Secondary Voltage	208Y/120 V to 14,400 V
Specialty Designs	Inverter/Rectifier Bridge
	K-Factor (up to K-19)
	Vacuum Fault Interrupter (VFI)
	UL® Listed & Labeled and Classified
	Factory Mutual (FM) Approved®
	Solar/Wind Designs
	Differential Protection
	Seismic Applications (including OSHPD)
	Hardened Data Center

Table 2. Three-Phase Ratings

Three-Phase 50 or 60 Hz
kVA Available[1]: 45, 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 3750, 5000, 7500, 10000

[1]Transformers are available in the standard ratings and configurations shown or can be customized to meet specific needs.

Table 3. Impedance Voltage

	Low-voltage rating		
Rating (kVA)	**≤ 600 V**	**2400 Δ through 4800 Δ**	**6900 Δ through 13800GY/7970 or 13800 Δ**
45-75	2.70-5.75	2.70-5.75	2.70-5.75
112.5-300	3.10-5.75	3.10-5.75	3.10-5.75
500	4.35-5.75	4.35-5.75	4.35-5.75
750-2500	5.75	5.75	5.75
3750	5.75	5.75	6.00
5000		6.00	6.50

Note: The standard tolerance is ± 7.5%

Table 4. Audible Sound Levels

	NEMA® TR-1 Average
Self-Cooled, Two Winding kVA Rating	**Decibels (dB)**
45-500	56
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001-4000	64
4001-5000	65
5001-6000	66
6001-7500	67
7501-10000	68

Table 5. Insulation Test Levels

KV Class	Induced Test 180 or 400 Hz 7200 Cycle	kV BIL Distribution	Applied Test 60 Hz (kV)
1.2	Twice Rated Voltage	30	10
2.5		45	15
5		60	19
8.7		75	26
15		95	34
25		125	40
34.5		150	50

Table 6. Temperature Rise Ratings 0-3300 Feet (0-1000 meters)

	Standard	Optional
Unit Rating (Temperature Rise Winding)	65 °C	55 °C, 55/65 °C, 75 °C
Ambient Temperature Max	40 °C	50 °C
Ambient Temperature 24 Hour Average	30 °C	40 °C
Temperature Rise Hotspot	80 °C	65 °C

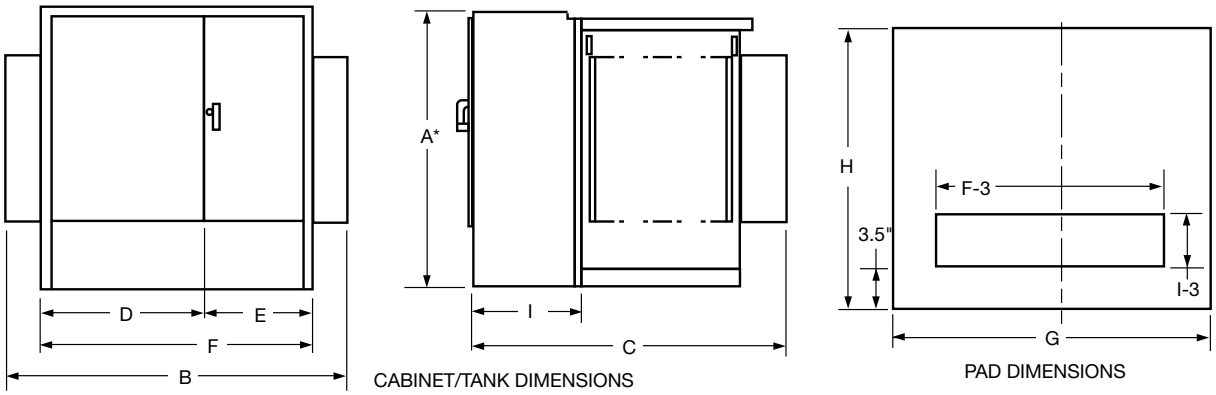

Figure 2. Transformer and pad dimensions.

* Add 9" for Bay-O-Net fusing.

Table 7. Fluid-filled—aluminum windings 55/65 °C Rise[1]

65° Rise	DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—ALUMINUM WINDINGS										
	OUTLINE DIMENSIONS (in.)										
kVA Rating	A*	B	C	D	E	F	G	H	I	Gallons of Fluid	Approx. Total Weight (lbs.)
45	50	68	39	42	26	68	72	43	20	110	2,100
75	50	68	39	42	26	68	72	43	20	115	2,250
112.5	50	68	49	42	26	68	72	53	20	120	2,350
150	50	68	49	42	26	68	72	53	20	125	2,700
225	50	72	51	42	30	72	76	55	20	140	3,150
300	50	72	51	42	30	72	76	55	20	160	3,650
500	50	89	53	42	30	72	93	57	20	190	4,650
750	64	89	57	42	30	72	93	61	20	270	6,500
1000	64	89	59	42	30	72	93	63	20	350	8,200
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	490	12,500
2500	73	72	99	42	30	72	76	103	24	530	14,500
3000	73	84	99	46	37	84	88	103	24	620	16,700
3750	84	85	108	47	38	85	88	112	24	660	19,300
5000	84	96	108	48	48	96	100	112	24	930	25,000
7500	94	102	122	54	48	102	100	126	24	1,580	41,900

1 Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton for exact dimensions.

* Add 9" for Bay-O-Net fusing.

Table 8. Fluid-Filled—Copper Windings 55/65 °C Rise[1]

65° Rise	DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—COPPER WINDINGS										
	OUTLINE DIMENSIONS (in.)										
kVA Rating	A*	B	C	D	E	F	G	H	I	Gallons of Fluid	Approx. Total Weight (lbs.)
45	50	64	39	34	30	64	69	43	20	110	2,100
75	50	64	39	34	30	64	69	43	20	115	2,350
112.5	50	64	49	34	30	64	69	53	20	115	2,500
150	50	64	49	34	30	64	69	53	20	120	2,700
225	50	64	51	34	30	64	73	55	20	140	3,250
300	50	64	51	34	30	64	75	55	20	160	3,800
500	50	81	53	34	30	64	85	57	20	200	4,800
750	64	89	57	42	30	72	93	61	20	255	6,500
1000	64	89	59	42	30	72	93	63	20	300	7,800
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	420	11,600
2500	73	72	99	42	30	72	76	103	24	500	14,000
3000	73	84	99	46	37	84	88	103	24	720	18,700
3750	84	85	108	47	38	85	88	112	24	800	20,500
5000	84	96	108	48	48	96	100	112	24	850	25,000
7500	94	102	122	54	48	102	100	126	24	1,620	46,900

[1] Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton for exact dimensions.

* Add 9" for Bay-O-Net fusing.

Standard features

Connections and neutral configurations

- Delta - Wye: Low voltage neutral shall be a fully insulated X0 bushing with removable ground strap.
- Grounded Wye-Wye: High voltage neutral shall be internally tied to the low voltage neutral and brought out as the H0X0 bushing in the secondary compartment with a removable ground strap.
- Delta-Delta: Transformer shall be provided without a neutral bushing.
- Wye-Wye: High voltage neutral shall be brought out as the H0 bushing in the primary compartment and the low voltage neutral shall be brought as the X0- bushing in the secondary compartment.
- Wye-Delta: High voltage neutral shall be brought out as the H0 bushing in the primary compartment. No ground strap shall be provided (line to line rated fusing is required).

High and low voltage bushings

- 200 A bushing wells (15, 25, and 35 kV)
- 200 A, 35 kV Large Interface
- 600 A (15, 25, and 35 kV) Integral bushings (dead-front)
- Electrical-grade wet-process porcelain bushings (live-front)

Tank/cabinet features

- Bolted cover for tank access (45-2500 kVA)
- Welded cover with hand hole (>2500 kVA)
- Three-point latching door for security
- Removable sill for easy installation
- Lifting lugs (4)
- Stainless steel cabinet hinges and mounting studs
- Steel divider between HV and LV compartment
- 20″ Deep cabinet (45-1000 kVA)
- 24″ Deep cabinet (1500-7500 kVA)
- 30″ Deep cabinet (34.5/19.92 kV)
- Pentahead captive bolt
- Stainless steel 1-hole ground pads (45-500 kVA)
- Stainless steel 2-hole ground pads (750-10,000 kVA)
- Parking Stands (dead-front)

Valves/plugs

- One-inch upper filling plug
- One-inch drain plug (45-500 kVA)
- One-inch combination drain valve with sampling device in low voltage compartment (750-10,000 kVA)
- Automatic pressure relief valve

Nameplate

- Laser-scribed anodized aluminum nameplate

Figure 3. Drain valve with sampler.

Figure 4. Automatic Pressure relief valve.

Figure 5. Liquid level gauge.

Figure 6. External Gauges.

Figure 7. External visible break with gauges.

Optional features

High and low voltage bushings

- 200 A (15, 25 kV) bushing inserts
- 200 A (15, 25 kV) feed thru inserts
- 200 A (15, 25 kV) (HTN) bushing wells with removable studs
- High-voltage 600 A (15, 25, 35 kV) deadbreak one-piece bushings
- Low voltage 6-, 8-holes spade
- Low voltage 12-, 16-, 20-holes spade (750-2500 kVA)
- Low voltage bushing supports

Tank/cabinet features

- Stainless steel tank base and cabinet
- Stainless steel tank base, cabinet sides and sill
- 100% stainless steel unit
- Service entrance (2 inch) in sill or cabinet side
- Touch-up paint (domestic)
- Copper ground bus bar
- Kirk-Key provisions
- Nitrogen blanket
- Bus duct cutout

Special designs

- Factory Mutual (FM)
- UL® Classified
- Triplex
- High altitude
- K-Factors
- Step-up
- Critical application
- Modulation transformers
- Seismic applications (including OSHPD)

Switches

- One, two, or three On/Off loadbreak switches
- 4-position loadbreak V-blade switch or T-blade switch
- Delta-wye switch
- 3-position V-Blade selector switch
- 100 A, 150 A, 300 A tap changers
- Dual voltage switch
- Visible break with VFI interrupter interlock
- External visible break (15, 25, and 35 kV, up to 3 MVA)
- External visible break with gauges (15, 25, and 35 kV, up to 3 MVA)

Gauges and devices

- Liquid level gauge (optional contacts)
- Pressure vacuum gauge (optional contacts and bleeder)
- Dial-type thermometer (optional alarm contacts)
- Cover mounted pressure relief device (optional alarm contacts)
- Ground connectors
- Hexhead captive bolt
- Molded case circuit breaker mounting provisions
- External gauges in padlockable box

Overcurrent protection

- Bay-O-Net fusing (Current sensing, dual sensing, dual element, high amperage overload)
- Bay-O-Net expulsion fuse in series with a partial range under-oil ELSP current limiting fuse (below 23 kV)
- Cartridge fusing in series with a partial range under-oil ELSP current limiting fuse (above 23 kV)
- MagneX™ interrupter with ELSP current-limiting fuse
- Vacuum Fault Interrupter (VFI)
- Visible break window
- Fuse/switch interlock

Valves/plugs

- Drain/sampling valve in high-voltage compartment
- Globe type upper fill valve

Overvoltage protection

- Distribution-, intermediate-, or station-class surge arresters
- Elbow arresters (for dead-front connections)

Metering/fan/control

- Full metering package
- Current Transformers (CTs)
- Metering Socket
- NEMA® 4 control box (optional stainless steel)
- NEMA® 7 control box (explosion proof)
- Fan Packages

Testing

- Customer test witness
- Customer final inspection
- Zero Sequence Impedance Test
- Heat Run Test
- ANSI® Impulse Test
- Audible Sound Level Test
- RIV (Corona) Test
- Dissolved Gas Analysis (DGA) Test
- 8- or 24-Hour Leak Test

Coatings (paint)

- ANSI® Bell Green
- ANSI® #61 Light Gray
- ANSI® #70 Sky Gray
- Special paint available per request

Nameplate

- Stainless steel nameplate

Decals and labels

- High voltage warning signs
- Mr. Ouch
- Bi-lingual warning
- DOE compliant
- Customer stock code
- Customer stenciling
- Shock and arc flash warning decal
- Non-PCB decal

Construction

Core

The three-legged, step-lap mitered core construction is manufactured using a high-quality cutting machine. For maximum efficiency, cores are precisely stacked, virtually eliminating gaps in the corner joints.

Five-legged wound core or shell-type triplex designs are used for wye-wye connected transformers, and other special transformer designs.

Cores are manufactured with precision cut, burr-free, grain-oriented silicon steel or amorphous metal, depending on customer preference or optimal material based upon performance requirements. Many grades of core steel are available for optimizing core loss efficiency.

Coils

Pad-mounted transformers feature a rectangular coil configuration with wire-wound, high-voltage primaries and sheet-wound secondaries. The design minimizes axial stress developed by short circuits and provides for magnetic balancing of tap connections.

Coils are wound using the highest quality winding machines providing exacting tension control and conductor placement for superior short-circuit strength and maximum efficiency.

Extra mechanical strength is provided by diamond pattern, epoxy-coated paper insulation, used throughout the coil, with additional epoxy at heavy stress points. The diamond pattern distribution of the epoxy and carefully arranged ducts, provide a network of passages through which cooling fluid can freely circulate.

Coil assemblies are heat-cured under calculated hydraulic pressure to ensure performance against short-circuit forces.

Core and coil assemblies

Pad-mounted transformer core and coil assemblies are braced with heavy steel ends to prevent the rectangular coil from distorting under short-circuit conditions. Plates are clamped in place using presses, and welded or bolted to form a solid core and coil assembly. Core and coil assemblies exceed ANSI® and IEEE® requirements for short-circuit performance. Due to the rigidity of the design, impedance shift after short-circuit is comparable to that of circular wound assemblies.

Tanks

Transformer tanks are designed for high strength and ease of handling, installation, and maintenance. Tanks are welded using precision-cut, hot rolled, pickled and oiled steel. They are sealed to protect the insulating fluid and other internal components.

Transformer tanks are pressure-tested to withstand 7 psig without permanent distortion and 15 psig without rupture.

Tank finish

An advanced multi-stage finishing process exceeds IEEE Std C57.12.28™-2014 standards. The eight-stage pre-treatment process assures coating adhesion and retards corrosion. It converts tank surfaces to a nonmetallic, water insoluble iron phosphate coating.

The paint method consists of two distinct layers of paint. The first is an epoxy primer (E-coat) layer which provides a barrier against moisture, salt and corrosives. The two-component urethane final coat seals and adds ultraviolet protection.

Vacuum processing

Transformers are dried and filled with filtered insulating fluid under vacuum, while secondary windings are energized. Coils are heated to drive out moisture, ensuring maximum penetration of fluid into the coil insulation system.

Insulating fluid

Eaton's Cooper Power series transformers are available with electrical-grade mineral insulating oil or Envirotemp™ FR3™ fluid. The highly refined fluids are tested and degassed to assure a chemically inert product with minimal acid ions. Special additives minimize oxygen absorption and inhibit oxidation. To ensure high dielectric strength, the fluid is re-tested for dryness and dielectric strength, refiltered, heated, dried, and stored under vacuum before being added to the completed transformer.

Eaton's Cooper Power series transformers filled with Envirotemp™ FR3™ fluid enjoy unique fire safety, environmental, electrical, and chemical advantages, including insulation life extending properties.

A bio-based, sustainable, natural ester dielectric coolant, Envirotemp™ FR3™ fluid quickly and thoroughly biodegrades in the environment and is non-toxic per acute aquatic and oral toxicity tests.

Building for Environmental and Economic Sustainability (BEES) total life cycle assessment software, utilized by the US Dept. of Commerce, reports its overall environmental performance impact score at 1/4th that reported for mineral oil. Envirotemp™ FR3™ fluid has also earned the EPA Environmental Technology Verification of transformer materials.

With a fire point of 360 °C, Envirotemp™ FR3™ fluid is FM Approved® and Underwriters Laboratories (UL®) Classified "Less-Flammable" per NEC® Article 450-23, fitting the definition of a Listed Product per NEC®.

Figure 8. VFI transformer with visible break.

Pad-mounted VFI transformer

Eaton's Cooper Power series VFI transformer combines a conventional distribution transformer with the proven Vacuum Fault Interrupter (VFI). This combination provides both voltage transformation and transformer over current protection in one space saving and money saving package. The pad-mounted VFI transformer protects the transformer and provides proper coordination with upstream protective devices. When a transformer fault or overload condition occurs, the VFI breaker trips and isolates the transformer.

The three-phase VFI breaker has independent single-phase initiation, but is three-phase mechanically gang-tripped. A trip signal on any phase will open all three phases. This feature eliminates single-phasing of three phase loads. It also enables the VFI breaker to be used as a three-phase load break switch.

Due to the resettable characteristics of the VFI breaker, restoring three-phase service is faster and easier.

The sealed visible break window and switch is an option that can be installed to provide visible break contact. This feature provides enhanced safety and allows an operator to see if the loadbreak switch contacts are in an open or closed position before performing

maintenance.

Envirotran™ FM Approved special protection transformer

Eaton's Cooper Power series Envirotran™ transformer is FM Approved and suitable for indoor locations. Factory Mutual Research Corporation's (FMRC) approval of the Envirotran transformer line makes it easy to comply with and verify compliance with Section 450.23, 2008 NEC, Less-Flammable Liquid-Filled Transformer Requirements for both indoor and outdoor locations.

Envirotran FM Approved transformers offer the user the benefit of a transformer that can be easily specified to comply with NEC, and makes FM Safety Data Sheet compliance simpler, while also providing maximum safety and flexibility for both indoor and outdoor installations.

Because the "FM Approved" logo is readily visible on the transformer and its nameplate, NEC compliance is now easily verifiable by the inspector.

Envirotran FM Approved transformers are manufactured under strict compliance with FMRC Standard 3990 and are filled with

FM APPROVED

FM Approved Envirotemp™ FR3™ fluid, a fire-resistant dielectric coolant.

Special application transformers

Data Center transformer

With focus rapidly shifting from simply maximizing uptime and supporting demand to improving energy utilization, the data center industry is continually looking for methods to increase its energy efficiency and reliability. Utilizing cutting edge technology, Eaton's Cooper Power series Hardened Data Center (HDC) transformers are the solution. Designed with special attention given to surge protection, HDC liquid-filled transformers provide superior performance under the harshest electrical environments. Contrary to traditional dry-type units, HDC transformers provide unsurpassed reliability, overloadability, operational life, efficiency, thermal loading and installed footprint. These units have reliably served more than 100 MW of critical data center capacity for a total of more than 6,000,000 hours without any reported downtime caused by a thermal or short-circuit coil failure.

The top priority in data center operations is uninterrupted service. Envirotran HDC transformers from Eaton, having substantially higher levels of insulation, are less susceptible to voltage surges. Eaton has experienced zero failures due to switching transients. The ANSI® and IEEE® standard impulse withstand ratings are higher for liquid-filled transformers, making them less susceptible to insulation failure. The Envirotran HDC transformer provides ultimate protection by increasing the BIL rating one level higher than standard liquid-filled transformer ratings. The cooling system of liquid-filled transformers provides better protection from severe overloads—overloads that can lead to significant loss of life or failure.

Data center design typically includes multiple layers of redundancy, ensuring maximum uptime for the critical IT load. When best in class transformer manufacturing lead times are typically weeks, not days, an unexpected transformer failure will adversely affect the facility's reliability and profitability. Therefore, the ability to determine the electrical and mechanical health of a transformer can reduce the probability of costly, unplanned downtime. Routine diagnostic tests, including key fluid properties and dissolved gas analysis (DGA), can help determine the health of a liquid-filled transformer. Although sampling is not required for safe operation, it will provide the user with valuable information, leading to scheduled repair or replacement, and minimizing the duration and expense of an outage. With a dry-type transformer, there is no reliable way to measure the health or likelihood of an impending failure.

Solar transformer

As a result of the increasing number of states that are adopting aggressive Renewable & Alternative Energy Portfolio Standards, the solar energy market is growing—nearly doubling year over year. Eaton, a key innovator and supplier in this expanding market, is proud to offer its Cooper Power series Envirotran transformers specifically designed for Solar Photovoltaic medium-voltage applications. Eaton is working with top solar photovoltaic developers, integrators and inverter manufacturers to evolve the industry and change the way we distribute power.

In accordance with this progressive stance, every Envirotran Solar transformer is filled with non-toxic, biodegradable Envirotemp™ FR3™ dielectric fluid, made from renewable seed oils. On top of its biodegradability, Envirotemp™ FR3™ fluid substantially extends the life of the transformer insulation, saving valuable resources. What better way to distribute green power than to use a green transformer. In fact, delaying conversion to Envirotran transformers places the burden of today's environmental issues onto tomorrow's generations. Eaton can help you create a customized transformer, based on site specific characteristics including: temperature profile, site altitude, solar profile and required system life. Some of the benefits gained from this custom rating include:

- Reduction in core losses
- Improved payback on investment
- Reduction in footprint
- Improved fire safety
- Reduced environmental impact

For the solar photovoltaic industry, Eaton is offering standard step up transformers and dual secondary designs, including 4-winding, 3-winding (Low-High-Low) and 3-winding (Low-Low-High) designs.

Wind transformer

Eaton is offering custom designs for renewable energy power generation. Eaton manufactures its Cooper Power series Generator Step-Up (GSU) transformers for installation at the base of every wind turbine. Additionally, grounding transformers are available for wind power generation.

DOE efficiency

The United States Department of Energy (DOE) has mandated efficiency values for most liquid type, medium voltage transformers. As a result, all applicable Eaton's Cooper Power series transformers 2500 kVA and below conform to efficiency levels as specified in the DOE ruling "10 CFR Part 431 Energy Conservation Program".

Underwriters Laboratories® (UL®) Listed and Labeled/ Classified

The Envirotran transformer from Eaton can be specified as UL® Listed & Labeled, and/or UL® Classified. Underwriters Laboratories (UL®) listing is a verification of the design and construction of the transformer to the ANSI® and IEEE® standards. UL® listing generally is the most efficient, cost-effective solution for complying with relevant state and local electrical codes. UL® Combination Classification/Listing is another way in which to comply with Section 450.23, 2008 NEC® requirements. This combines the UL® listed transformer with a UL® Classified Less-Flammable Liquid and complies with the use restrictions found within the liquid Classification.

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K-Factor transformer

With a drastic increase in the use of ferromagnetic devices, arcing devices, and electric power converters, higher frequency loads have increased significantly. This harmonic loading has the potential to generate higher heat levels within a transformer's windings and leads by as much as 300%. Harmonic loading has the potential to induce premature failure in standard-design distribution transformers.

In addition to standard UL® "K-Factor" ratings, transformers can be designed to customer-provided specifications detailing precise loading scenarios. Onsite measurements of magnitude and frequency, alongside harmonic analysis of the connected load can be performed by Eaton engineers or a third party consultant. These field measurements are used to determine exact customer needs and outline the transformer specifications.

Eaton will design harmonic-resistant transformers that will be subjected to the unique harmonic loads. These units are designed to maintain normal temperature rise under harmonic, full-load conditions. Standard UL® "K-Factor" designs can result in unnecessary costs when the "next-highest" K-Factor must be selected for a calculated design factor. To save the customer these unnecessary costs, Eaton can design the transformer to the specific harmonic spectrum used in the application. Eaton's Cooper Power series K-factor transformers are filled with mineral oil or Envirotemp™ FR3™ fluid and enjoy the added benefits of dielectric cooling such as higher efficiencies than dry-type transformers.

Modulation transformer

Bundled with an Outboard Modulation Unit (OMU) and a Control and Receiving Unit (CRU), a Modulation Transformer Unit (MTU) is designed to remotely achieve two way communication.

The use of an MTU reduces travel time and expense versus traditional meter reading performed by high voltage electricians. Additionally, with MTU it is possible to manage and evaluate energy consumption data, providing reduced metering costs and fewer tenant complaints.

An MTU utilizes existing utility infrastructure, therefore eliminating the need to engineer and construct a dedicated communication network.

Figure 9. Modular transformer.

Inverter/rectifier bridge

Eaton complements its range of applications for transformers by offering dual winding designs. These designs are intended for connection to 12-pulse rectifier bridges.

Product attributes

To set us apart from other transformer manufactures, Eaton includes the following guarantees with every three-phase pad-mounted transformer.

Engineered to order (ETO)

Providing the customer with a well developed, cost-effective solution is the number one priority at Eaton. Using customer specifications, Eaton will work with the customer from the beginning to the end to develop a solution to fit their needs. Whether it is application specific, site specific, or a uniquely specified unit, Eaton will provide transformers with the best in class value and performance, saving the customer time and money.

Made in the U.S.A.

Eaton's three-phase pad-mounted transformers are produced right here in the United States of America. Our manufacturing facilities are positioned strategically for rapid shipment of products. Furthermore, should the need arise, Eaton has a broad network of authorized service repair shops throughout the United States.

Superior paint performance

Protecting transformers from nature's elements worldwide, Eaton's E-coat system provides unrivaled transformer paint life, and exceeds IEEE Std C57.12.28™-2014 and IEEE Std C57.12.29™-2005 standards. In addition to the outside of the unit, each transformer receives a gray E-coat covering in the interior of the tank and cabinet, providing superior rust resistance and greater visibility during service.

If the wide range of standard paint selections does not suit the customer's needs, Eaton will customize the paint color to meet their requirements.

Rectangular coil design

Eaton utilizes a rectangular coil design. This winding technique results in a smaller overall unit footprint as well as reducing the transformer weight. The smaller unit size does not hinder the transformer performance in the least. Units have proven short circuit withstand capabilities up to 10 MVA.

Testing

Eaton performs routing testing on each transformer manufactured including the following tests:

- Insulation Power Factor: This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- Ratio, Polarity, and Phase Relation: Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- Resistance: This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- Routine Impulse Tests: The most severe test, simulating a lightning surge. Applies one reduced wave and one full wave to verify the BIL rating.
- Applied Potential: Applied to both high-voltage and low-voltage windings, this test stresses the entire insulation system to verify all live-to-ground clearances.
- Induced Potential: 3.46 times normal plus 1000 volts for reduced neutral designs.
- Loss Test: These design verification tests are conducted to assure that guaranteed loss values are met and that test values are

within design tolerances. Tests include no-load loss and excitation current along with impedance voltage and load loss.

- Leak Test: Pressurizing the tank to 7 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or fluid oxidation.

Design performance tests

The design performance tests include the following:

- Temperature Rise: Our automated heat run facility ensures that any design changes meet ANSI® and IEEE® temperature rise criteria.
- Audible Sound Level: Ensures compliance with NEMA® requirements.
- Lightning Impulse: To assure superior dielectric performance, this test consists of one reduced wave, two chopped waves and one full wave in sequence, precisely simulating the harshest conditions.

Thomas A Edison Research and Test Facility

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Q CELLS YIELD SECURITY
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Higher yield per surface area, lower BOS costs and up to 30 watts more power per module.

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Q.ANTUM DUO combines cutting edge cell separation and innovative 12-busbar design with Q.ANTUM Technology.

[1] APT test conditions according to IEC/TS 62804-1:2015, method B (–1500 V, 168 h)
[2] See data sheet on rear for further information.

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Rooftop arrays on commercial / industrial buildings

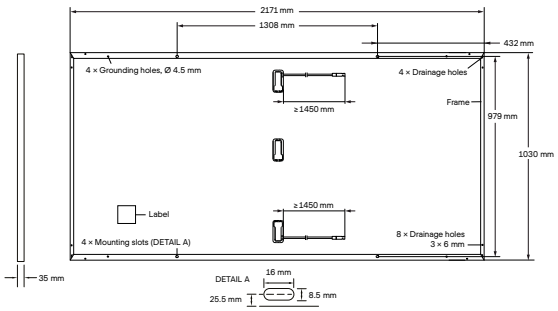
Ground-mounted solar power plants

Engineered in Germany

Q CELLS

MECHANICAL SPECIFICATION

Format	2171 mm × 1030 mm × 35 mm (including frame)
Weight	26.0 kg
Front Cover	3.2 mm thermally pre-stressed glass with anti-reflection technology
Back Cover	Composite film
Frame	Anodised aluminium
Cell	6 × 26 monocrystalline Q.ANTUM solar half cells
Junction box	53-101 mm × 32-60 mm × 15-18 mm Protection class IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥1450 mm, (–) ≥1450 mm
Connector	Stäubli MC4-Evo2, Hanwha Q CELLS HQC4, Amphenol UTX, Renhe 05-8, JMTHY JM601A, Tongling Cable01S-F; IP68 or Friends PV2e; IP67

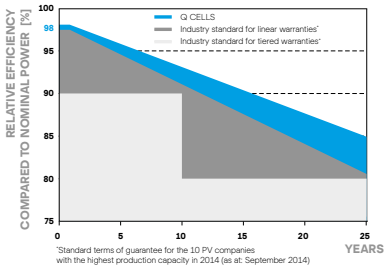


ELECTRICAL CHARACTERISTICS

POWER CLASS				440	445	450	455	460
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC[1] (POWER TOLERANCE +5 W / –0 W)								
Minimum	Power at MPP[1]	P_{MPP}	[W]	440	445	450	455	460
	Short Circuit Current[1]	I_{SC}	[A]	10.55	10.57	10.60	10.62	10.65
	Open Circuit Voltage[1]	V_{OC}	[V]	53.13	53.17	53.20	53.24	53.27
	Current at MPP	I_{MPP}	[A]	10.02	10.07	10.12	10.16	10.21
	Voltage at MPP	V_{MPP}	[V]	43.92	44.21	44.49	44.76	45.04
	Efficiency[1]	η	[%]	≥19.7	≥19.9	≥20.1	≥20.3	≥20.6
MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT[2]								
Minimum	Power at MPP	P_{MPP}	[W]	329.5	333.2	337.0	340.7	344.5
	Short Circuit Current	I_{SC}	[A]	8.50	8.52	8.54	8.56	8.58
	Open Circuit Voltage	V_{OC}	[V]	50.10	50.13	50.17	50.20	50.24
	Current at MPP	I_{MPP}	[A]	7.88	7.92	7.97	8.01	8.05
	Voltage at MPP	V_{MPP}	[V]	41.81	42.06	42.30	42.53	42.77

[1]Measurement tolerances P_{MPP} ±3%; I_{SC}; V_{OC} ±5% at STC: 1000 W/m², 25±2°C, AM 1.5 according to IEC 60904-3 • [2]800 W/m², NMOT, spectrum AM 1.5

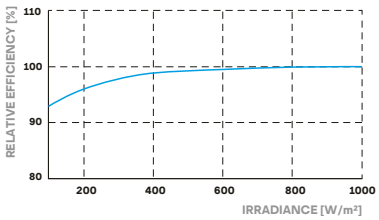
Q CELLS PERFORMANCE WARRANTY



At least 98% of nominal power during first year. Thereafter max. 0.54% degradation per year. At least 93.1% of nominal power up to 10 years. At least 85% of nominal power up to 25 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Q CELLS sales organisation of your respective country.

PERFORMANCE AT LOW IRRADIANCE



Typical module performance under low irradiance conditions in comparison to STC conditions (25°C, 1000 W/m²).

TEMPERATURE COEFFICIENTS

Temperature Coefficient of I_{SC}	α	[%/K]	+0.04	Temperature Coefficient of V_{OC}	β	[%/K]	–0.27
Temperature Coefficient of P_{MPP}	γ	[%/K]	–0.35	Normal Module Operating Temperature	NMOT	[°C]	43±3

PROPERTIES FOR SYSTEM DESIGN

Maximum System Voltage	V_{SYS}	[V]	1500 (IEC) / 1500 (UL)	Safety Class	II
Maximum Reverse Current	I_R	[A]	20	Fire Rating based on ANSI / UL 1703	C / TYPE 1
Max. Design Load, Push / Pull		[Pa]	3600 / 1600	Permitted Module Temperature on Continuous Duty	–40°C - +85°C
Max. Test Load, Push / Pull		[Pa]	5400 / 2400		

QUALIFICATIONS AND CERTIFICATES

IEC 61215:2016; IEC 61730:2016, Application Class II;
This data sheet complies with DIN EN 50380.

PACKAGING INFORMATION

Number of Modules per Pallet	29
Number of Pallets per Trailer (24 t)	24
Number of Pallets per 40' HC-Container (26 t)	20
Pallet Dimensions (L × W × H)	2241 × 1150 × 1220 mm
Pallet Weight	814 kg

Note: Installation instructions must be followed. See the installation and operating manual or contact our technical service department for further information on approved installation and use of this product.

Hanwha Q CELLS GmbH
Sonnenallee 17-21, 06766 Bitterfeld-Wolfen, Germany | **TEL** +49 (0)3494 66 99-23444 | **FAX** +49 (0)3494 66 99-23000 | **EMAIL** sales@q-cells.com | **WEB** www.q-cells.com

Specifications subject to technical changes © **Q CELLS** Q.PEAK DUO XL-G9.3_440-460_2019-08_Rev01_EN

Engineered in Germany

Attachment C: Original EIS (dated January 31, 2020)

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ENVIRONMENTAL IMPACT STATEMENT

Frontier Road Solar Development
Assessor's Plat 7 Lots 62, 62A and 63
Hopkinton, Rhode Island

Prepared for:

Revity Energy
117 Metro Center Boulevard, Suite 1007
Warwick, RI 02886

Prepared by:

SAGE Environmental, Inc.
172 Armistice Boulevard
Pawtucket, Rhode Island 02860

SAGE Project No. M896

January 31, 2020

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EXECUTIVE SUMMARY

This report presents the findings of an Environmental Impact Statement (EIS) to determine the potential environmental impacts associated with the proposed installation of a 15.125-megawatt (AC) solar development by Revity Energy, LLC in the Town of Hopkinton, Rhode Island (hereinafter the Site). The criteria covered in this EIS meet the requirements outlined in the Town of Hopkinton's Non-Residential Photovoltaic Solar Energy System (PSES) Ordinance (dated January 22, 2019).

The construction activities associated with the installation of the PSES will produce minimal adverse effects on the existing environment and ecology; this is consistent with any commercial or residential development. There are minimal wildlife impacts expected, as there is minimal clearing of land and there are no natural heritage areas or natural corridors located within the Site.

During the 30-years of operation and maintenance, there are no expected impacts. The design of the solar development will be done to minimize the removal of vegetation and will include buffering and screening to avoid adverse visual impacts to any adjacent property. The use of the Site as a solar farm would have no long term, permanent effects on the land, and would not necessarily inhibit the future use of the land for residential, commercial or agricultural purposes.

The development of this solar farm meets the need for renewable energy production, that will reduce carbon emitted, while minimizing the overall effects on the environment.

1.0 INTRODUCTION

1.1 Purpose

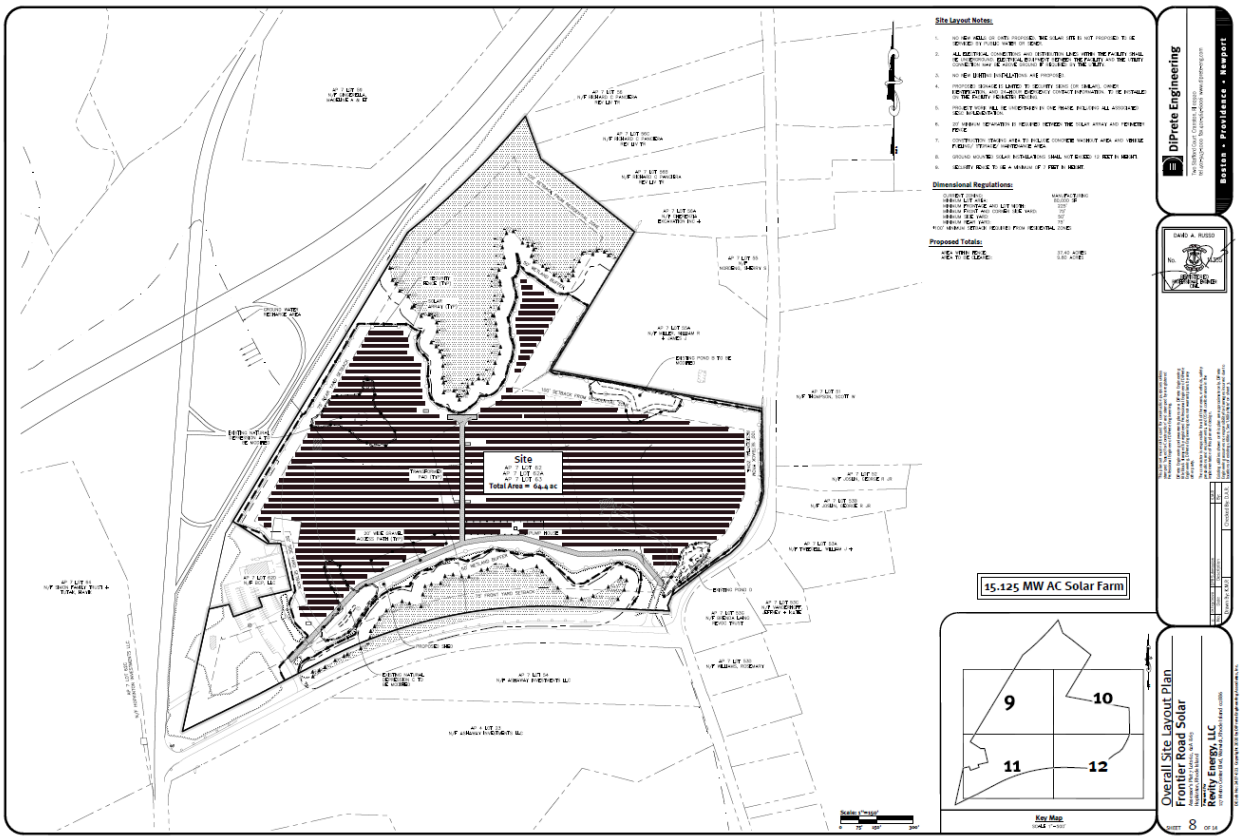
SAGE Environmental Inc. (SAGE) has prepared this Environmental Impact Statement (EIS) for the proposed installation of a 15.125-megawatt (AC) solar development by Revity Energy, LLC in the Town of Hopkinton, Rhode Island referred to as Frontier Road Solar located at Assessor's Plat 7 Lots 62, 62A and 63. The proposed development is comprised of ground mounted photovoltaic (PV) panels. The purpose of this assessment is to outline the potential impacts on the environment due to the proposed operations to take place at the Site. The term "environment" in this report shall encompass the following criteria to be covered in detail throughout the report:

- Geology and Soils
- Hydrology and Water Quality
- Floodplains
- Wetlands
- Wildlife Habitat and Vegetation
- Visual resources
- Air Quality
- Noise
- Transportation
- Cultural Resources
- Solid and Hazardous Waste

1.2 Project Site Location

The proposed project would cover an area located in Hopkinton, RI (hereinafter the Site). The project Site is comprised of approximately 64.4 acres of land located on 3 parcels, referred to as Frontier Road Solar located at Assessor's Plat 7 Lots 62, 62A and 63. The Site parcels are zoned as manufacturing (MFG). Residential neighborhoods and properties are nearby the Site. Interstate 95 (I-95) runs along the northern border of the Site. **Figure 1** provides a map showing the site layout prepared by DiPrete Engineering (dated January 29, 2020).

Figure 1
Frontier Road Solar



1.3 Solar Arrays

Before installation, the proposed solar array field would be mowed and cleared of existing tall vegetation. Permanent access roads would be cleared of vegetation and graded as necessary before being covered with gravel for reliable transport of materials for installation. Grading of the Site would occur as necessary for efficient installation of the solar arrays as well as to allow for proper containment and drainage of stormwater on the Site.

Solar panels would be constructed in multiple parallel east-west rows. It is anticipated that power generated by the panels would be directed to 64 SunGrow string inverters and 5 Cooper Power Series - three-phase pad-mounted compartmental type transformers located at convenient locations throughout the Site; note that these numbers are subject to change and will be evaluated as part of the design stage of this development project. **Appendix A** provides the manufacture technical specification data sheets for the inverters, and transformers. All equipment will follow National Electric Code, State and/or Local signage and labeling requirements.

The transformers utilized will contain transformer oil, the transformers will be located on an equipment pad that includes containment sufficient to contain at least 125% of the fluid found in the transformers.

Appendix A provides an example of the containment that may be used, the exact containment equipment will be determined during the final design stage.

The perimeter of the solar panels will be enclosed with 6 to 7-foot-tall fence. The fence will be elevated 6 inches above ground level to allow for passage of small animals. All applicable signage per National Grid, National Electric Code and/or state requirements will be affixed on the fences.

Once installation of the arrays is complete and the solar development is in operation, maintenance of the vegetation in the solar array fields would occur regularly to control growth and prevent the shading of the solar panels. Vegetative maintenance would occur at the Site in the form of mechanical methods (i.e. lawn mowers and weed whackers).

1.4 Operation and Maintenance

Operation and maintenance of the system would involve inverters, transformers, and other supporting equipment, which would be expected to occur on a limited basis at certain points during the system's estimated 30-year life cycle. The area would be left unplowed from snow during the winter months except for when maintenance is necessary. Routine maintenance would also include periodic (2 to 3 times per year – Spring/Summer/Fall) mowing of the ground. No chemicals, solvents, or herbicides (excluded water) will be used in the operation and maintenance of the PSES.

1.5 Grid Connections and Distribution Lines

All grid connections and distribution lines will be evaluated as part of the design stage of this development project.

1.6 Decommissioning

Solar PV panels have an estimated lifetime of about 30-35 years. At the end of operational life, or substantially reduced efficiency, the arrays would be dismantled and disposed of as part of a planned decommissioning process. All support structures, fencing, and associated electrical hardware (wiring, conduit, towers, etc.)
would also be removed. The land would then be available for future operations by the land owner.

2.0 EXISTING CONDITIONS AND EFFECTS ON THE ENVIRONMENT

2.1 Geology, Soils, and Farmland

2.1.1 Existing Conditions

The soils located on the Site are sandy-stony soil types, identified by the United States Department of Agriculture Natural Recourses Conservation Service (NRCS) Web Soil Survey (WSS) as well-drained Canton-Charlton fine sandy loams (very stony) and Ridgebury, Leicester and Whitman soils (extremely stony). The area of the Site currently used for golf operations is identified as having "Prime Farmland". **Figure 2** provides a map of the NRCS identified soils; and **Figure 3** displays the "Statewide Important" farmland and "Prime Farmland.

Figure 2
Soil Types Located at Site

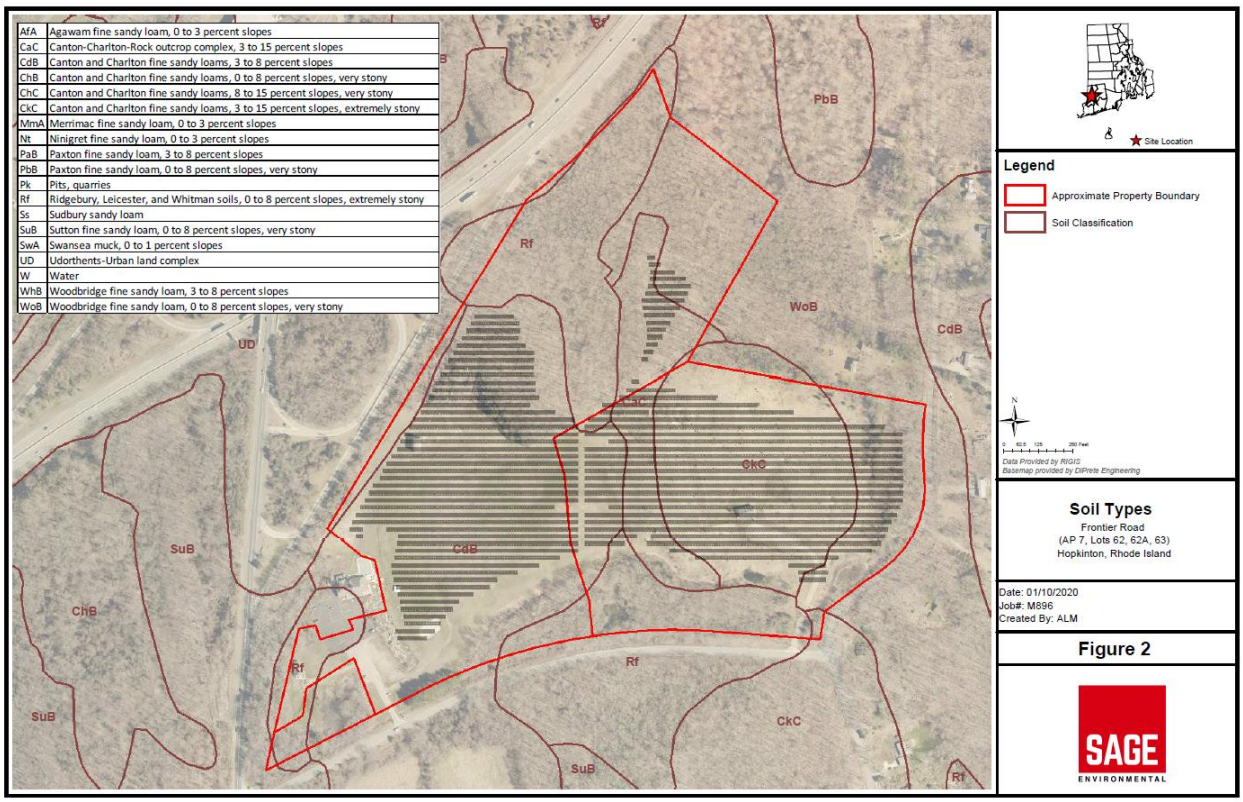
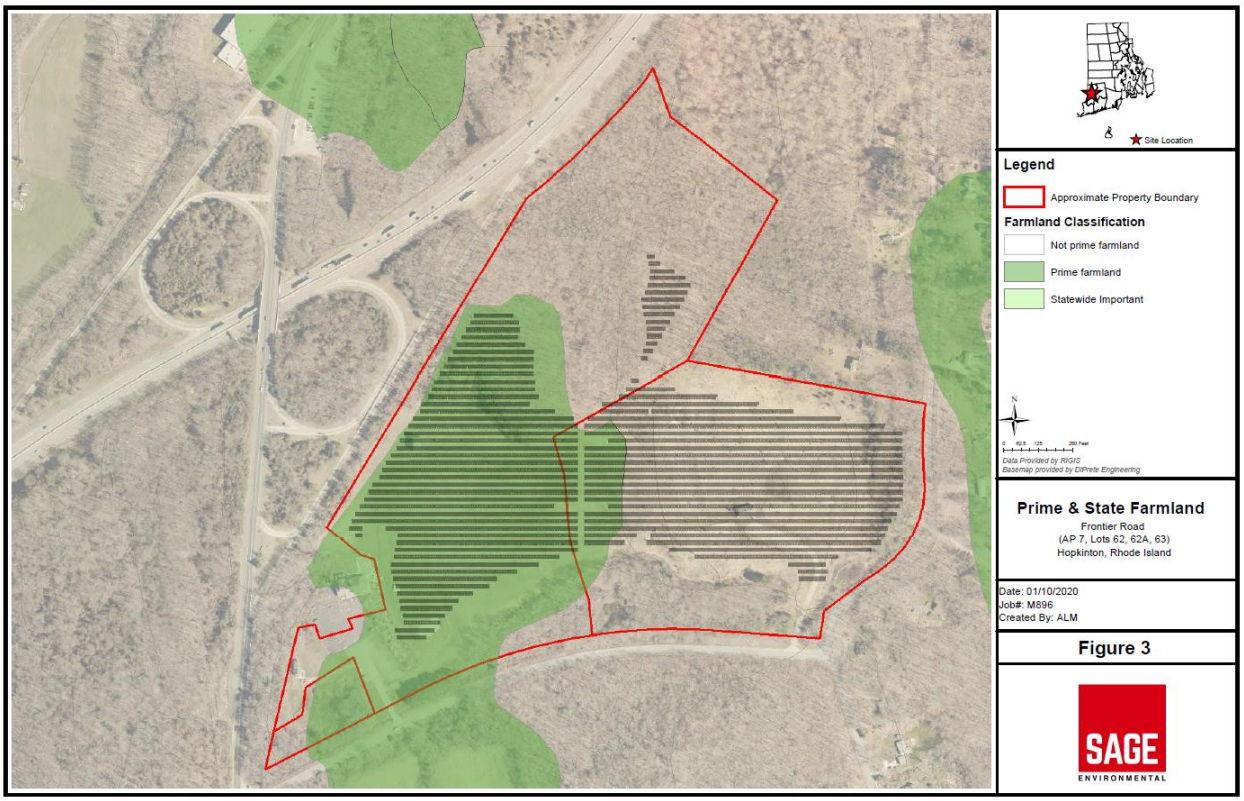


Figure 3
Farm Land Soil Designation



2.1.2 Effects on the Environment

Impacts to the soils and geology at the Site would be minimal. The only impermeable surfaces to be constructed would be the concrete equipment pads with a containment system for the proposed inverters and transformers. The containment system will protect the soils from the release of any transformer fluid should a leak occur. Additionally, groundwater and bedrock would not be reached as a part of the site construction.

After construction of the solar farm is complete, exposed soils would be stabilized with vegetation, and no additional impacts to the soils is projected. Portions of soil classified as "Prime Farmland" will be developed as part of the solar development, however this area is already in use for golf operations. Note that the use of the site as a solar farm would have no long term, permanent effects on the soil, and would not necessarily inhibit the future use of the land for agricultural purposes.

DiPrete Engineering has incorporated detailed soil erosion and sediment control measures as part of the design stage of this development project that conforms to RIDEM Best Management Practices (BMPs). Soil erosion and sediment control BMPs include silt fences, silt socks, and landscape plantings.

2.2 Water Resources

2.2.1 Existing Conditions

2.2.1.1 Groundwater

The Site is located within a groundwater recharge area, meaning that under certain hydraulic conditions water that enters the zone of saturation can move to the Pawcatuck Aquifer. The Site is also located within a Noncommunity Wellhead Protection Area. **Figure 4** provides a map of the wellhead protection areas.

2.2.1.2 Surface Water

There is a small body of water located in the middle of the southern side of the Site, located within the wetland protection areas for the Site.

2.2.1.3 Wetlands

The Site contains two areas denoted as freshwater wetlands. These features include swamps and forested wetlands. **Figure 1** provides the location of the approximated wetland areas. **Appendix B** provides the Freshwater Wetland Delineation Assessment conducted by Natural Resource Services, Inc (dated September 10, 2019).

2.2.1.4 Vernal Pools

Vernal pools were not found during the Freshwater Wetland Delineation Assessment conducted by Natural Resource Services, Inc (dated September 10, 2019). **Appendix B** provides the Freshwater Wetland Delineation Assessment conducted by Natural Resource Services, Inc (dated September 10, 2019).

2.2.1.5 Floodplains

The Site is not located within any flood plains. According to the Rhode Island Emergency Management Agency (RIEMA) floodplain maps, the entire property is located within Flood Zone X, which is designated as an area of 0.2% mean annual flood hazard and within the 500-year flood zone. **Figure 5** provides a map displaying floodplains produced by the Rhode Island Emergency Management Agency, which provides flood zone determination relative to the flood hazard areas delineated on FEMA's FIRMs.

Figure 4
Wellhead Protection Area Map

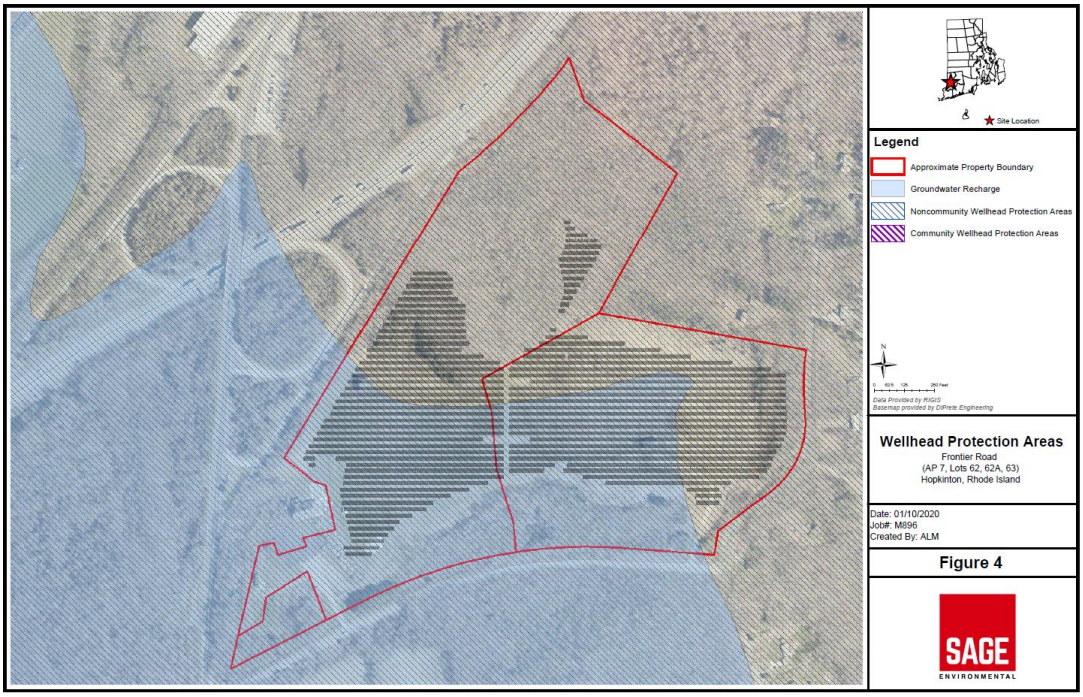
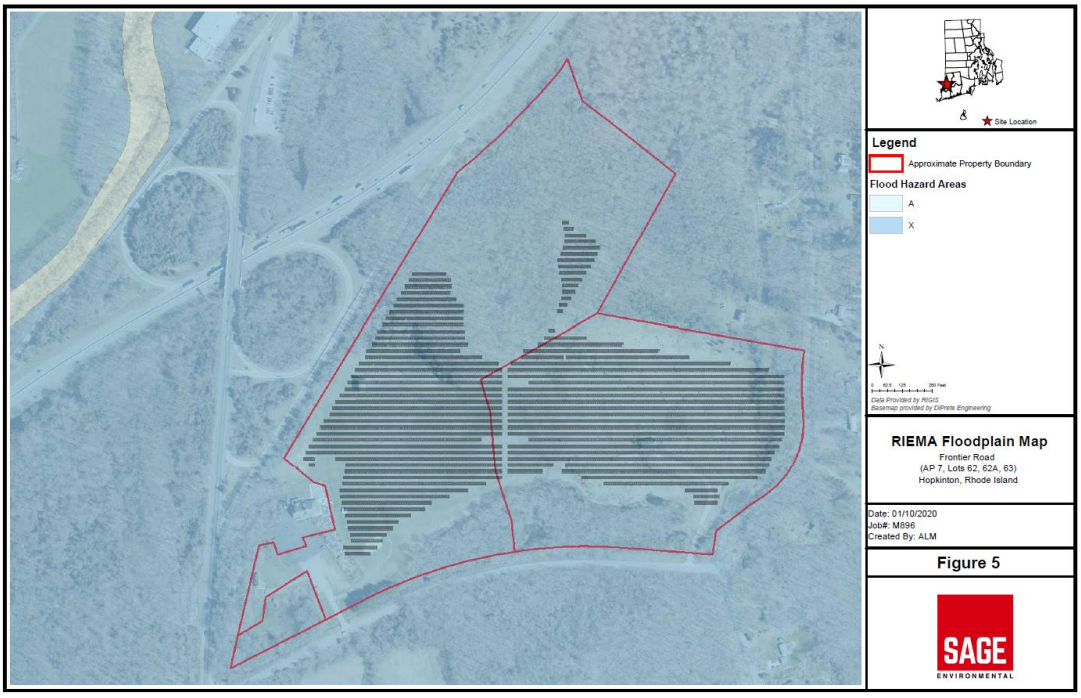


Figure 5
RIEMA Floodplain Map



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2.2.2 Effects on the Environment

2.2.2.1 Groundwater

Based on the nature of the proposed work to be completed at the Site, ground surface installations with minimal excavation, it is expected that there will be no groundwater impacts. The only petroleum products projected to be used at the Site are related to the use of electrical transformers, which will have a containment system to protect groundwater should a release occur. This equipment will be constructed above surface grade and will be maintained regularly. As such, the risk of release of hazardous materials or petroleum products to the subsurface at the Site is negligible.

2.2.2.2 Surface Water

Surface water is located within the wetland protection areas for the Site, thus no impact is projected because development will not occur in the wetland protection areas. DiPrete Engineering has incorporated detailed stormwater management at the preliminary design stage of this development project that conforms to RIDEM Best Management Practices (BMPs). Storm water BMPs include upgrades to existing detention basins and grass swales at down gradient locations for stormwater attenuation.

2.2.2.3 Wetlands

There are regulated wetlands at the Site, minimal impact is projected to this type of habitat. All Wetlands will be protected from clearing, grading, filling and building. There will be a 50 foot undisturbed upland buffer required for all wetlands.

2.2.2.4 Vernal Pools

Vernal pools were not found during the Freshwater Wetland Delineation Assessment conducted by Natural Resource Services, Inc (dated September 10, 2019).

2.2.2.5 Floodplains

The Site is not located within any floodplains, and as such, no impact is projected.

2.3 Wildlife Habitat and Vegetation

2.3.1 Existing Conditions

Figure 6 displays Conservation Opportunity Areas. There are no natural heritage areas, natural corridors, or unfragmented forest blocks located within the Site boundaries.

Figure 7 displays ecological communities within the Site. These communities include; Forested Swamp, Oak Forest, Ruderal Grassland/Shrubland, Tree Plantation, Urban/Recreational Grasses and Urban/Suburban Built.

Figure 6
Conservation Opportunity Areas

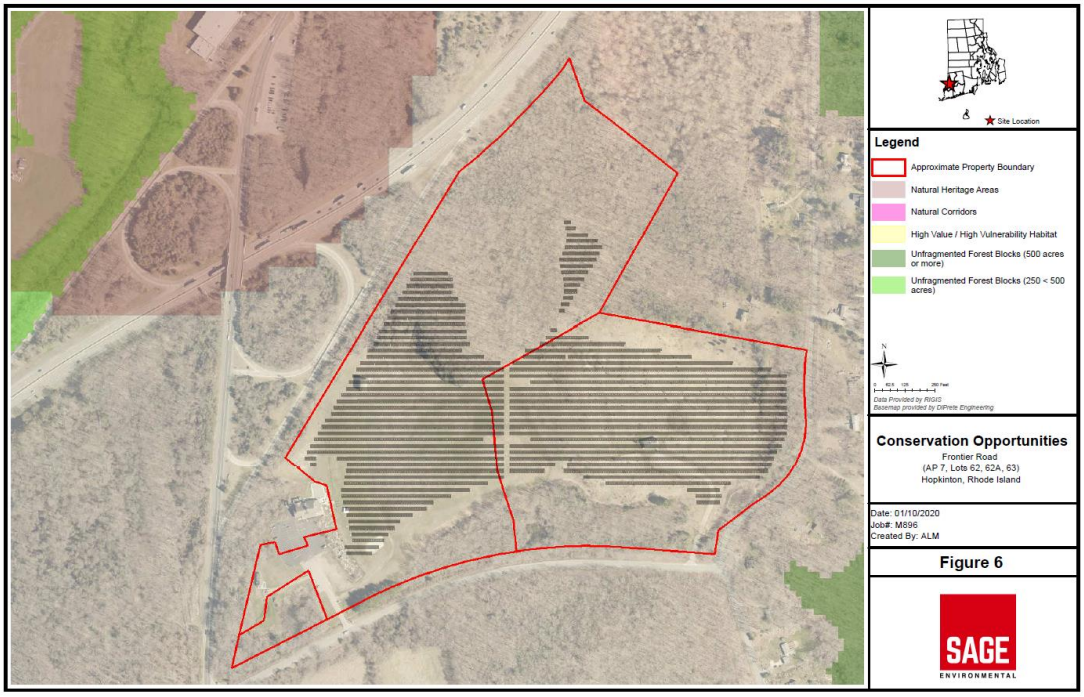
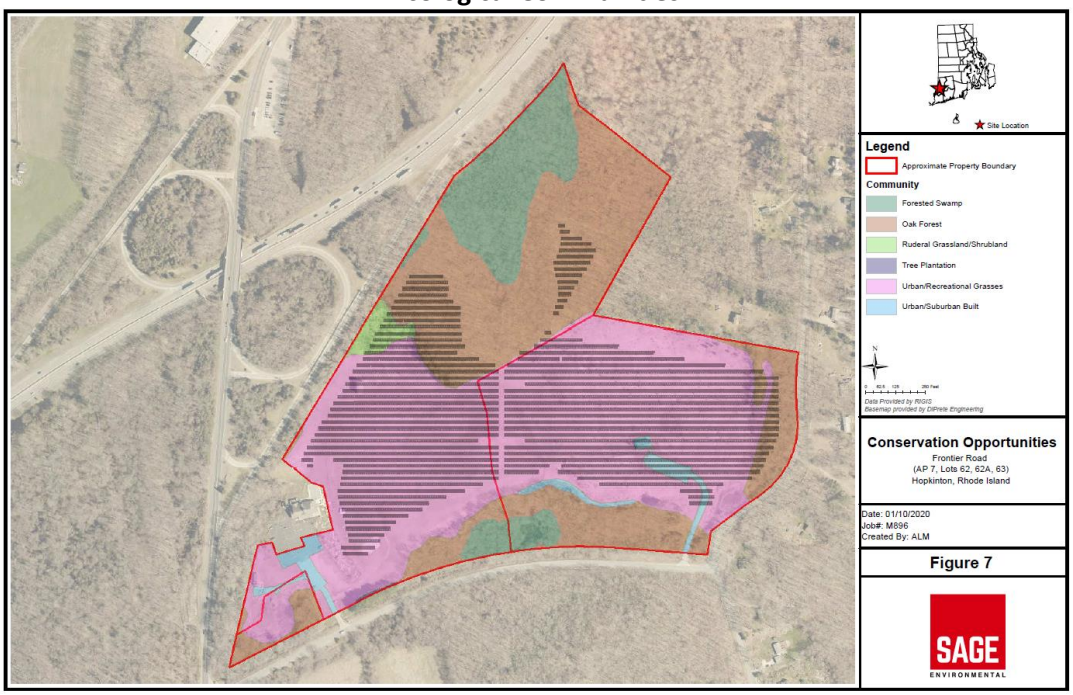


Figure 7
Ecological Communities



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2.3.2 Effects on the Environment

There is minimal forested area planned for clearing for solar panels and drainage areas. It is estimated that approximately 9.8 acres will require tree clearing. Note that this number is greater than initial estimates due to the Class I land survey and additional area needed for drainage.

Construction work at the site would increase wildlife interaction with anthropogenic activity; however, construction would remain within the proposed boundaries of the project and construction activities would cause only impacts to the existing habitat and wildlife. The impacts would be comparable to any other development activity that required clearing of land. After construction, the use of the Site would become passive, with maintenance of the solar fields occurring at regular intervals throughout the year as described above in Section 1.4. The use of the Site as a solar farm would allow for habitat and vegetation to reestablish. Fencing will surround the perimeter of the solar panels. Preserved vegetated areas on the boundary of the Site will still be accessible to all wildlife.

There are minimal wildlife and vegetation impacts expected, as there is minimal clearing of land and there are no natural heritage areas or natural corridors located within the Site boundaries.

2.4 Threatened or Endangered Species

2.4.1 Existing Conditions

The Site is not located within a Natural Heritage Area, as depicted in **Figure 6**.

2.4.2 Effects on the Environment

No impacts to threatened or endangered species is projected.

2.5 Air Quality and Greenhouse Gas Emissions

2.5.1 Existing Conditions

The Site currently provides golfing services, and as such, the air quality at the Site is most likely consistent with RI background conditions. Due to the current use of the property, the Site has a minor positive impact on the air quality from the absorption of CO_2 by the existing vegetation. Additionally, no current sources of significant greenhouse gas emissions have been identified at the Site, and due to the low density of development in the surrounding area, no significant impacts to the air quality were identified in the vicinity of the Site.

2.5.2 Effects on the Environment

Impacts to the air quality at the Site would be most prominent during the construction of the solar farm.

The power generation from the proposed solar panels would produce near-zero greenhouse gas emissions, and over the 30-year lease period, would promote beneficial impacts to the Site and

surrounding air quality.

2.6 Noise

2.6.1 Existing Conditions

The Site currently provides golfing services, as such, noise at the Site is generally consistent with background noise levels in the surrounding area, with the exception of anthropogenic activity related to golfing. Typical wilderness ambient sound is 35 dB (Berger et al., 2015).

2.6.2 Effects on the Environment

Noise impacts associated with the development of the proposed solar farm would primarily occur during construction activities.

Following the completion of construction activities, the ambient sound environment would be expected to return to existing levels. The only sound emitting equipment would be the inverters and transformers. The Town of Hopkinton's Non-Residential Photovoltaic Solar Energy System Ordinance (dated January 22, 2019) states that noise levels from the Photovoltaic Solar Energy Systems (PSES) cannot exceed 40 dB at the property line.

Appendix C provides a pre-construction noise assessment, which concludes that sound emitted from the PSES is expected to be less than 40 dB at the property line. Note that this assessment used representative noise data for the inverters that will be located on the Site. This noise assessment will be reassessed when the project is built. If during this reassessment it is found that noise emitted would cause an exceedance of 40 dB at the property line, noise barriers will be utilized around the equipment to reduce the sound levels such that they are less than 40 dB at the property line.

2.7 Visual Aesthetics

2.7.1 Existing Conditions

The Site currently provides golfing services and is comprised of cleared areas and forested areas. Portions of the cleared area used for golfing services are viewable along Maxson Hill Road and Frontier Road where there is no or limited vegetation buffering. The interior of the Site is not viewable along the property boundaries along I-95 and Main Street (Route 3).

2.7.2 Effects on the Environment

In general, the proposed Site layout will focus on maintaining as much existing vegetation as possible at the Site perimeters to obscure construction and operational activities from the view of adjacent properties, homes, and roadways. The construction activity would change the appearance of the site by the presence of heavy equipment, grading, installation of the security fencing, PV racking systems, PV panels, electrical connections, inverters and transformers, as well as the electrical interconnection entering and leaving the Site. However, once construction is completed, there would be minimal traffic

entering and leaving the Site. The goal of the overall site design is to minimize any visual impacts of the proposed facility and provide buffering and screening to avoid adverse visual impacts to any adjacent property.

The development of the solar farm would result in minor temporary visual impacts due to construction activities, however the visual presence of construction would occur for any commercial or residential development. The long term operation of the solar farm will have negligible impacts during operation and maintenance of the solar farm, as the goal of the overall site design is to minimize any visual impacts of the proposed facility.

2.8 Lighting

2.8.1 Existing Conditions

The Site currently provides golfing services and includes a golfing driving range that emits artificial light.

2.8.2 Effects on the Environment

No lighting is planned or required for the site operations, and as such, no light pollution is projected.

2.9 Transportation

2.9.1 Existing Conditions

The Site currently provides golfing services with a driving range, as such transportation would be related to clients for the golfing operations.

2.9.2 Effects on the Environment

Transportation impacts from the proposed solar development are expected to be minimal to none, with limited activity during construction.

2.10 Cultural Resources

2.10.1 Existing Conditions

Cultural resources include, but are not limited to, prehistoric and historic archaeological sites, historic structures, and historic sites at which important events occurred. **Figure 8** displays the location of historical sites and historical cemeteries. Note that there are no historic sites located on the Site that are listed on the National Register of Historic Places by the RI Historic Preservation & Heritage Commission. Also, there are no historical cemeteries found on Site per an evaluation of the Rhode Island Advisory Commission on Historical Cemeteries database.

Figure 9 provides a map depicting estimated locations of stone walls at the Site based on DiPrete Engineer's field survey conducted on November 27, 2019. The stone wall legend identifier has been highlighted in yellow on the site plan in **Figure 9** for easy identification of the location of stone walls.

Figure 8
Historical Cemeteries and Sites

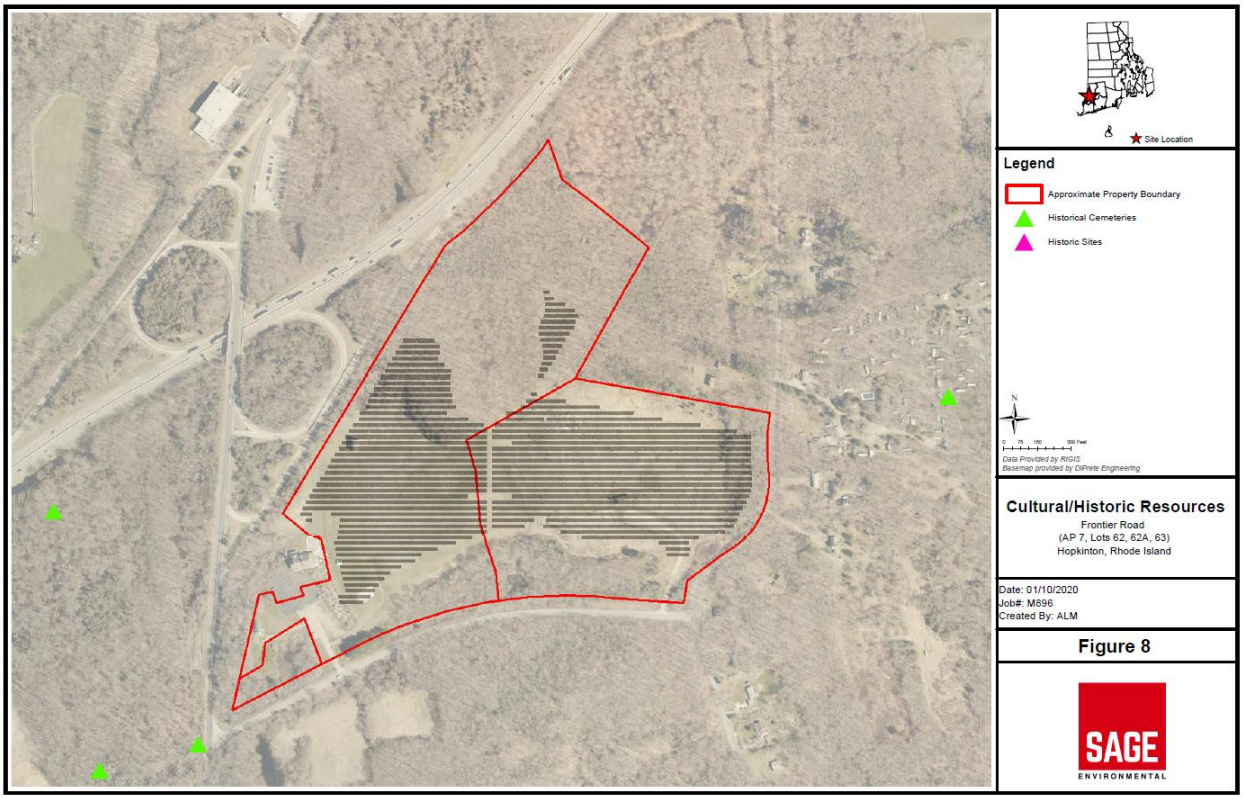
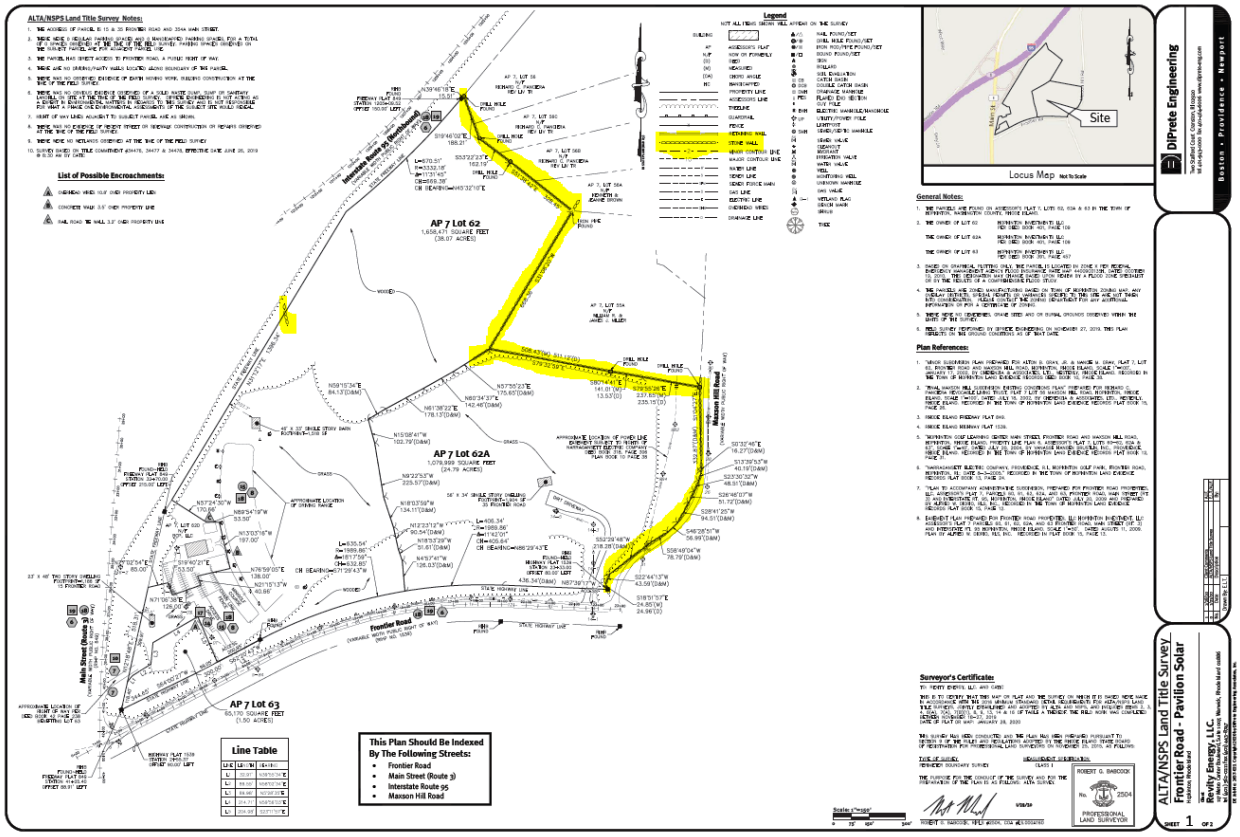


Figure 9
Approximate Location of Stone Walls



2.10.2 Effects on the Environment

No historical cemeteries or national registered historical sites exist at the Site and as such, no impacts are anticipated.

2.11 Waste Management and Pollution Prevention

2.11.1 Existing Conditions

Waste generation and pollution occurring activities currently take place at the Site would be related to golfing services and would be minimal.

2.11.2 Effects on the Environment

Waste generated from the proposed Site activities would occur during the construction process. Materials denoted as waste would be removed from the Site properly and taken to an approved facility where the materials could be recycled as either fuel, mulch, or construction supply.

Additional waste would be generated from the shipping materials used to transport the solar panels and

SAGE ENVIRONMENTAL

accompanying equipment associated with the project (i.e. metal support racks and beams, transformers, inverters, concrete, conduit). Materials would be properly contained on Site in dumpsters until removal, and as much of the shipping materials as possible would be recycled before the remainder is disposed of in an approved landfill.

No hazardous materials are proposed as part of the construction, operation or maintenance process, and all appropriate measures will be taken to prevent leakage or spills from construction equipment. The transformers proposed for the Site will use non-PCB containing transformer oil and will be placed on impermeable concrete pads with a containment system to prevent the release of petroleum products to the environment.

The development of the solar farm would result in waste production due to construction activities, however no hazardous waste will be generated. Waste generation would occur for any commercial or residential development at the Site. The long term operation of the solar farm will have insignificant impacts during operation and maintenance of the solar farm.

3.0 CONCLUSION

The construction activities associated with the installation of the solar farm will comply with all RIDEM air, water quality and waste standards. The construction of the solar farm will produce minor adverse effects on the existing environment and ecology; however, this is consistent with any commercial or residential development and is therefore considered insignificant. There are minimal wildlife impacts expected, as there is minimal clearing of land and there are no natural heritage areas or natural corridors located within the Site. During the 30-years of operation and maintenance, there are no expected environmental impacts from the Site.

4.0 LIMITATIONS

Data obtained from contributing consulting firms, public agencies, Site inspections, and data mapping sources were used in the assessment of this Site. The accuracy of the conclusions derived from these data is based solely on the accuracy of the data reported and/or supplied. Should information be made available concerning the Site which is not included in this report, it should be reported to SAGE so that findings, conclusions, and/or recommendations can be altered and modified (if necessary). Any qualitative or quantitative information regarding the Site, which was not available to SAGE at the time of this assessment, may result in modification(s) to the conclusions and/or representations made in this report.

Appendix A: Manufacture Technical Specification Data Sheets for Inverters, Transformers and Containment System

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SG250HX-US New

Multi-MPPT String Inverter for 1500 Vdc System

SUNGROW
Clean power for all

HIGH YIELD

- 12 MPPTs with max. efficiency 99%
- Compatible with bifacial module
- Built-in Anti-PID and PID recovery function

SMART O&M

- Touch free commissioning and remote firmware upgrade
- Online IV curve scan and diagnosis*
- Fuse free design with smart string current monitoring

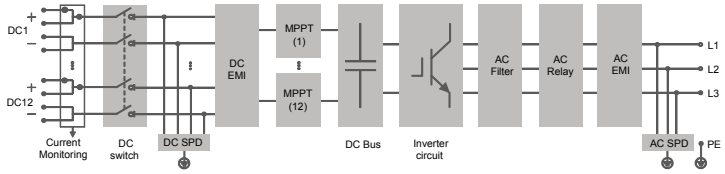
LOW COST

- Compatible with Al and Cu AC cables
- DC 2 in 1 connection enabled
- Power line communication (PLC)
- Reactive power at night function

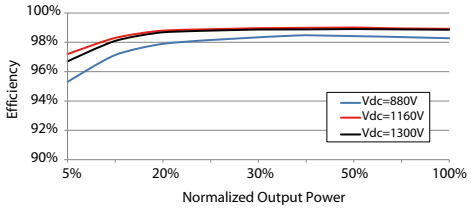
PROVEN SAFETY

- Integrated Arc fault circuit protection
- NEMA 4X protection and C5 anti-corrosion grade
- Type II SPD for both DC and AC

CIRCUIT DIAGRAM



EFFICIENCY CURVE



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Type designation	SG250HX-US
Input (DC)	
Max. PV input voltage	1500 V
Min. PV input voltage / Startup input voltage	600 V / 600 V
Nominal PV input voltage	1080 V
MPP voltage range	600 V – 1500 V
MPP voltage range for nominal power	860 V – 1300 V
No. of independent MPP inputs	12
Max. PV input current	26 A * 12
Max. current for input connector	30 A
Max. DC short-circuit current	50 A * 12
Output (AC)	
AC output power	250 kVA @ 30 ℃ / 225 kVA @40 ℃/200 KVA @50℃
Max. AC output current	180.5 A
Nominal AC voltage	3 / PE, 800 V
AC voltage range	680 – 880V
Nominal grid frequency / Grid frequency range	50 Hz / 45 – 55 Hz, 60 Hz / 55 – 65 Hz
THD	< 3 % (at nominal power)
DC current injection	< 0.5 % In
Power factor at nominal power / Adjustable power factor	> 0.99 / 0.8 leading – 0.8 lagging
Feed-in phases / connection phases	3 / 3
Efficiency	
Max. efficiency	99.0 %
CEC efficiency	98.5 %
Protection	
DC reverse connection protection	Yes
AC short circuit protection	Yes
Leakage current protection	Yes
Grid monitoring	Yes
Ground fault monitoring	Yes
DC switch	Yes
AC switch	No
Arc fault circuit interrupter (AFCI)	Yes
PV String current monitoring	Yes
Reactive powe at night function	Yes
PID protection	An-ti PID or PID recovery
Overvoltage protection	DC Type II and AC Type II
General Data	
Dimensions (W*H*D)	1051*660*363 mm (41.4''*26''*14.3'')
Weight	95kg (209.4 lbs)
Isolation method	Transformerless
Ingress protection rating	NEMA 4X
Night power consumption	< 2 W
Operating ambient temperature range	'-30 to 60 ℃ ('-22 to 140 ℉)
Allowable relative humidity range (non-condensing)	0 – 100 %
Cooling method	Smart forced air cooling
Max. operating altitude	4000 m (> 3000 m der ating) 13123 ft (> 9843 ft derating)
Display	LED, Bluetooth+APP
Communication	RS485 / PLC
DC connection type	Amphenol UTX (Max. 6 mm² 10AWG)
AC connection type	OT terminal (Max. 300 mm² 600 Kcmil)
Compliance	UL1741, UL1741SA, IEEE1547, IEEE1547.1, CSA C22.2 107.1-01-2001, FCC Part15 Sub-part B Class A Limits, California Rule 21,UL 1699B
Grid Support	Reactive power at night function, LVRT, HVRT,active & reactive power control and power ramp rate control, Volt/Watt, Frequency/Watt

*: Only compatible with Sungrow logger and iSolarCloud

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SUNGROW

SG125HV NEW

String Inverter for 1500 Vdc Systems

High Yield

- Patented five-level topology, 98.8% CEC efficiency, 98.5% Euro efficiency
- Full power operation without derating up to 50 ℃

Easy O&M

- Virtual central inverter design concept enables easy O&M
- Compact design and light weight (68kg) for easy installation

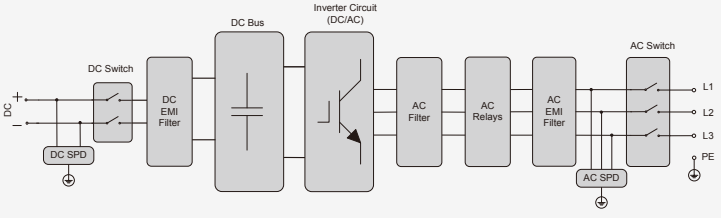
Higher ROI

- World's highest output string inverter at 125kW (1500Vdc/600Vac)
- 2 to 5 MW power block design for lower total installed costs
- DC/AC ratio up to 1.5

Grid Support

- Compliant with CEA, IEC 61727/62116
- Low/High voltage ride through (L/HVRT)
- Active & reactive power control, power ramp rate control

Circuit Diagram



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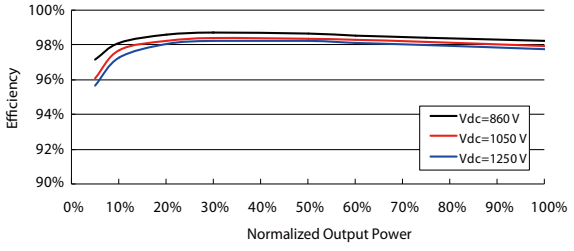
Input (DC)	SG125HV
Max. PV input voltage	1500 V
Min. PV input voltage / Startup input voltage	860 V / 860 V
Nominal input voltage	1050 V
MPP voltage range	860 - 1450 V
MPP voltage range for nominal power	860 - 1250 V
No. of independent MPP inputs	1
Max. number of PV strings per MPPT	1
Max. DC short circuit current	240 A
Output (AC)	
Nominal AC power (at 50 ˚C)	125000 W
Max. AC output at PF=1 (at 50 ˚C)	125000 W
Max. AC apparent power (at 50 ˚C)	125000 VA
Max. AC output current	120 A
Nominal AC voltage	3 / PE, 600 V
AC voltage range	480 - 690 V
Nominal grid frequency / Grid frequency range	50 Hz / 45 - 55 Hz, 60 Hz / 55 - 65 Hz
THD	< 3 % (at nominal power)
DC current injection	< 0.5 % In
Power factor at nominal powe / Adjustable power factor	> 0.99 / 0.8 leading - 0.8 lagging
Feed-in phases / Connection phases	3 / 3
Efficiency	
CEC efficiency / Euro efficiency	98.8 % / 98.5 %
Protection	
DC reverse connection protection	Yes
AC short-circuit protection	Yes
Leakage current protection	Yes
Grid monitoring	Yes
DC switch / AC switch	Yes / Yes
DC fuse	No
PV string current monitoring	No
Anti-PID function	Optional
Overvoltage protection	DC Type II / AC Type II
General Data	
Dimensions (W*H*D)	670*810*294 mm
Weight	68 kg (150 lbs)
Isolation method	Transformerless
Degree of protection	IP65
Night power consumption	< 2 W
Operating ambient temperature range	-25 to 60 ℃ (> 50 ℃ derating)
Allowable relative humidity range (non-condensing)	0 - 100 %
Cooling method	Smart forced air cooling
Max. operating altitude	4000 m (> 3000 m derating)
Display / Communication	LED / RS485, Bluetooth +APP
DC connection type	Screw Clamp terminal (Max. 120 mm²)
AC connection type	Screw Clamp terminal (Max. 120 mm²)
Compliance	CEA, IEC 62109, IEC 61727, IEC 62116, IEC 60068, IEC 61683, CE
Grid Support	LVRT, HVRT, active & reactive power control and power ramp rate control

Efficiency Curve



Three-phase pad-mounted compartmental type transformer

General

At Eaton, we are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality, most reliable transformers. Eaton's Cooper Power series Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. In order to drive this innovation, we have invested both time and money in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin. Such revolutionary products as distribution-class UltraSIL™ Polymer-Housed Evolution™ surge arresters and Envirotemp™ FR3™ fluid have been developed at our Franksville lab.

With transformer sizes ranging from 45 kVA to 12 MVA and high voltages ranging from 2400 V to 46 kV, Eaton has you covered. From fabrication of the tanks and cabinets to winding of the cores and coils, to production of arresters, switches, tap changers, expulsion fuses, current limit fuses, bushings (live and dead) and molded rubber goods, Eaton does it all. Eaton's Cooper Power series transformers are available with electrical grade mineral oil or Envirotemp™ FR3™ fluid, a less-flammable and bio-degradable fluid. Electrical codes recognize the advantages of using Envirotemp™ FR3™ fluid both indoors and outdoors for fire sensitive applications. The bio-based fluid meets Occupational Safety and Health Administration (OSHA) and Section 450.23 NEC Requirements.

EATON
Powering Business Worldwide

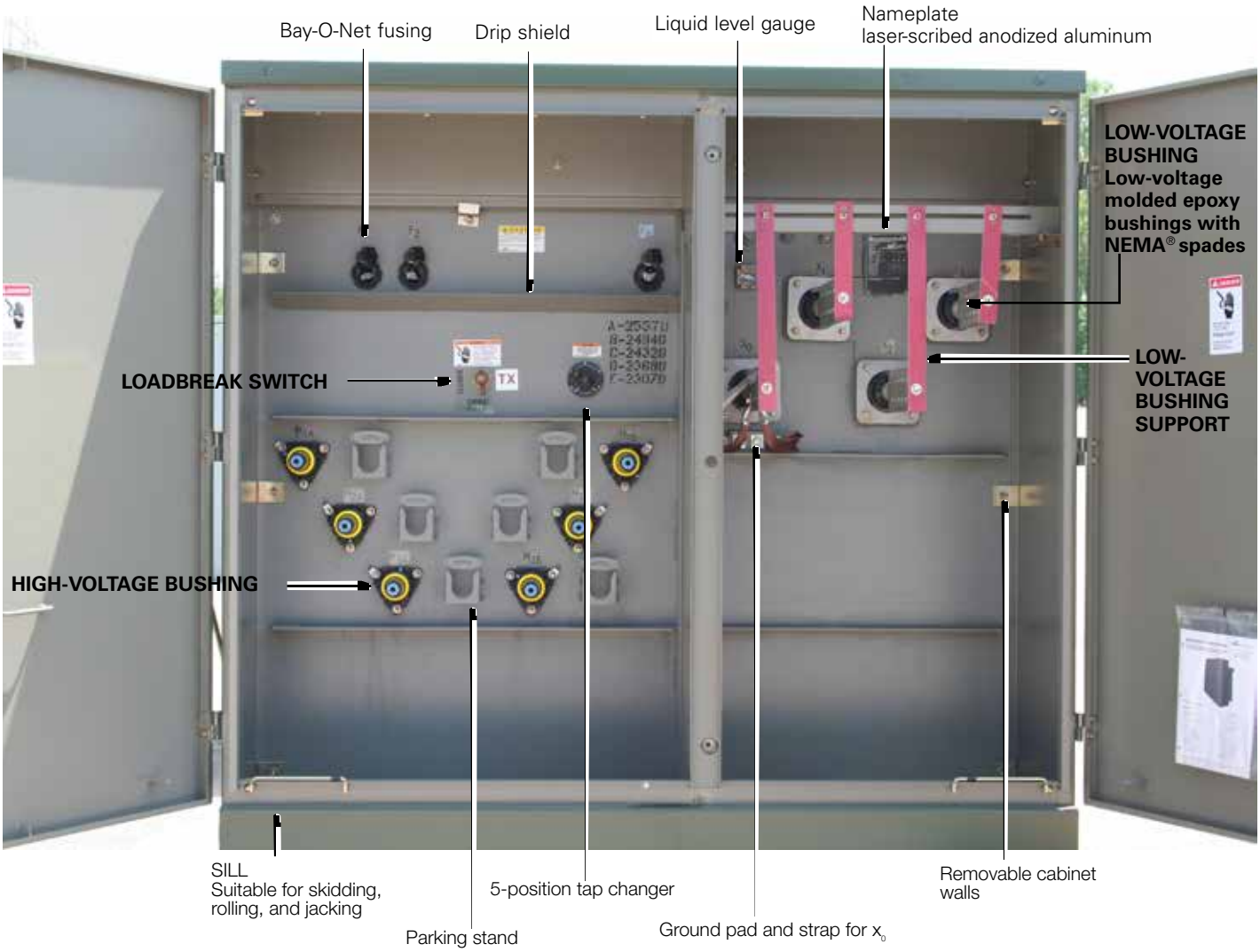


Figure 1. Three-phase pad-mounted compartmental type transformer.

Table 1. Product Scope

Type	Three Phase, 50 or 60 Hz, 65 °C Rise (55 °C, 55/65 °C), 65/75 °C, 75 °C
Fluid Type	Mineral oil or Envirotemp™ FR3™ fluid
Coil Configuration	2-winding or 4-winding or 3-winding (Low-High-Low), 3-winding (Low-Low-High)
Size	45 – 10,000 kVA
Primary Voltage	2,400 – 46,000 V
Secondary Voltage	208Y/120 V to 14,400 V
Specialty Designs	Inverter/Rectifier Bridge
	K-Factor (up to K-19)
	Vacuum Fault Interrupter (VFI)
	UL® Listed & Labeled and Classified
	Factory Mutual (FM) Approved®
	Solar/Wind Designs
	Differential Protection
	Seismic Applications (including OSHPD)
	Hardened Data Center

Table 2. Three-Phase Ratings

Three-Phase 50 or 60 Hz
kVA Available[1]: 45, 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 3750, 5000, 7500, 10000

[1]Transformers are available in the standard ratings and configurations shown or can be customized to meet specific needs.

Table 3. Impedance Voltage

	Low-voltage rating		
Rating (kVA)	**≤ 600 V**	**2400 Δ through 4800 Δ**	**6900 Δ through 13800GY/7970 or 13800 Δ**
45-75	2.70-5.75	2.70-5.75	2.70-5.75
112.5-300	3.10-5.75	3.10-5.75	3.10-5.75
500	4.35-5.75	4.35-5.75	4.35-5.75
750-2500	5.75	5.75	5.75
3750	5.75	5.75	6.00
5000		6.00	6.50

Note: The standard tolerance is ± 7.5%

Table 4. Audible Sound Levels

	NEMA® TR-1 Average
Self-Cooled, Two Winding kVA Rating	**Decibels (dB)**
45-500	56
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001-4000	64
4001-5000	65
5001-6000	66
6001-7500	67
7501-10000	68

Table 5. Insulation Test Levels

KV Class	Induced Test 180 or 400 Hz 7200 Cycle	kV BIL Distribution	Applied Test 60 Hz (kV)
1.2	Twice Rated Voltage	30	10
2.5		45	15
5		60	19
8.7		75	26
15		95	34
25		125	40
34.5		150	50

Table 6. Temperature Rise Ratings 0-3300 Feet (0-1000 meters)

	Standard	Optional
Unit Rating (Temperature Rise Winding)	65 °C	55 °C, 55/65 °C, 75 °C
Ambient Temperature Max	40 °C	50 °C
Ambient Temperature 24 Hour Average	30 °C	40 °C
Temperature Rise Hotspot	80 °C	65 °C

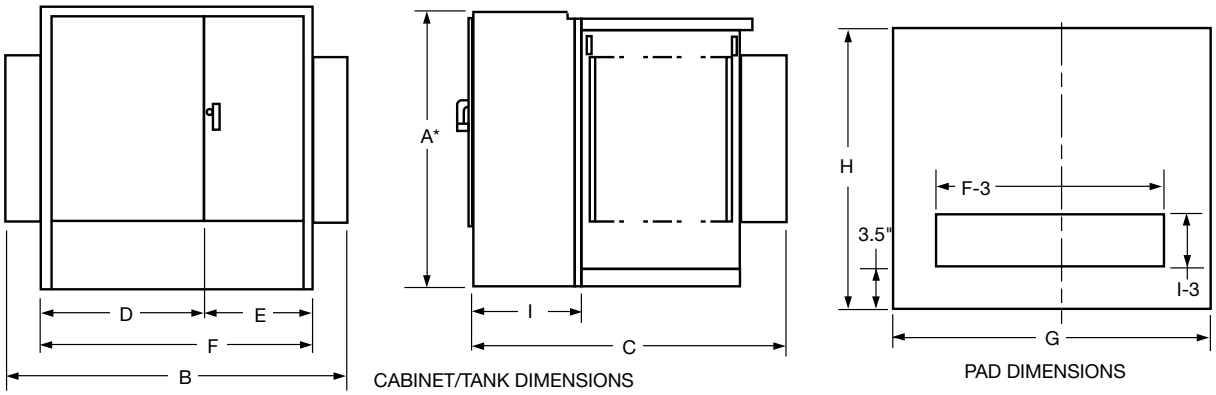


Figure 2. Transformer and pad dimensions.

* Add 9" for Bay-O-Net fusing.

Table 7. Fluid-filled—aluminum windings 55/65 °C Rise[1]

65° Rise	DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—ALUMINUM WINDINGS										
	OUTLINE DIMENSIONS (in.)										
kVA Rating	A*	B	C	D	E	F	G	H	I	Gallons of Fluid	Approx. Total Weight (lbs.)
45	50	68	39	42	26	68	72	43	20	110	2,100
75	50	68	39	42	26	68	72	43	20	115	2,250
112.5	50	68	49	42	26	68	72	53	20	120	2,350
150	50	68	49	42	26	68	72	53	20	125	2,700
225	50	72	51	42	30	72	76	55	20	140	3,150
300	50	72	51	42	30	72	76	55	20	160	3,650
500	50	89	53	42	30	72	93	57	20	190	4,650
750	64	89	57	42	30	72	93	61	20	270	6,500
1000	64	89	59	42	30	72	93	63	20	350	8,200
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	490	12,500
2500	73	72	99	42	30	72	76	103	24	530	14,500
3000	73	84	99	46	37	84	88	103	24	620	16,700
3750	84	85	108	47	38	85	88	112	24	660	19,300
5000	84	96	108	48	48	96	100	112	24	930	25,000
7500	94	102	122	54	48	102	100	126	24	1,580	41,900

1 Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton for exact dimensions.

* Add 9" for Bay-O-Net fusing.

Table 8. Fluid-Filled—Copper Windings 55/65 °C Rise[1]

65° Rise	DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—COPPER WINDINGS										
	OUTLINE DIMENSIONS (in.)										
kVA Rating	A*	B	C	D	E	F	G	H	I	Gallons of Fluid	Approx. Total Weight (lbs.)
45	50	64	39	34	30	64	69	43	20	110	2,100
75	50	64	39	34	30	64	69	43	20	115	2,350
112.5	50	64	49	34	30	64	69	53	20	115	2,500
150	50	64	49	34	30	64	69	53	20	120	2,700
225	50	64	51	34	30	64	73	55	20	140	3,250
300	50	64	51	34	30	64	75	55	20	160	3,800
500	50	81	53	34	30	64	85	57	20	200	4,800
750	64	89	57	42	30	72	93	61	20	255	6,500
1000	64	89	59	42	30	72	93	63	20	300	7,800
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	420	11,600
2500	73	72	99	42	30	72	76	103	24	500	14,000
3000	73	84	99	46	37	84	88	103	24	720	18,700
3750	84	85	108	47	38	85	88	112	24	800	20,500
5000	84	96	108	48	48	96	100	112	24	850	25,000
7500	94	102	122	54	48	102	100	126	24	1,620	46,900

[1] Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton for exact dimensions.

* Add 9" for Bay-O-Net fusing.

Standard features

Connections and neutral configurations

- Delta - Wye: Low voltage neutral shall be a fully insulated X0 bushing with removable ground strap.
- Grounded Wye-Wye: High voltage neutral shall be internally tied to the low voltage neutral and brought out as the H0X0 bushing in the secondary compartment with a removable ground strap.
- Delta-Delta: Transformer shall be provided without a neutral bushing.
- Wye-Wye: High voltage neutral shall be brought out as the H0 bushing in the primary compartment and the low voltage neutral shall be brought as the X0- bushing in the secondary compartment.
- Wye-Delta: High voltage neutral shall be brought out as the H0 bushing in the primary compartment. No ground strap shall be provided (line to line rated fusing is required).

High and low voltage bushings

- 200 A bushing wells (15, 25, and 35 kV)
- 200 A, 35 kV Large Interface
- 600 A (15, 25, and 35 kV) Integral bushings (dead-front)
- Electrical-grade wet-process porcelain bushings (live-front)

Tank/cabinet features

- Bolted cover for tank access (45-2500 kVA)
- Welded cover with hand hole (>2500 kVA)
- Three-point latching door for security
- Removable sill for easy installation
- Lifting lugs (4)
- Stainless steel cabinet hinges and mounting studs
- Steel divider between HV and LV compartment
- 20″ Deep cabinet (45-1000 kVA)
- 24″ Deep cabinet (1500-7500 kVA)
- 30″ Deep cabinet (34.5/19.92 kV)
- Pentahead captive bolt
- Stainless steel 1-hole ground pads (45-500 kVA)
- Stainless steel 2-hole ground pads (750-10,000 kVA)
- Parking Stands (dead-front)

Valves/plugs

- One-inch upper filling plug
- One-inch drain plug (45-500 kVA)
- One-inch combination drain valve with sampling device in low voltage compartment (750-10,000 kVA)
- Automatic pressure relief valve

Nameplate

- Laser-scribed anodized aluminum nameplate

Figure 3. Drain valve with sampler.

Figure 4. Automatic Pressure relief valve.

Figure 5. Liquid level gauge.

Figure 6. External Gauges.

Figure 7. External visible break with gauges.

Optional features

High and low voltage bushings

- 200 A (15, 25 kV) bushing inserts
- 200 A (15, 25 kV) feed thru inserts
- 200 A (15, 25 kV) (HTN) bushing wells with removable studs
- High-voltage 600 A (15, 25, 35 kV) deadbreak one-piece bushings
- Low voltage 6-, 8-holes spade
- Low voltage 12-, 16-, 20-holes spade (750-2500 kVA)
- Low voltage bushing supports

Tank/cabinet features

- Stainless steel tank base and cabinet
- Stainless steel tank base, cabinet sides and sill
- 100% stainless steel unit
- Service entrance (2 inch) in sill or cabinet side
- Touch-up paint (domestic)
- Copper ground bus bar
- Kirk-Key provisions
- Nitrogen blanket
- Bus duct cutout

Special designs

- Factory Mutual (FM)
- UL® Classified
- Triplex
- High altitude
- K-Factors
- Step-up
- Critical application
- Modulation transformers
- Seismic applications (including OSHPD)

Switches

- One, two, or three On/Off loadbreak switches
- 4-position loadbreak V-blade switch or T-blade switch
- Delta-wye switch
- 3-position V-Blade selector switch
- 100 A, 150 A, 300 A tap changers
- Dual voltage switch
- Visible break with VFI interrupter interlock
- External visible break (15, 25, and 35 kV, up to 3 MVA)
- External visible break with gauges (15, 25, and 35 kV, up to 3 MVA)

Gauges and devices

- Liquid level gauge (optional contacts)
- Pressure vacuum gauge (optional contacts and bleeder)
- Dial-type thermometer (optional alarm contacts)
- Cover mounted pressure relief device (optional alarm contacts)
- Ground connectors
- Hexhead captive bolt
- Molded case circuit breaker mounting provisions
- External gauges in padlockable box

Overcurrent protection

- Bay-O-Net fusing (Current sensing, dual sensing, dual element, high amperage overload)
- Bay-O-Net expulsion fuse in series with a partial range under-oil ELSP current limiting fuse (below 23 kV)
- Cartridge fusing in series with a partial range under-oil ELSP current limiting fuse (above 23 kV)
- MagneX™ interrupter with ELSP current-limiting fuse
- Vacuum Fault Interrupter (VFI)
- Visible break window
- Fuse/switch interlock

Valves/plugs

- Drain/sampling valve in high-voltage compartment
- Globe type upper fill valve

Overvoltage protection

- Distribution-, intermediate-, or station-class surge arresters
- Elbow arresters (for dead-front connections)

Metering/fan/control

- Full metering package
- Current Transformers (CTs)
- Metering Socket
- NEMA® 4 control box (optional stainless steel)
- NEMA® 7 control box (explosion proof)
- Fan Packages

Testing

- Customer test witness
- Customer final inspection
- Zero Sequence Impedance Test
- Heat Run Test
- ANSI® Impulse Test
- Audible Sound Level Test
- RIV (Corona) Test
- Dissolved Gas Analysis (DGA) Test
- 8- or 24-Hour Leak Test

Coatings (paint)

- ANSI® Bell Green
- ANSI® #61 Light Gray
- ANSI® #70 Sky Gray
- Special paint available per request

Nameplate

- Stainless steel nameplate

Decals and labels

- High voltage warning signs
- Mr. Ouch
- Bi-lingual warning
- DOE compliant
- Customer stock code
- Customer stenciling
- Shock and arc flash warning decal
- Non-PCB decal

Construction

Core

The three-legged, step-lap mitered core construction is manufactured using a high-quality cutting machine. For maximum efficiency, cores are precisely stacked, virtually eliminating gaps in the corner joints.

Five-legged wound core or shell-type triplex designs are used for wye-wye connected transformers, and other special transformer designs.

Cores are manufactured with precision cut, burr-free, grain-oriented silicon steel or amorphous metal, depending on customer preference or optimal material based upon performance requirements. Many grades of core steel are available for optimizing core loss efficiency.

Coils

Pad-mounted transformers feature a rectangular coil configuration with wire-wound, high-voltage primaries and sheet-wound secondaries. The design minimizes axial stress developed by short circuits and provides for magnetic balancing of tap connections.

Coils are wound using the highest quality winding machines providing exacting tension control and conductor placement for superior short-circuit strength and maximum efficiency.

Extra mechanical strength is provided by diamond pattern, epoxy-coated paper insulation, used throughout the coil, with additional epoxy at heavy stress points. The diamond pattern distribution of the epoxy and carefully arranged ducts, provide a network of passages through which cooling fluid can freely circulate.

Coil assemblies are heat-cured under calculated hydraulic pressure to ensure performance against short-circuit forces.

Core and coil assemblies

Pad-mounted transformer core and coil assemblies are braced with heavy steel ends to prevent the rectangular coil from distorting under short-circuit conditions. Plates are clamped in place using presses, and welded or bolted to form a solid core and coil assembly. Core and coil assemblies exceed ANSI® and IEEE® requirements for short-circuit performance. Due to the rigidity of the design, impedance shift after short-circuit is comparable to that of circular wound assemblies.

Tanks

Transformer tanks are designed for high strength and ease of handling, installation, and maintenance. Tanks are welded using precision-cut, hot rolled, pickled and oiled steel. They are sealed to protect the insulating fluid and other internal components.

Transformer tanks are pressure-tested to withstand 7 psig without permanent distortion and 15 psig without rupture.

Tank finish

An advanced multi-stage finishing process exceeds IEEE Std C57.12.28™-2014 standards. The eight-stage pre-treatment process assures coating adhesion and retards corrosion. It converts tank surfaces to a nonmetallic, water insoluble iron phosphate coating.

The paint method consists of two distinct layers of paint. The first is an epoxy primer (E-coat) layer which provides a barrier against moisture, salt and corrosives. The two-component urethane final coat seals and adds ultraviolet protection.

Vacuum processing

Transformers are dried and filled with filtered insulating fluid under vacuum, while secondary windings are energized. Coils are heated to drive out moisture, ensuring maximum penetration of fluid into the coil insulation system.

Insulating fluid

Eaton's Cooper Power series transformers are available with electrical-grade mineral insulating oil or Envirotemp™ FR3™ fluid. The highly refined fluids are tested and degassed to assure a chemically inert product with minimal acid ions. Special additives minimize oxygen absorption and inhibit oxidation. To ensure high dielectric strength, the fluid is re-tested for dryness and dielectric strength, refiltered, heated, dried, and stored under vacuum before being added to the completed transformer.

Eaton's Cooper Power series transformers filled with Envirotemp™ FR3™ fluid enjoy unique fire safety, environmental, electrical, and chemical advantages, including insulation life extending properties.

A bio-based, sustainable, natural ester dielectric coolant, Envirotemp™ FR3™ fluid quickly and thoroughly biodegrades in the environment and is non-toxic per acute aquatic and oral toxicity tests.

Building for Environmental and Economic Sustainability (BEES) total life cycle assessment software, utilized by the US Dept. of Commerce, reports its overall environmental performance impact score at 1/4th that reported for mineral oil. Envirotemp™ FR3™ fluid has also earned the EPA Environmental Technology Verification of transformer materials.

With a fire point of 360 °C, Envirotemp™ FR3™ fluid is FM Approved® and Underwriters Laboratories (UL®) Classified "Less-Flammable" per NEC® Article 450-23, fitting the definition of a Listed Product per NEC®.

Figure 8. VFI transformer with visible break.

Pad-mounted VFI transformer

Eaton's Cooper Power series VFI transformer combines a conventional distribution transformer with the proven Vacuum Fault Interrupter (VFI). This combination provides both voltage transformation and transformer over current protection in one space saving and money saving package. The pad-mounted VFI transformer protects the transformer and provides proper coordination with upstream protective devices. When a transformer fault or overload condition occurs, the VFI breaker trips and isolates the transformer.

The three-phase VFI breaker has independent single-phase initiation, but is three-phase mechanically gang-tripped. A trip signal on any phase will open all three phases. This feature eliminates single-phasing of three phase loads. It also enables the VFI breaker to be used as a three-phase load break switch.

Due to the resettable characteristics of the VFI breaker, restoring three-phase service is faster and easier.

The sealed visible break window and switch is an option that can be installed to provide visible break contact. This feature provides enhanced safety and allows an operator to see if the loadbreak switch contacts are in an open or closed position before performing

maintenance.

Envirotran™ FM Approved special protection transformer

Eaton's Cooper Power series Envirotran™ transformer is FM Approved and suitable for indoor locations. Factory Mutual Research Corporation's (FMRC) approval of the Envirotran transformer line makes it easy to comply with and verify compliance with Section 450.23, 2008 NEC, Less-Flammable Liquid-Filled Transformer Requirements for both indoor and outdoor locations.

Envirotran FM Approved transformers offer the user the benefit of a transformer that can be easily specified to comply with NEC, and makes FM Safety Data Sheet compliance simpler, while also providing maximum safety and flexibility for both indoor and outdoor installations.

Because the "FM Approved" logo is readily visible on the transformer and its nameplate, NEC compliance is now easily verifiable by the inspector.

Envirotran FM Approved transformers are manufactured under strict compliance with FMRC Standard 3990 and are filled with

FM APPROVED

FM Approved Envirotemp™ FR3™ fluid, a fire-resistant dielectric coolant.

Special application transformers

Data Center transformer

With focus rapidly shifting from simply maximizing uptime and supporting demand to improving energy utilization, the data center industry is continually looking for methods to increase its energy efficiency and reliability. Utilizing cutting edge technology, Eaton's Cooper Power series Hardened Data Center (HDC) transformers are the solution. Designed with special attention given to surge protection, HDC liquid-filled transformers provide superior performance under the harshest electrical environments. Contrary to traditional dry-type units, HDC transformers provide unsurpassed reliability, overloadability, operational life, efficiency, thermal loading and installed footprint. These units have reliably served more than 100 MW of critical data center capacity for a total of more than 6,000,000 hours without any reported downtime caused by a thermal or short-circuit coil failure.

The top priority in data center operations is uninterrupted service. Envirotran HDC transformers from Eaton, having substantially higher levels of insulation, are less susceptible to voltage surges. Eaton has experienced zero failures due to switching transients. The ANSI® and IEEE® standard impulse withstand ratings are higher for liquid-filled transformers, making them less susceptible to insulation failure. The Envirotran HDC transformer provides ultimate protection by increasing the BIL rating one level higher than standard liquid-filled transformer ratings. The cooling system of liquid-filled transformers provides better protection from severe overloads—overloads that can lead to significant loss of life or failure.

Data center design typically includes multiple layers of redundancy, ensuring maximum uptime for the critical IT load. When best in class transformer manufacturing lead times are typically weeks, not days, an unexpected transformer failure will adversely affect the facility's reliability and profitability. Therefore, the ability to determine the electrical and mechanical health of a transformer can reduce the probability of costly, unplanned downtime. Routine diagnostic tests, including key fluid properties and dissolved gas analysis (DGA), can help determine the health of a liquid-filled transformer. Although sampling is not required for safe operation, it will provide the user with valuable information, leading to scheduled repair or replacement, and minimizing the duration and expense of an outage. With a dry-type transformer, there is no reliable way to measure the health or likelihood of an impending failure.

Solar transformer

As a result of the increasing number of states that are adopting aggressive Renewable & Alternative Energy Portfolio Standards, the solar energy market is growing—nearly doubling year over year. Eaton, a key innovator and supplier in this expanding market, is proud to offer its Cooper Power series Envirotran transformers specifically designed for Solar Photovoltaic medium-voltage applications. Eaton is working with top solar photovoltaic developers, integrators and inverter manufacturers to evolve the industry and change the way we distribute power.

In accordance with this progressive stance, every Envirotran Solar transformer is filled with non-toxic, biodegradable Envirotemp™ FR3™ dielectric fluid, made from renewable seed oils. On top of its biodegradability, Envirotemp™ FR3™ fluid substantially extends the life of the transformer insulation, saving valuable resources. What better way to distribute green power than to use a green transformer. In fact, delaying conversion to Envirotran transformers places the burden of today's environmental issues onto tomorrow's generations. Eaton can help you create a customized transformer, based on site specific characteristics including: temperature profile, site altitude, solar profile and required system life. Some of the benefits gained from this custom rating include:

- Reduction in core losses
- Improved payback on investment
- Reduction in footprint
- Improved fire safety
- Reduced environmental impact

For the solar photovoltaic industry, Eaton is offering standard step up transformers and dual secondary designs, including 4-winding, 3-winding (Low-High-Low) and 3-winding (Low-Low-High) designs.

Wind transformer

Eaton is offering custom designs for renewable energy power generation. Eaton manufactures its Cooper Power series Generator Step-Up (GSU) transformers for installation at the base of every wind turbine. Additionally, grounding transformers are available for wind power generation.

DOE efficiency

The United States Department of Energy (DOE) has mandated efficiency values for most liquid type, medium voltage transformers. As a result, all applicable Eaton's Cooper Power series transformers 2500 kVA and below conform to efficiency levels as specified in the DOE ruling "10 CFR Part 431 Energy Conservation Program".

Underwriters Laboratories® (UL®) Listed and Labeled/ Classified

The Envirotran transformer from Eaton can be specified as UL® Listed & Labeled, and/or UL® Classified. Underwriters Laboratories (UL®) listing is a verification of the design and construction of the transformer to the ANSI® and IEEE® standards. UL® listing generally is the most efficient, cost-effective solution for complying with relevant state and local electrical codes. UL® Combination Classification/Listing is another way in which to comply with Section 450.23, 2008 NEC® requirements. This combines the UL® listed transformer with a UL® Classified Less-Flammable Liquid and complies with the use restrictions found within the liquid Classification.

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K-Factor transformer

With a drastic increase in the use of ferromagnetic devices, arcing devices, and electric power converters, higher frequency loads have increased significantly. This harmonic loading has the potential to generate higher heat levels within a transformer's windings and leads by as much as 300%. Harmonic loading has the potential to induce premature failure in standard-design distribution transformers.

In addition to standard UL® "K-Factor" ratings, transformers can be designed to customer-provided specifications detailing precise loading scenarios. Onsite measurements of magnitude and frequency, alongside harmonic analysis of the connected load can be performed by Eaton engineers or a third party consultant. These field measurements are used to determine exact customer needs and outline the transformer specifications.

Eaton will design harmonic-resistant transformers that will be subjected to the unique harmonic loads. These units are designed to maintain normal temperature rise under harmonic, full-load conditions. Standard UL® "K-Factor" designs can result in unnecessary costs when the "next-highest" K-Factor must be selected for a calculated design factor. To save the customer these unnecessary costs, Eaton can design the transformer to the specific harmonic spectrum used in the application. Eaton's Cooper Power series K-factor transformers are filled with mineral oil or Envirotemp™ FR3™ fluid and enjoy the added benefits of dielectric cooling such as higher efficiencies than dry-type transformers.

Modulation transformer

Bundled with an Outboard Modulation Unit (OMU) and a Control and Receiving Unit (CRU), a Modulation Transformer Unit (MTU) is designed to remotely achieve two way communication.

The use of an MTU reduces travel time and expense versus traditional meter reading performed by high voltage electricians. Additionally, with MTU it is possible to manage and evaluate energy consumption data, providing reduced metering costs and fewer tenant complaints.

An MTU utilizes existing utility infrastructure, therefore eliminating the need to engineer and construct a dedicated communication network.

Figure 9. Modular transformer.

Inverter/rectifier bridge

Eaton complements its range of applications for transformers by offering dual winding designs. These designs are intended for connection to 12-pulse rectifier bridges.

Product attributes

To set us apart from other transformer manufactures, Eaton includes the following guarantees with every three-phase pad-mounted transformer.

Engineered to order (ETO)

Providing the customer with a well developed, cost-effective solution is the number one priority at Eaton. Using customer specifications, Eaton will work with the customer from the beginning to the end to develop a solution to fit their needs. Whether it is application specific, site specific, or a uniquely specified unit, Eaton will provide transformers with the best in class value and performance, saving the customer time and money.

Made in the U.S.A.

Eaton's three-phase pad-mounted transformers are produced right here in the United States of America. Our manufacturing facilities are positioned strategically for rapid shipment of products. Furthermore, should the need arise, Eaton has a broad network of authorized service repair shops throughout the United States.

Superior paint performance

Protecting transformers from nature's elements worldwide, Eaton's E-coat system provides unrivaled transformer paint life, and exceeds IEEE Std C57.12.28™-2014 and IEEE Std C57.12.29™-2005 standards. In addition to the outside of the unit, each transformer receives a gray E-coat covering in the interior of the tank and cabinet, providing superior rust resistance and greater visibility during service.

If the wide range of standard paint selections does not suit the customer's needs, Eaton will customize the paint color to meet their requirements.

Rectangular coil design

Eaton utilizes a rectangular coil design. This winding technique results in a smaller overall unit footprint as well as reducing the transformer weight. The smaller unit size does not hinder the transformer performance in the least. Units have proven short circuit withstand capabilities up to 10 MVA.

Testing

Eaton performs routing testing on each transformer manufactured including the following tests:

- Insulation Power Factor: This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- Ratio, Polarity, and Phase Relation: Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- Resistance: This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- Routine Impulse Tests: The most severe test, simulating a lightning surge. Applies one reduced wave and one full wave to verify the BIL rating.
- Applied Potential: Applied to both high-voltage and low-voltage windings, this test stresses the entire insulation system to verify all live-to-ground clearances.
- Induced Potential: 3.46 times normal plus 1000 volts for reduced neutral designs.
- Loss Test: These design verification tests are conducted to assure that guaranteed loss values are met and that test values are

within design tolerances. Tests include no-load loss and excitation current along with impedance voltage and load loss.

- Leak Test: Pressurizing the tank to 7 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or fluid oxidation.

Design performance tests

The design performance tests include the following:

- Temperature Rise: Our automated heat run facility ensures that any design changes meet ANSI® and IEEE® temperature rise criteria.
- Audible Sound Level: Ensures compliance with NEMA® requirements.
- Lightning Impulse: To assure superior dielectric performance, this test consists of one reduced wave, two chopped waves and one full wave in sequence, precisely simulating the harshest conditions.

Thomas A Edison Research and Test Facility

We are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality transformer for the lowest cost. Eaton's Cooper Power series Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. We have invested millions of dollars in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin affirming our dedication to introducing new innovations and technologies to the transformer industry. This research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.

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For Eaton's Cooper Power series three-phase transformer product information call 1-877-277-4636 or visit: www.eaton.com/cooperpowerseries.

Powering Business Worldwide

SPCC 40CFR112.7 and 8

USDA Bulletin 1724E-302, Chapter 3-3.2.2 and 3.2.3

IEEE STD. 980

- spcc compliant solution
- engineered for your specific needs
- minimizes risk to your investment & reputation

C.I.Agent® Geomembrane Liner Solution

Geomembrane Liner System with Oil Filtration Panels. A geotextile is placed over the vinyl to protect it.

Geomembrane Liner System with Oil Filtration Panels uses HDPE corrugated pipe to accommodate a smaller footprint.

Retrofitting an old cracked concrete containment with C.I.Agent Geomembrane saved the customer time and money.

PRODUCT DESCRIPTION:

The C.I.Agent® Geomembrane Liner with Oil Filtration Panels System is site-specific engineered secondary containment for hydrocarbon filtration in sandy or undetermined subsoils. The system allows storm water to flow through the C.I.Agent Oil Filtration Panels to remove and capture hydrocarbons. The Oil Filtration Panels are constructed from non-woven geo-textile material filled with patented C.I.Agent® Agent-Q*, a unique filtration media capable of preventing penetration of oil and petroleum products while allowing a high water flow rate. In the event of a large spill, the C.I.Agent polymers in the panels completely solidify to shut down the flow and contain the hydrocarbons, keeping them from escaping the site.

The C.I.Agent Geomembrane Liner with Oil Filtration Panels ship in sections, each marked to correspond to a site map, for easy assembly in the field. It comes with pre-formed corners for height consistency and the C.I.Agent Oil Filtration Panels are pre-bonded to the Geomembrane Liner. Shipment includes all the products necessary for the installation. Depending on the size of the site and the completion of site preparation, most installs can be completed in one or two days.

PRODUCT APPLICATIONS:

- The C.I.Agent® Geomembrane Liner installs quickly and is perfect for secondary containment of substations, tank storage, wind farms and solar fields
- For a smaller footprint, HDPE corrugated pipes can be used with the Geomembrane Liner System, either with or without the Oil Filtration Panels, reducing the excavation time, labor and material costs
- The C.I.Agent Geomembrane Liner can be used to line chipped or cracked concrete containment reducing the cost of repair or replacement
- The C.I.Agent Geomembrane Liner can be used with fabricated or composite wall systems to prevent leaks
- The vinyl liner can be either 22 oz. or 40 oz.

OIL FILTRATION PANEL PERFORMANCE SPECIFICATIONS:

- Water flow rate: Minimum 4 GPM per ft^2 of material with one foot head pressure
- Hydrocarbon flow rate: 0 GPM (100%+ containment)
- Solidifies approximately a half gallon of oil per ft^2 depending on type of oil, viscosity, and temperature
- Service life of installed product: Life of equipment it protects
- UV resistance of 70% (typically covered with clean stone)
- Oxidation resistance of 80%

***U.S.Patent No. 8,986,82**

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C.I.Agent® Geomembrane Liner Solution

Enhancement Solutions

C.I.Agent® HFF Oil Stop Valve

A C.I.Agent® HFF Oil Stop Valve can be used with our Geomembrane Liner System, concrete or fabricated secondary containment. A drain inside the containment area directs water to an adjacent vault containing the HFF to process organic hydrocarbons out of the water.

C.I.Agent® VIPOR Pump

The C.I.Agent® VIPOR Pump uses proven C.I.Agent® containment technology to provide a safe and ensured compliant discharge from an application where an automatic sump pump is desired.

C.I.Agent® Hydrocarbon Detection Strips

An easy-to-use tool for testing the presence of hydrocarbons in discharge water.

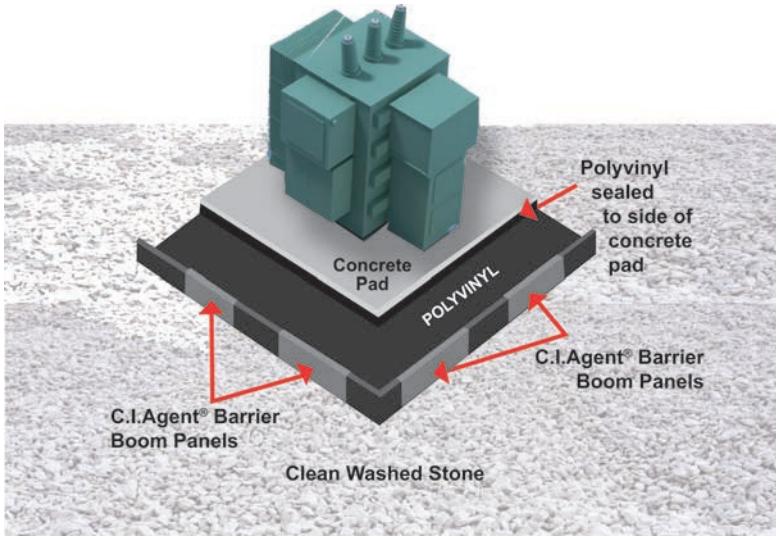
BENEFITS:

- Evacuates waste water without valves, pumps, sumps or oil-water separators
- A bury and forget application
- Cost-effective solution for Secondary Spill Containment
- Custom made for site-specific application
- C.I.Agent® Geomembrane Liner and Oil Filtration Panels Containment Systems can be installed in one or two days (depending on size of install)
- Equipment can remain energized during installation
- The C.I.Agent Geomembrane Liner and Oil Friltration Panel Window Containment Systems are made in the U.S.A., pre-fabricated at the factory, and assembled on site
- C.I.Agent Geomembrane Liner and Oil Filtration Containment Systems are backed by a $7 Million Product and Enviromental Insurance Policy when installed according to the manufacturer's specifications and documented with photographs
- The C.I.Agent Geomembrane Liner and Oil Filtration Panel Containment System comes complete with all the supplies needed for installation

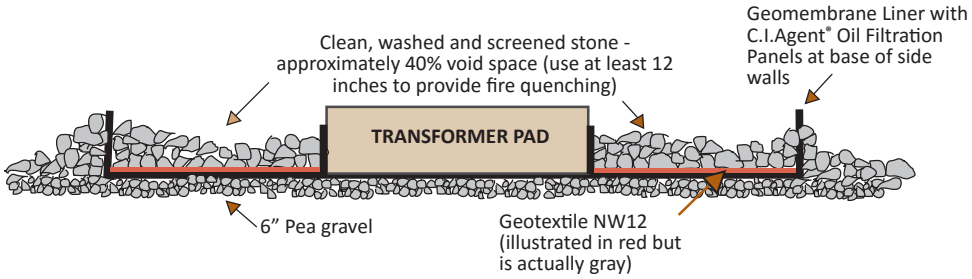
NOTE:

C.I.Agent Solutions recommends laying a bed of washed pea stone (at least six inches) to provide a leach bed. It is recommended that a geotextile fabric be laid over the vinyl before covering with clean, washed and screened stone, size 0.75" to 1.5", to prevent punctures in the vinyl during drive-overs.

TOP VIEW: Typical Example



SIDE VIEW: Typical Example



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Appendix B: Freshwater Wetland Delineation Assessment

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Natural Resource Services, Inc.

Report of Findings for Freshwater Wetland Delineation

15 and 35 Frontier Road
A.P. 7, Lots 62, 62A and 63
Hopkinton, Rhode Island

Prepared for:

Ralph Palumbo
Southern Sky Renewable Energy
117 Metro Center Boulevard, Suite 2007
Warwick, RI 02886

Report (NRS File No. 19-301) Prepared by:

Scott P. Rabideau, PWS
Principal

September 10, 2019

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Introduction

Natural Resource Services, Inc. (NRS) has completed its freshwater wetland delineations within the above-referenced parcels. This field work was performed in accordance with the delineation standards outlined in Appendix 2 of the Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act (250 RICR 150-15-1). Section 1.8(C)(4) of the wetland regulations states that all delineations performed by wetland consultants, including NRS, are not considered valid for regulatory purposes until the work is reviewed and approved by the RI Department of Environmental Management, Office of Water Resources (DEM, OWR).

NRS staff biologist Edward J. Avizinis, CPSS, PWS completed this field work on September 3, 2019. The regulatory section of this report will detail the classification of each wetland and the jurisdictional limits that may be applied to these features under the regulations.

Geographic Information System (GIS) graphics are included as appendices to this report. Wetland features were GPS located using a Trimble GeoXH 6000 handheld unit. GPS data has been overlain onto an accompanying GIS graphic for reference. Although this is not to be considered a survey, it is a reasonable approximation of the resource areas for preliminary planning purposes.

This report has been prepared in fulfillment of your authorization to proceed. Do not hesitate to contact NRS if you have any questions or if you require additional copies of this report.

Existing Conditions

The tax assessor's database for the Town of Hopkinton lists the subject parcels as having a combined area of approximately 64.09 acres. The properties feature existing residential structures which, according to the database, date back to 1938 (Lot 62), 2005 (Lot 62A) and 1970 (Lot 63) in the approximate years of their construction. A number of land uses and cover types span the subject lots, including developed land, open fields and forested upland and wetland areas. The forested upland areas are generally comprised of red oak (*Quercus rubra*), white oak (*Quercus alba*), red maple (*Acer rubrum*), sweet pepperbush (*Clethra alnifolia*), mountain laurel (*Kalmia latifolia*), sassafras (*Sassafras albidum*), cinnamon fern (*Osmundastrum cinnamomeum*), New York fern (*Thelypteris noveboracensis*) and greenbrier (*Smilax rotundifolia*), among other species.

Multiple regulated resource areas are located within and adjacent to the subject lots. These features include swamps, an intermittent stream and an area subject to storm flowage (ASSF). The forested swamps are generally vegetated with red maple (*Acer rubrum*), red oak (*Quercus rubra*), sweet pepperbush (*Clethra alnifolia*), winterberry (*Ilex verticillata*), black tupelo (*Nyssa sylvatica*), cinnamon fern (*Osmundastrum cinnamomeum*), greenbrier (*Smilax rotundifolia*), mountain laurel (*Kalmia latifolia*) and highbush blueberry (*Vaccinium corymbosum*), among other species.

In addition to the wetlands delineated on-site and described throughout this report, NRS identified an off-site forested wetland associated with the aforementioned stream. Additionally, there is a portion of the B-series swamp described below which extends along the ASSF.

Soil Conditions

The Rhode Island Soil Survey (2018) approximates multiple soil series within the subject lots. Soil units mapped within these areas include the Ridgebury, Whitman, and Leicester extremely stony fine sandy loams, the Canton-Charlton-Rock outcrop complex, the Canton and Charlton fine sandy loams, the Canton and Charlton extremely stony fine sandy loams, the Woodbridge very stony fine sandy loam and the Udorthents-Urban land complex. Of these map units, the Ridgebury, Whitman, and Leicester series is recognized as a hydric soil that is generally supportive of wetland features. The NRS findings were fairly consistent with the approximations of the soil survey.

Wetland Delineations

NRS has established and GPS located two (2) delineation flag series within the subject property. The regulations do not require the delineation of streams for regulatory purposes. Instead, the intermittent stream will need to be survey located and accurately plotted on all site plans. NRS has approximated the centerline of both the stream and the ASSF on the accompanying graphic for preliminary planning purposes.

Flagging labeled A1 – A72 and B1 – B44 depict the boundary of swamps. Each swamp receives a regulatory setback in the form of a 50-foot perimeter wetland.

Jurisdictional Limits

The following table depicts each NRS flag series in relation to its classification under the DEM's freshwater wetland regulations as well as any additional jurisdictional limits that may be required.

NRS Flag Series	DEM Classification	Jurisdictional Limit
A1 – A72	Swamp	50 ft. Perimeter Wetland
B1 – B44	Swamp	50 ft. Perimeter Wetland
Not Flagged	Intermittent Stream	100 ft. Riverbank Wetland
Not Flagged	ASSF	None

The A- and B-series swamp each receive a 50-foot perimeter wetland. Intermittent streams receive riverbank wetlands based on the mean width of the watercourse. As this watercourse is less than ten (10) feet in average width, it receives a 100-foot riverbank wetland. No additional jurisdictional limits are applied to the ASSF.

It is important to note that perimeter and riverbank wetlands are considered to be regulated resource areas and not simple buffer zones. Any work that is contemplated within the wetlands or their additional jurisdictional limits shall require approval in the form of a permit from the DEM, OWR.

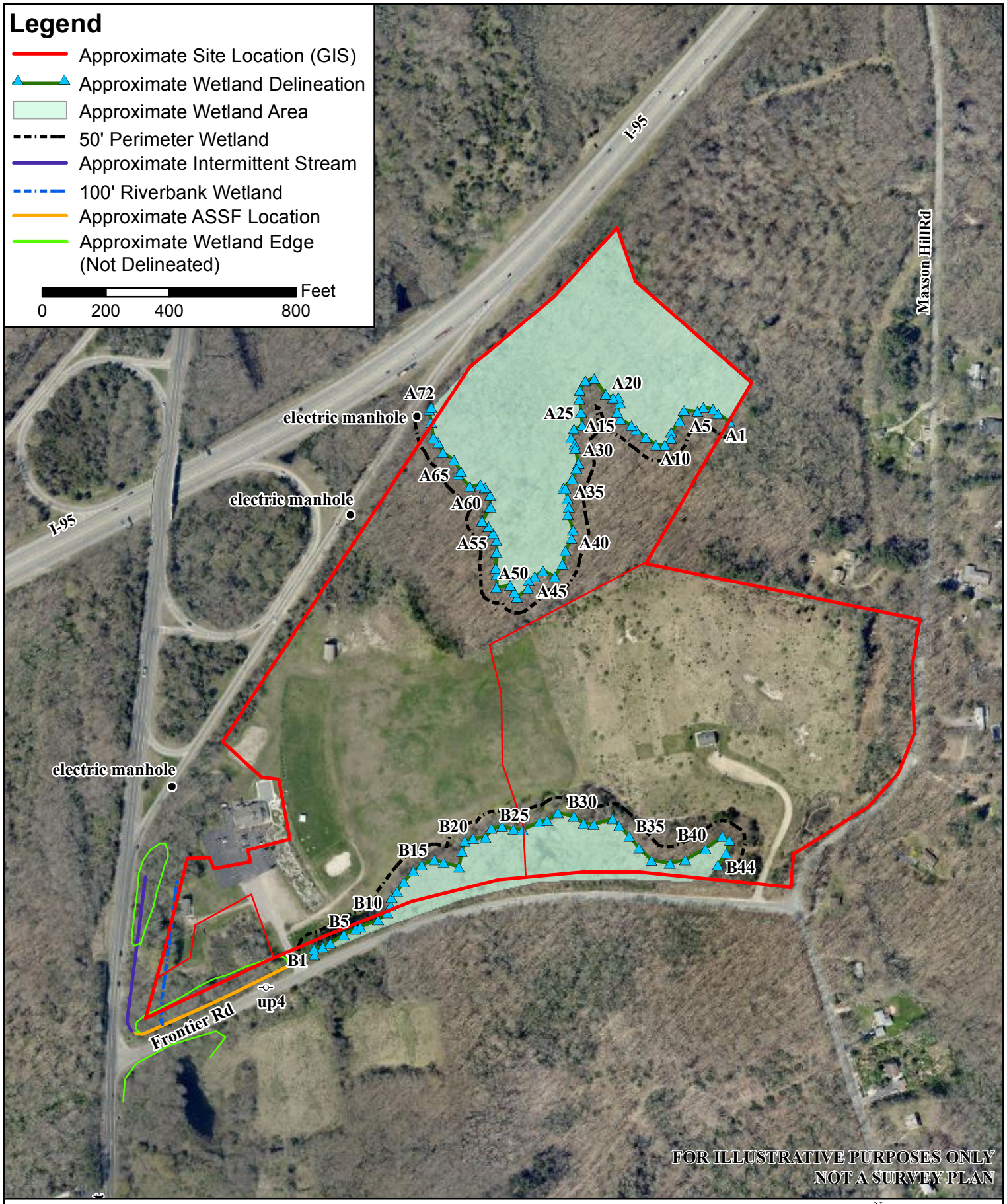
Summation

This report has been prepared to describe the field work performed by NRS. There are multiple regulated resource areas within the subject lots, including swamps, an intermittent stream and an ASSF. These features receive additional jurisdictional limits as tabulated in the preceding section of this report. Any work proposed within these regulatory setbacks shall require a permit from the DEM, OWR.

It is also important to note that a new state freshwater wetlands law was enacted in July of 2015. This law made changes to the jurisdictional limits currently utilized in the regulations. The DEM, OWR is writing new regulations which will require buffer zones for all freshwater wetlands. While a comprehensive timeline has not been established for the enactment of these rules, it is anticipated that they will be in effect at some point in 2020. If you submit an application prior to the promulgation of these rules, your project would then be grandfathered under the current setback standards.

Please do not hesitate to contact NRS if you have any questions or if you require elaboration on the findings of this report.

Appendix



Site Sketch Depicting Approximate Wetland Delineation
15 & 35 Frontier Rd
A.P. 7, Lots 62, 62A & 63

Hopkinton, RI

Performed by
Edward J. Avizinis, PWS, CPSS - 9/3/19
Located using hand-held Trimble GeoXH

N W E S

April 2019 aerial
RI DEM Mapping

RIGIS
Natural Resource Services, Inc.
PO Box 311
180 Tinkham Lane
Harrisville, RI 02830
p: (401) 568-7390
f: (401) 568-7490

(c) RIGIS

USDA Soil Survey Map
15 & 35 Frontier Rd
A.P. 7, Lots 62, 62A & 63

Hopkinton, RI

Approximate Site Location

0 200 400 800 Feet

N W E S

RIGIS

April 2019 aerial
RI DEM Mapping

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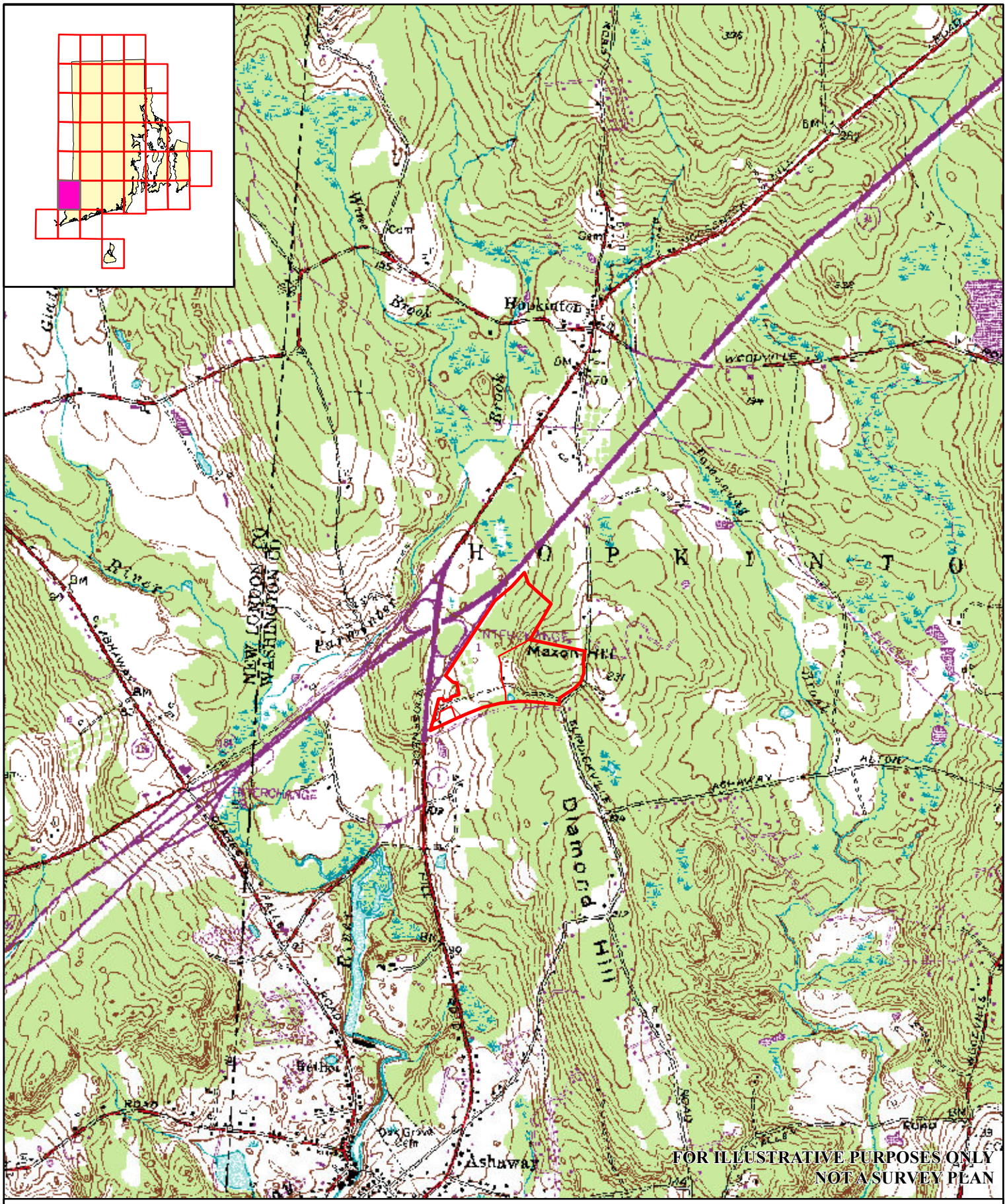

USGS Topographic Map
15 & 35 Frontier Rd
A.P. 7, Lots 62, 62A & 63

Hopkinton, RI
Ashaway Quad Map

Approximate Site Location

USGS Topographic Series
Contour Interval 10 Feet
National Geodetic Vertical Datum of 1929

0 1,000 2,000 4,000 Feet

N W E S

RIGIS
Natural Resource Services, Inc.
PO Box 311
180 Tinkham Lane
Harrisville, RI 02830
p: (401) 568-7390
f: (401) 568-7490
(c) RIGIS

Wetland Edge Delineation Data Form (Wetland)

Applicant:
Project: 15 & 35 Frontier Road
City/Town: Hopkinton, RI

Wetland No.: 1
Flag No. Sequence: A1 – A72
Date: September 3, 2019

Vegetation: List the three dominant species in each vegetative strata along with their NWI status.

Tree	Indicator Status	Herbs	Indicator Status
1. *Acer rubrum*	FAC	1. *Osmundastrum cinnamomeum*	FACW
2. *Quercus rubra*	FACU	2.	
3. *Nyssa sylvatica*	FAC	3.	
Saplings/Shrubs		**Woody Vines**	
1. *Vaccinium corymbosum*	FACW	1. *Smilax rotundifolia*	FAC
2. *Clethra alnifolia*	FAC	2.	
3. *Ilex verticillata*	FACW	3.	

List other vegetative species noted which may have affected determination of the wetland edge: *Kalmia latifolia* (FACU)

Soil: SCS Soil Survey Mapping Unit: Rf
On Hydric Soils List (Y / N) Y

Soil Profile: (Note wetland flag no. nearest soil test pit): A55

Horizon	Depth	Matrix Color	Mottling Description	Depth to Saturation	Depth to Free Water
Oe	0-3”	-	-	-	-
Ap	3-9”	10YR 3/1	-	-	-
Bg	9-18”	10YR 5/2	c: 10YR 5/8 d: 10YR 6/1	-	-
-	-	-	-	-	-

Other indicators of wetland hydrology (eg. water marks, drainage patterns, root Rhizospheres, etc:
Landscape Position: Drainageway/footslope
Altered / atypical situation? (describe)
Comments:

Wetland Edge Delineation Data Form (Upland)

Applicant:
Project: 15 & 35 Frontier Road
City/Town: Hopkinton, RI

Wetland No.: 1
Flag No. Sequence: A1 – A72
Date: September 3, 2019

Vegetation: List the three dominant species in each vegetative strata along with their NWI status.

Tree	Indicator Status	Herbs	Indicator Status
1. *Quercus alba*	FACU	1. *Osmundastrum cinnamomeum*	FACW
2. *Quercus rubra*	FACU	2. *Thelypteris noveboracensis*	FAC
3. *Acer rubrum*	FAC	3.	
Saplings/Shrubs		**Woody Vines**	
1. *Clethra alnifolia*	FACU	1. *Smilax rotundifolia*	FAC
2. *Kalmia latifolia*	FACU	2.	
3.		3.	

List other vegetative species noted which may have affected determination of the wetland edge: *Sassafras albidum* (FACU)

Soil: SCS Soil Survey Mapping Unit: CdB
On Hydric Soils List (Y / N) N

Soil Profile: (Note wetland flag no. nearest soil test pit): A55

Horizon	Depth	Matrix Color	Mottling Description	Depth to Saturation	Depth to Free Water
Oe	0-2”	-	-	-	-
Ap	2-6”	10YR 3/1	-	-	-
Bw	6-18”	10YR 4/6	-	-	-
-	-	-	-	-	-

Other indicators of wetland hydrology (eg. water marks, drainage patterns, root Rhizospheres, etc.): _____
Landscape Position: Footslope
Altered / atypical situation? (describe)_____
Comments:_____

Appendix C: Pre-Construction Noise Assessment

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SAGE
ENVIRONMENTAL

January 31, 2019

Mr. Ralph Palumbo
Revity Energy
117 Metro Center Boulevard, Suite 1007
Warwick, RI 02886
Sent via email to: Ralph@RevityEnergy.com

RE: Pre-Installation Noise Assessment
A Proposed Solar Farm Development
Frontier Road (AP: 7, Lots: 62, 62A and 63)
Hopkinton, Rhode Island
SAGE Project No. M896

Dear Mr. Palumbo:

This correspondence presents the findings of a noise assessment for the proposed installation of a 15.125-megawatt (AC) solar development by Revity Energy, LLC in the Town of Hopkinton, Rhode Island referred to as Frontier Road Solar located at Assessor's Plat 7 Lots 62, 62A and 63. The pre-installation noise assessment estimates the sound emitted from 64 inverters and 5 transformers that are part of the proposed Frontier Road Solar development. The proposed project groups the inverters and transformers into "islands", such that there are 5 islands located at the site. Two islands consist of 1 transformer and 13 inverters, two islands consist of 1 transformer and 16 inverters and one island consists of 1 transformer and 6 inverters. **Attachment 1** provides a map displaying the location of the "islands" and the closest distance (in feet) to the property line.

The Town of Hopkinton's Non-Residential Photovoltaic Solar Energy System Ordinance (dated January 22, 2019) states that noise levels from the Photovoltaic Solar Energy Systems (PSES) cannot exceed 40 dB at the property line. **Attachment 2** provides a map displaying the total sound emitted from each inverter and transformer (i.e. 69 sound emitting objects) for the Frontier Road solar development study area. This assessment notes that sound emitted from the proposed project does not exceed 40 dB at any location along the property line, which is comparable to a computer/quite urban nighttime. The pink dashed line displayed in **Attachment 2** figure represents the 40 dB contour, meaning that any area past the dashed line would experience sounds emitted from the solar equipment that is below 40 dB.

Note that this assessment used representative noise data for the inverters that will be located on the Site, as actual noise data for the inverters was not available. This noise assessment will be reassessed when actual noise data for the inverters become available. If during this reassessment it is found that noise emitted would cause an exceedance of 40 dB at the property line, noise barriers will be evaluated and incorporated into the reassessment to reduce the sound levels such that they are less than 40 dB at the property line.

Table 1 provides common noise sources and the associated decibel (dB) sound level, for example sounds below 40 dB would be comparable to ambient wilderness or a quiet suburban nighttime.

Table 1
Common Sounds with Associated Decibel (dB) Levels

Min (dB)	Max (dB)	Description
20	25	rustling leaves
25	30	quiet rural nighttime
30	35	whisper
35	40	ambient wilderness/quiet suburban nighttime
40	45	computer/quite urban nighttime
45	50	birds/light traffic
50	55	fan/campfire
55	60	refrigerator/dishwasher
60	65	typical conversation/ air conditioner
65	70	vacuum cleaner
70	75	busy traffic/noisy urban area
75	80	leaf blower/garbage disposal
80	85	kitchen blender
85	120	motorcycle/MRI machine

Source: Berger, Elliott H., Rick Neitzel, and Cynthia A. Kladden. Noise Navigator Sound Level Database. 3M Personal Safety Division, E•A•RCAL Laboratory, Univ. of Michigan, Dept. of Environmental Health Science, 26 June 2015. Version 1.8.
Fox, Sarinne. "Noise Level Chart." Noise Help. N.p., 2017. Web. 2018.
Technical Noise Supplement (TeNS), California Department of Transportation, November 2009

The sound calculations performed assume a "conservative" evaluation relative to noise propagation, such that the spread of sound was spread equally in all directions in a free field (i.e. no obstruction). It is likely that the combination of environmental (e.g. trees and shrubs) and site-specific features will serve to dampen additive noise levels.

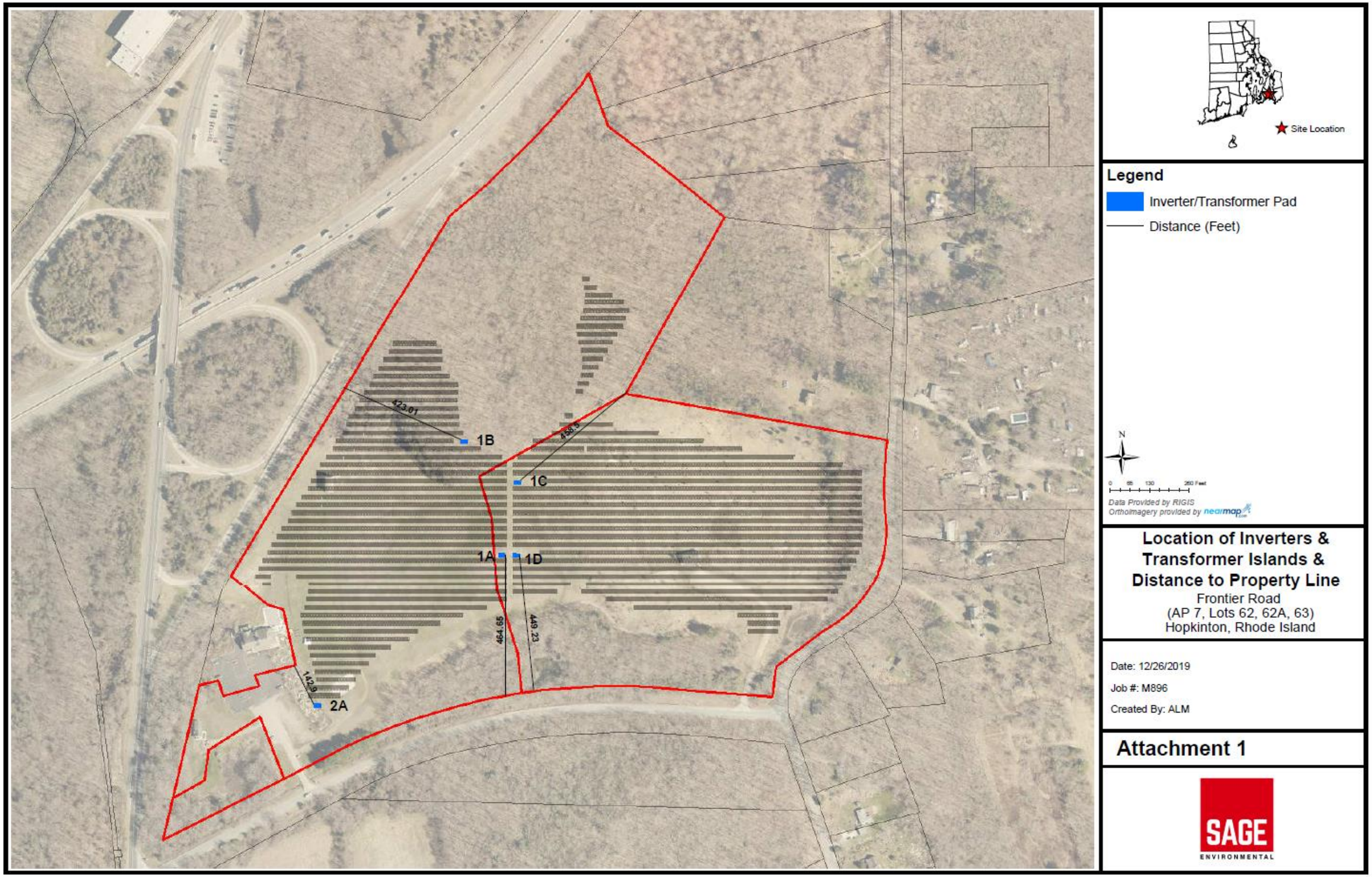
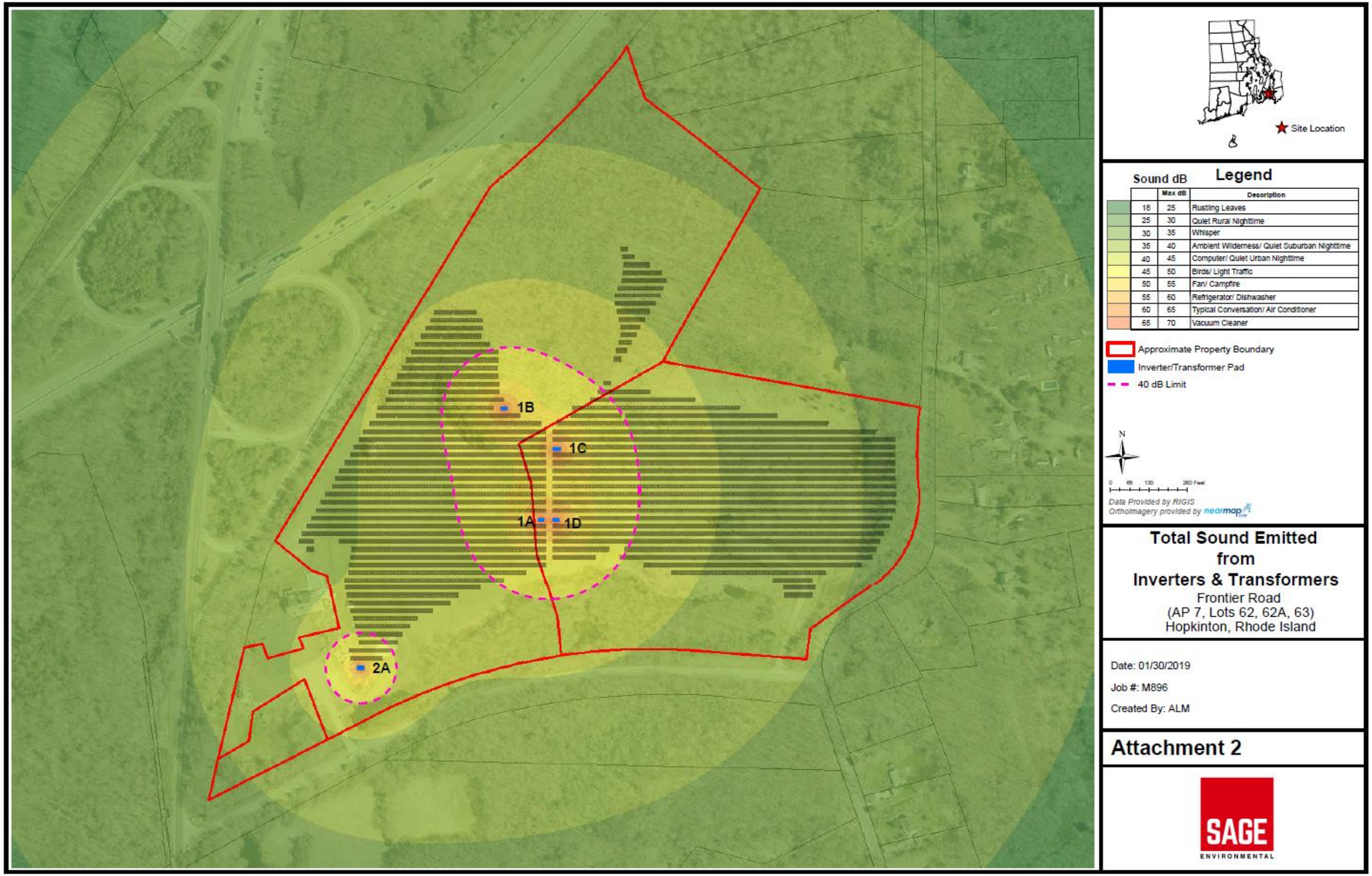
Should you have any questions or concerns, please do not hesitate to contact me.

Sincerely,
SAGE Environmental, Inc.

Nicole Mulanaphy, P.E.
Senior Project Manager
Attachments:

Attachment 1: Location of Inverters and Transformer Islands and Distance to Property Line
Attachment 2: Total Sound Emitted from Each Inverter and Transformer

Attachment 1: Location of Inverters and Transformer Islands and Distance to Property Line



Attachment 2: Total Sound Emitted from Inverters and Transformers