RE SMITHS FALLS 1 SOLAR PROJECT

Noise Assessment Study

July 8, 2011

RECURRENT ENERGY

RE Smiths Falls 1 ULC

Noise Assessment Study

RE Smiths Falls 1 Solar Project

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Rev. 1
July 8, 2011

Project Report

July 8, 2011

RE Smiths Falls 1 ULC
RE Smiths Falls 1 Solar Project

Noise Assessment Study

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Executive Summary

This report presents the results of the noise assessment study required for Solar Facilities under O. Reg. 359/09, as part of the Renewable Energy Approval Process (REA).

RE Smiths Falls 1 ULC has retained Hatch Ltd. (Hatch) to prepare a Noise Assessment Study for the RE Smiths Falls 1 Solar Project, with an installed capacity of 10 MW. The Project will be located about 3 km south of Smiths Falls, Ontario, in the Township of Rideau Lakes.

This Noise Impact Assessment has been prepared based on the document entitled "Basic Comprehensive Certificates of Approval (Air) – User Guide" by the Ontario Ministry of the Environment (MOE). The sound pressure levels at the points of reception (POR) have been estimated using ISO 9613-2, implemented in the CADNA-A computer code. The performance limits used for verification of compliance correspond to the values for Class 3 areas (45 dBA for day time, 40 dBA for night time). The results presented in this report are based on the best available information at this time. It is the intention that, in the detailed engineering phase of the Project, certified noise data based on final plans and designs will confirm the conclusions of this noise study.

Based on the results obtained in this study, we believe that the sound pressure levels at POR will not exceed MOE requirements for Class 3 areas (rural). Any noise issues that might arise during commissioning will be manageable and can be resolved by implementing typical remediation measures as described in this report. It is our intention to verify by field measurements taken on completion of installation and during commissioning that the noise levels at the POR are within the limits set by the MOE.

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1. Introduction

This report presents the results of the noise assessment study required for Solar Facilities under O. Reg. 359/09, as part of the Renewable Energy Approval Process (REA).

RE Smiths Falls 1 ULC retained Hatch Ltd. (Hatch) to prepare a Noise Assessment Study for the RE Smiths Falls 1 Solar Project, with an installed capacity of 10 MW. The Project will be located about 3 km south of Smiths Falls, Ontario, in the Township of Rideau Lakes.

The report was prepared according to publication "Basic Comprehensive Certificates of Approval (Air) – User Guide, 2004" by the Ministry of the Environment (MOE), and includes a general description of the facility, sources and Points of Reception (POR), assessment of compliance, as well as all the supporting information relevant to this Project.

2. Facility Description

RE Smiths Falls 1 is a solar electric generating facility that will utilize photovoltaic (PV) panels installed on fixed racking structures, mounted on the ground. The PV panels generate DC electricity, which is converted to 560-V AC electricity by clusters of inverters. The 560-V power is transformed to 13.8 kV by a transformer located at each inverter cluster. The 13.8-kV power is brought to a single central substation transformer to be stepped up for transmission away from the site.

Since the panels will be ground-mounted and the total nameplate capacity is over 10 kW, RE Smiths Falls 1 is considered a Class 3 Solar Facility, according to the classification presented in Regulation 359/09.

A general description of the facility is provided in Table 2.1.

Table 2.1 General Project Description

Project Description	Ground-mounted Solar PV, Class 3
System Nameplate Capacity	10 MW AC/10 MVA
Local Distribution Company	Hydro One Networks Inc.
Transmission Station	Smiths Falls
Coordinates of Connection Point	Latitude 44.876431°, Longitude -76.007303°

2.1 Site Location

The property consists of approximately 70 to 90 acres located south of Smiths Falls, Ontario, in the Township of Rideau Lakes. Figure 2.1 shows the geographical location of the Project, as well as areas to be occupied with the PV panels. The detailed scaled Zoning Designation Plan and Area Location Plan drawings are included in Appendix A. A total of 100 receptors are located within 1.0 km from the substation.

For modelling purposes, the vegetation that blocks some of the POR from the sources has not been incorporated, so the predicted sound levels at these locations may be slightly over predicted.

2.2 Acoustical Environment

The Project will be surrounded by farmland, with some forested areas to the north-northwest. The background noise levels are expected to be typical of rural areas, classified as a Class 3 based on Publication NPC-232 by the MOE, even though the Project site is located at less than 3 km from Smiths Falls. The Project area is bound by Otter Creek on the south side.

Some traffic noise is expected from County Road 29 and Eric Hutcheson Road, mainly during day hours. Some of the human-made noise sources located nearby the Project area include a Hershey's manufacturing plant (2 km to the northeast), and a shopping plaza (700 m to the north). The closest airport (Smiths Falls-Montague) is located 10 km northeast of the proposed site.

2.3 Life of Project

The expected life of the RE Smiths Falls 1 Solar Project is 30 years. The manufacturer's warranty on the PV modules is 25 years and the expected life of solar power plants of this type is 35 to 40 years.

2.4 Operating Hours

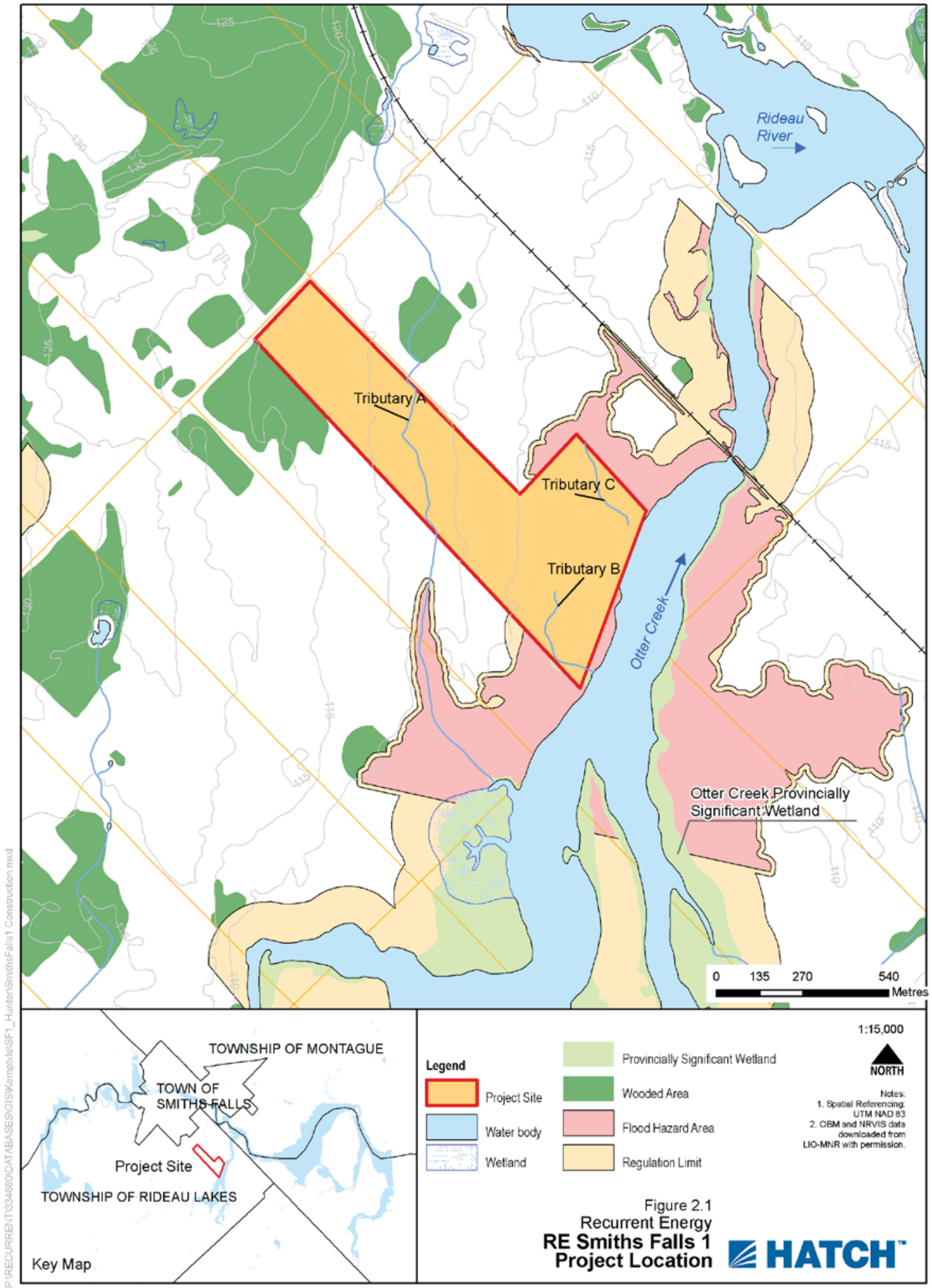
Solar PV facilities produce electricity during the day hours, when the sun rays are collected by the panels. After sunset, the plant will not receive solar radiation to generate any electricity. Under these conditions, the inverters will not produce noise and the transformers will be energized, but not in operation (no fans).

2.5 Approach to the Study

The sound pressure levels at the POR were predicted using procedures from ISO 9613-2, which is a widely used standard for evaluation of noise impact in environmental assessments. The sound power levels were estimated from the National Electrical Manufacturers Association (NEMA) standards for the transformers, or provided by the manufacturer in the case of the inverters. The software package CADNA-A, which implements ISO-9613-2, was used to predict the noise levels at the closest POR. This numerical modelling software is able to handle the sound sources present in this Project, as well as considering atmospheric and ground attenuation. The height contours for the site were taken from the Ontario Base Maps (OBM).

3. Noise Source Summary

The main sources of noise from the solar facility will be the step-up transformer, located at the substation, and four inverter clusters which also include medium-voltage transformers. Wardrop Engineering provided a layout of the RE Smiths Falls 1 Solar Project (see Figure A3, Appendix A). The coordinates of each source are presented in Appendix B.


Rideau River
Tributary A
Tributary C
Tributary B
Otter Creek
Otter Creek Provincially Significant Wetland
0 135 270 540 Metres
TOWNSHIP OF MONTAGUE
TOWN OF SMITHS FALLS
Project Site
TOWNSHIP OF RIDEAU LAKES
Key Map
Legend
Project Site
Water body
Wetland
Provincially Significant Wetland
Wooded Area
Flood Hazard Area
Regulation Limit
1:15,000
NORTH
Notes:
1. Spatial Referencing: UTM NAD 83
2. OBM and NRVIS data downloaded from LIO-MNR with permission.
Figure 2.1
Recurrent Energy
RE Smiths Falls 1
Project Location
HATCH

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3.1 Substation

At this point, it is anticipated that the step-up power transformer located in the substation will have a capacity of 10 MVA. In addition, the transformer will be oil-filled with air-forced cooling (ONAF). For the purpose of evaluating the potential noise impacts of the transformer, the sound power level was estimated using data from NEMA TR1-1993 (2000). This standard provides maximum sound level values for transformers, and manufacturers routinely meet this specification. Hence, the results based on NEMA slightly overestimate the impact on POR. The NEMA levels were then converted into frequency spectra using empirical correlations for transformer noise (Harris, 1998).

Power transformers are considered by the MOE to be tonal noise sources. A 5-dB penalty will be added to the sound power spectrum, as recommended by Publication NPC-104, "Sound Level Adjustments" for tonality. Table B2, Appendix B, shows the frequency spectrum used to model the substation transformer.

3.2 Inverter Clusters (Pads)

At this stage of the Project, RE Smiths Falls 1 ULC is planning to use inverter clusters manufactured by Satcon. Each 1.0-MW unit contains two 500-kW inverters (Satcon PVS-500). The main sources of noise are the cooling/ventilation fans for the inverter, the inverter itself and the step-up transformer. The inverters may be covered in an enclosure, as shown in Figure 3.1. However, the step-up transformer will be located outside the enclosure.

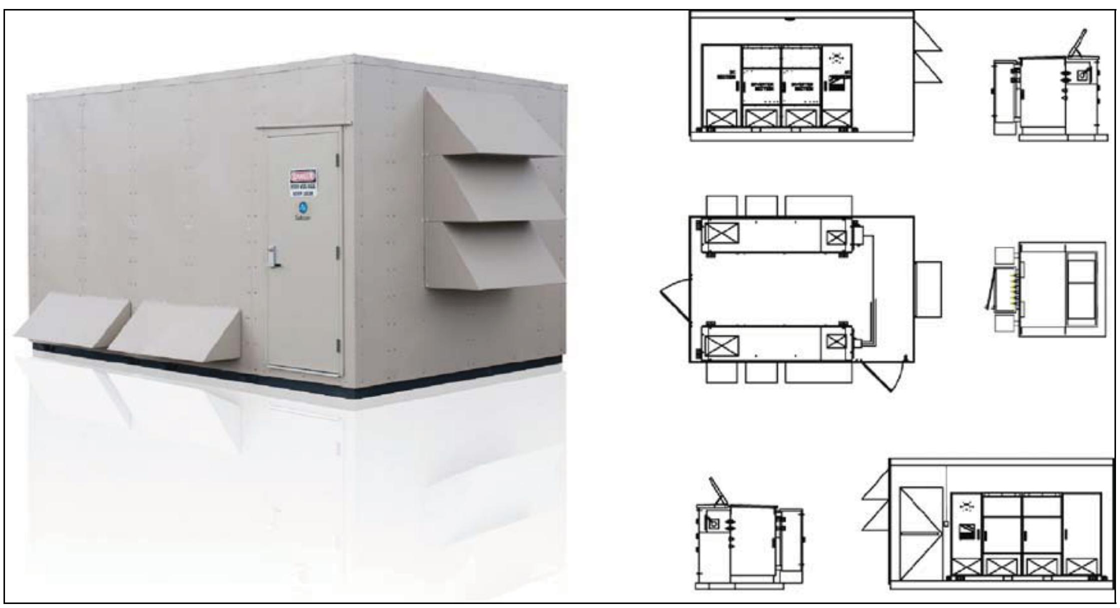


Figure 3.1 Proposed 1-MW Inverter Cluster (Satcon)

The installed capacity of the inverter clusters is 2.5 MW each, as shown in Table 3.1. Hatch assumed that the step-up transformer for each cluster will be dry type, in order to obtain a conservative estimate of the sound pressure levels at the POR. It is expected that the Project will use liquid-immersed, self-cooled transformer (ONAN).

Noise data was obtained for two inverter manufacturers: Satcon and Xantrex. Both inverters had the same capacity at 500 kW. Xantrex data was more complete, including third-octave band data, and it was also higher than the Satcon in terms of sound power level. Therefore, Xantrex data was used for modelling the inverter clusters (see Appendix B).

Each inverter cluster was modelled as two point sources: the inverters and the step-up transformer. For both sources, a 5-dBA penalty was added to the frequency spectrum, as stipulated in Publication NPC-104, "Sound Level Adjustments" to allow for tonality. The frequency spectra used for the inverter clusters and step-up transformers is shown in Table B2, Appendix B.

The "barrier effect" provided by the solar panels surrounding the inverter clusters has not been modelled, which means that the sound pressure levels predicted at the POR can be higher than would be the case if the barrier was accounted for. Note also that, at night time, the facility will not operate. Under these conditions, the inverters do not produce noise. The step-up transformers are energized and make some magnetostrictive noise at a reduced level but no cooling fans are in operation. None of these assumptions should affect the conclusions of this study.

3.3 Noise Summary Table

A summary of the sound sources described above, including sound level, characteristics and potential noise control measures, is presented in Table 3.1.

Table 3.1 Noise Source Summary

Source ID	Source Description	Overall Sound Power Level (dBA)	Source Location	Sound Characteristics	Noise Control Measures
1	Subs. Transformer: 10 MVA	93.3	O	S-T	B
2	Inverter Cluster #1: 2.5 MW	100.4	O	S-T	B/E/S
3	Inverter Cluster #2: 2.5 MW	100.4	O	S-T	B/E/S
4	Inverter Cluster #3: 2.5 MW	100.4	O	S-T	B/E/S
5	Inverter Cluster #4: 2.5 MW	100.4	O	S-T	B/E/S
6	Transformer Cluster-1: 2.5 MVA	91.7	O	S-T	B
7	Transformer Cluster-2: 2.5 MVA	91.7	O	S-T	B
8	Transformer Cluster-3: 2.5 MVA	91.7	O	S-T	B
9	Transformer Cluster-4: 2.5 MVA	91.7	O	S-T	B

Notes:
1. 5-dBA penalty is included in this table.
2. Location: Inside building (I), Outside building (O).
3. Sound Characteristics: Steady (S), Tonal (T), Impulsive (I), Quasi-Steady Impulsive (QSI).
4. Noise Control: Silencer (S), Acoustic lining (A), Barrier (B), Lagging (L), Enclosure (E), Other (O), Uncontrolled (U).

4. Point of Reception Summary

The POR used in this study have been taken from the OBM for the Smiths Falls area. Some additional receptors (residential buildings) were added based on satellite imagery from Google Earth Pro (dated 2009). The total number of POR within a 1-km radius from the substation is 100 (see Figure A2). Three of these receptors have been chosen as representative for evaluating the noise impact from the facility, and are presented in Table 4.1 (see Figure A2 in Appendix A). The complete set of results is included in Appendix C, including a noise map from CADNA-A. For this study, the elevation above ground of the POR is 4.5 m.

Table 4.1 Point of Reception Noise Impact (Day Time)

Source ID	POR 5		POR 33		POR 37	
	Distance (m)	Sound Level at POR 5 (L_{eq}), dBA	Distance (m)	Sound Level at POR 33 (L_{eq}), dBA	Distance (m)	Sound Level at POR 37 (L_{eq}), dBA
1	187	28.3	649	21.5	671	27.7
2	292	37.2	523	34.3	516	34.3
3	375	25.5	353	36.1	478	35.3
4	933	17.4	535	21.5	316	26.0
5	1090	15.8	606	20.6	502	22.0
6	292	27.4	523	27.9	516	25.2
7	375	21.4	353	31.6	478	28.2
8	933	13.4	535	20.1	316	22.5
9	1090	11.6	606	18.3	502	18.4

5. Impact Assessment

The purpose of the Acoustic Assessment Report is to demonstrate that the facility is in compliance with the noise performance limits. The RE Smiths Falls 1 Solar plant will be located in a Class 3 Area, based on the classification defined in Publication NPC-232 by the MOE. Class 3 area means a rural area with an acoustical environment that is dominated by natural sounds, having little or no traffic, such as an agricultural area.

Table 5.1 shows the Performance Limits set by the MOE for Class 3 Areas, according to Publication NPC-232.

Table 5.1 Performance Limits (One-Hour L_{eq}) by Time of Day for Class 3 Areas

Time of Day	One Hour L_{eq} (dBA) Class 3 Area
07:00-19:00	45
19:00-23:00	40
23:00-07:00	40

The solar plant will be operating during the day hours, that is, before 19:00 during most of the year. However, in the summer months, the sun may shine until past 21:00, although the inverters will be well below 100% loading conditions. This means that during the summer the plant will be operating at the time the applicable performance limit changes from 45 dBA to 40 dBA. At night time, the transformer is still energized, so the resultant sound pressure levels were compared to the lower limit of 40 dBA. The frequency spectrum of the transformer used at night time includes the fan noise, even though the sound is only magnetostrictive.

For this study, the overall ground attenuation coefficient was assumed to be 0.7, which is commonly used by the MOE for evaluating the noise impact of other renewable energy facilities.

5.1 Compliance With Performance Limits

Table 5.2 presents the predicted sound pressure levels for the representative POR. The complete set of results is included in Appendix C.

Table 5.2 Acoustic Assessment Summary (Day and Night Time)

POR ID	POR Description	Sound Level at POR (L_{eq}) Day / Night	Verified by Acoustic Audit (Yes/No)	Performance Limit (L_{eq})	Compliance With Performance Limit (Yes/No)
5	House – North	38.5/31.4	No	45.0/40.0	Yes
33	House – South	39.7/33.7	No	45.0/40.0	Yes
37	House – East	39.3/32.6	No	45.0/40.0	Yes

The results show that all POR are compliant with the MOE guidelines based on the performance limits.

6. Mitigation Measures

Mitigation for operation of the power station has been modelled and shown to be feasible in the form of acoustic barriers. However, if an enclosure is deployed to cover the inverters, the proposed barriers may be substituted by acoustically treated walls and/or fan silencers and acoustic louvers. In this case, these devices must be designed according to the specific dimensions and configuration of the enclosure. Berms can also be used to mitigate the noise impact on the POR.

The minimum construction requirements for the proposed noise barriers located at the substation transformer and next to each cluster are presented in Table 6.1, as well as the approximate dimensions. Figure B1 and Table B3 in Appendix B present a diagram of the barrier design and the absorption coefficients used in the noise model.

Table 6.1 Barrier Description

Mitigation ID	Location	Construction Requirements	Approximate Height (m)	Approximate Length (m)	Distance From Source (m)
BarrierS_1	See Figure B1	20 kg/m^2, continuous	6.0	5.0	1.5
BarrierS_2	See Figure B1	20 kg/m^2, continuous	6.0	5.0	1.5
Barrier1_1	See Figure B1	20 kg/m^2, continuous	3.0	9.5	1.5
Barrier2_1	See Figure B1	20 kg/m^2, continuous	3.0	9.5	1.5
Barrier2_2	See Figure B1	20 kg/m^2, continuous	3.0	5.5	1.5
Barrier3_1	See Figure B1	20 kg/m^2, continuous	3.0	9.5	1.5
Barrier3_2	See Figure B1	20 kg/m^2, continuous	3.0	5.5	1.5
Barrier4_1	See Figure B1	20 kg/m^2, continuous	3.0	9.5	1.5
Barrier4_2	See Figure B1	20 kg/m^2, continuous	3.0	5.5	1.5

While analysis indicates that no additional mitigation will be required, the noise levels will be verified at the closest POR after the RE Smiths Falls 1 facility goes into service. If measurements indicate a need to further reduce sound levels to satisfy MOE criteria, additional mitigation measures will be taken at the sources.

7. Conclusions and Recommendations

For the RE Smiths Falls 1 Solar Project, the sound pressure levels at the POR have been estimated using the CADNA-A model, based on ISO 9613-2. The performance limits used for comparison correspond to Class 3 areas, with 45 dBA during daytime (7:00 a.m. to 7:00 p.m.) and 40 dBA during night time. Mitigation for operation of the power station has been modelled and shown to be feasible.

Based on the results obtained in this study, it is concluded that the sound pressure levels at the POR will be below MOE requirements for Class 3 areas at night time (40 dBA) and day time (45 dBA).

8. References

Harris, C. 1998. Acoustical Measurements and Noise Control, Third Edition. Acoustical Society of America.

IEEE. 2006. C57.12.90-2006: Standard Test Code for Liquid-Immersed, Power and Regulating Transformers. pp 64 to 76.

Ministry of the Environment (MOE). 1997. Noise Assessment Criteria in Land Use Planning. Publication LU-131. Ontario Ministry of the Environment. 12 pp + Annex.

MOE. 1995. Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban). Publication NPC-205. Ontario Ministry of the Environment. 6 pp + Annex.

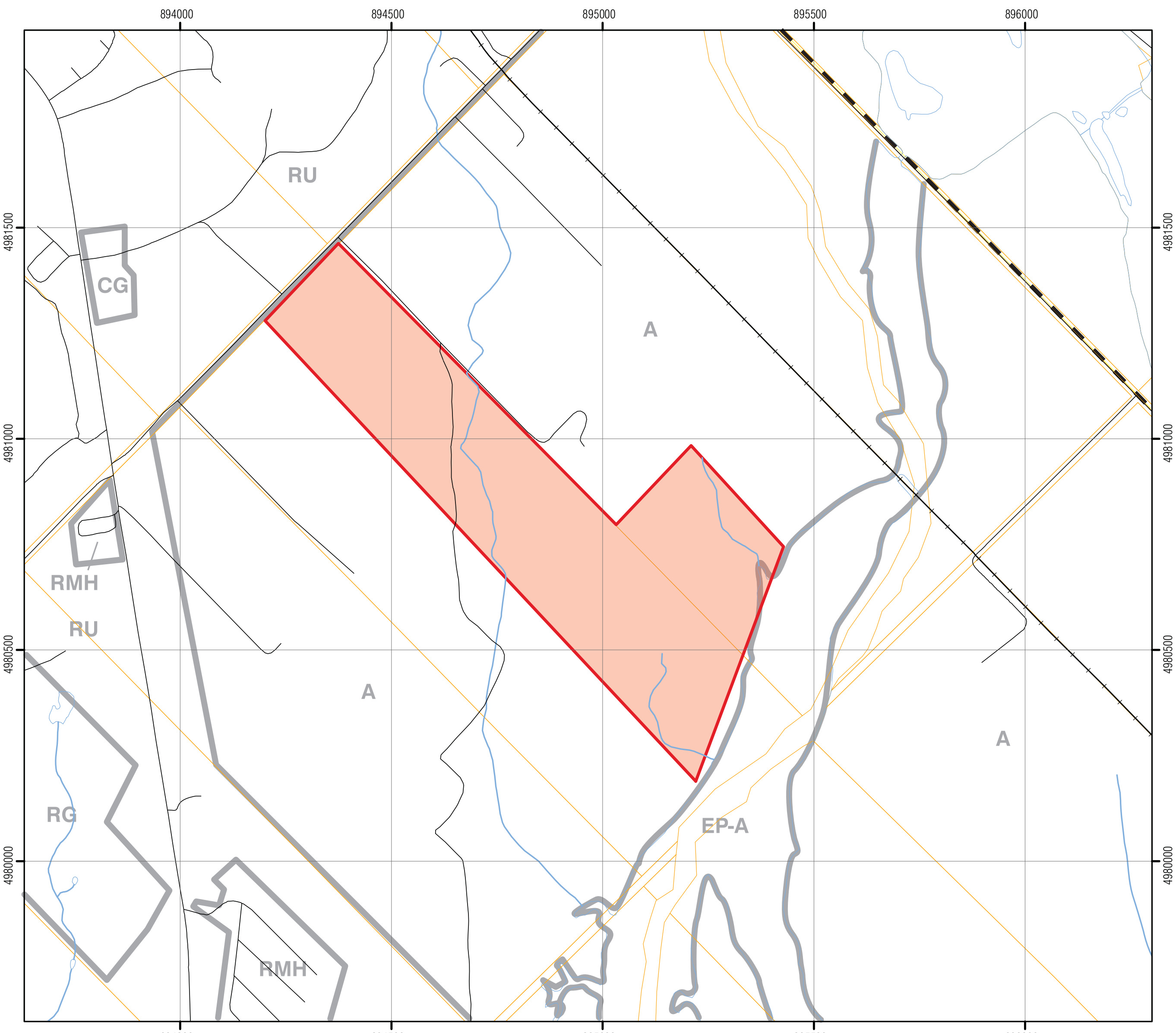
MOE. 1995. Sound Level Limits for Stationary Sources in Class 3 Areas (Rural). Publication NPC-232. Ontario Ministry of the Environment. 8 pp + Annex.

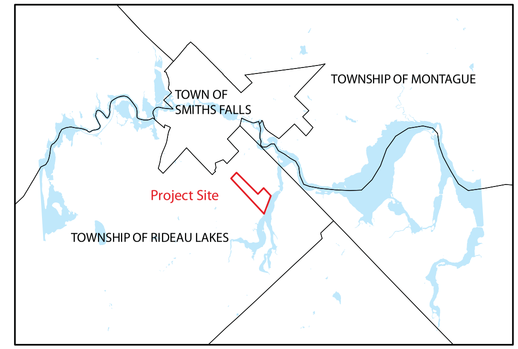
NEMA. 2000. Standards Publication No. TR 1-1993 (R2000): Transformers, Regulators and Reactors. National Electrical Manufacturers Association. 31 pp.

ISO 1996-1 Description, Measurement and Assessment of Environmental Noise – Part 1: Basic Quantities and Assessment Procedures.

Appendix A

Land-Use Zoning Designation Plan, Area Location Plan and Plant Layout





Zones	
RG	General Residential
RW	Waterfront Residential
RMH	Mobile Home Park Residential
CG	General Commercial
CL	Local Commercial
CT	Tourist Commercial
MG	General Industrial
MS	Salvage Yard Industrial
MD	Disposal Industrial
I	Institutional
OS	Open Space
PL	Parking Lot
RU	Rural
A	Agriculture
EX	Mineral Aggregate Extraction
EP-A	Environmental Protection - A
EP-B	Environmental Protection - B
FP	Flood Plain

Project Site

N

0 100 200 400 Metres

1:10,000

Source: Zoning by Law for Township of Rideau Lakes, South Elmsley Ward, Schedule A5, January 2005.

Recurrent Energy
Smith Falls 1

Land Use Zoning Designation Plan

Figure A.1

HATCH™

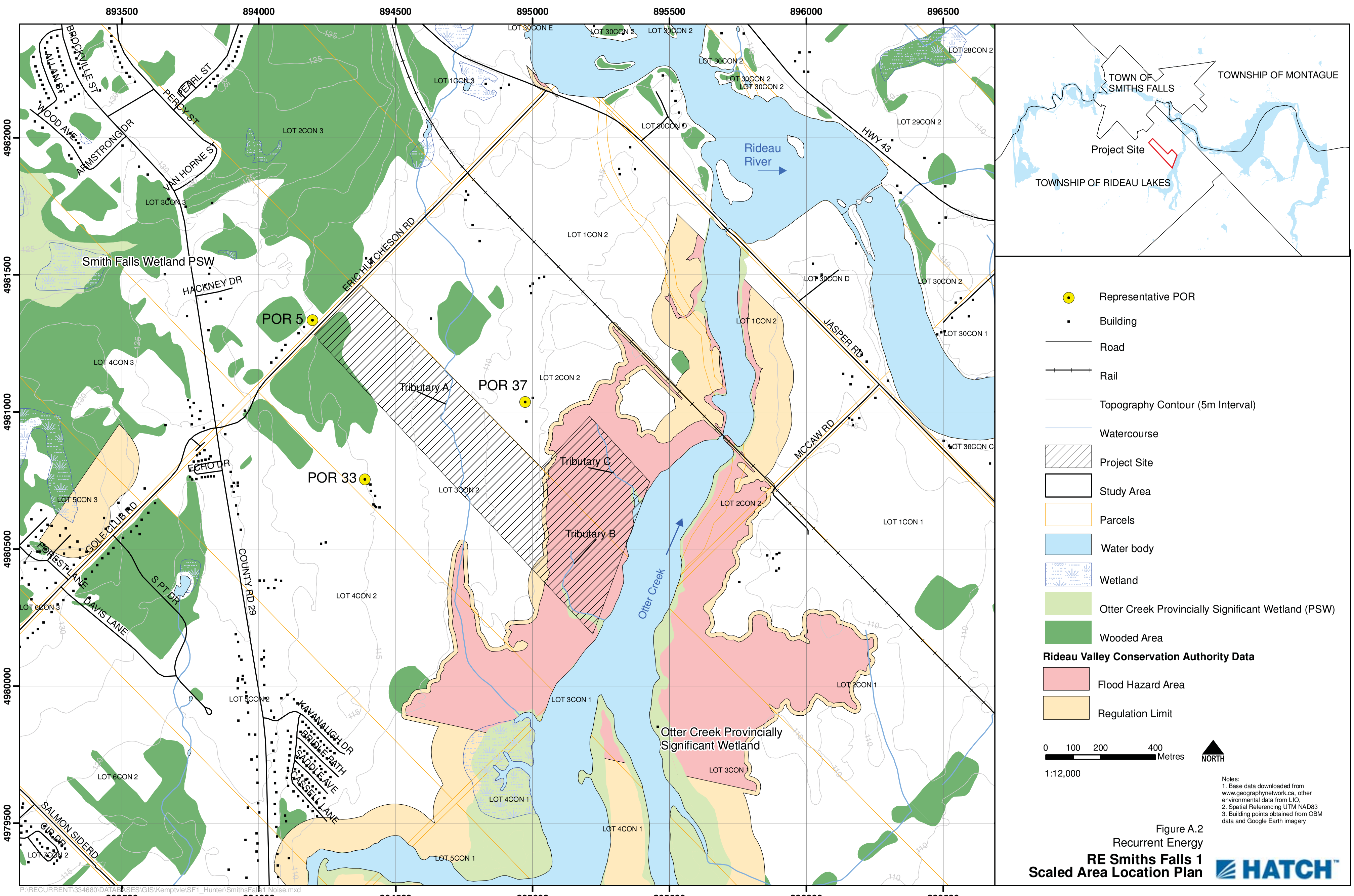


Figure A.2
Recurrent Energy
RE Smiths Falls 1
Scaled Area Location Plan

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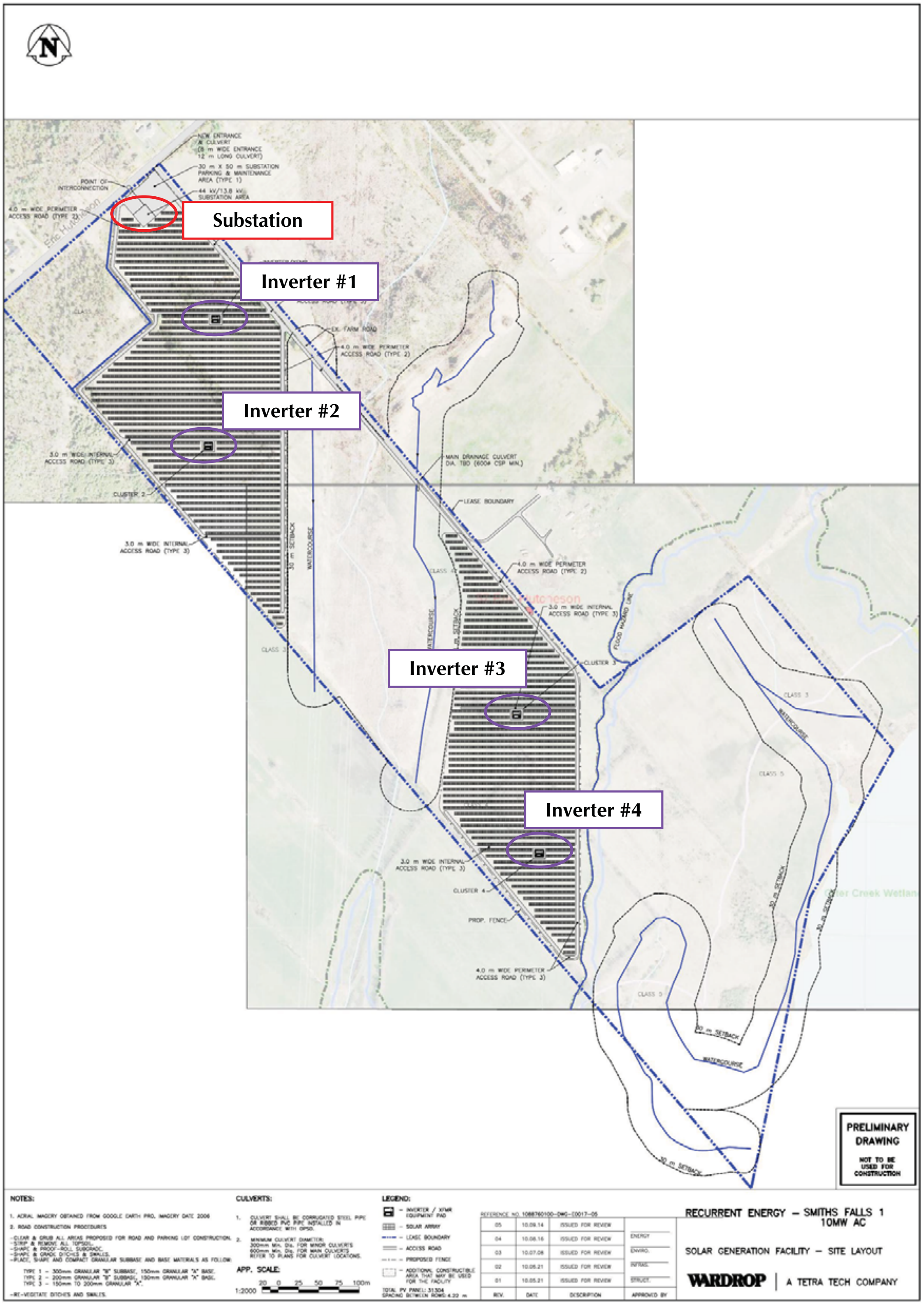

Figure A3 RE Smiths Falls 1 Layout Provided by Wardrop Engineering. The ID of inverter clusters and substation have been added by Hatch.

Appendix B

Noise Sources

Table B1 Point Sources Used in CADNA-A, Includes Tonality Penalty of 5 dBA

Name	Result PWL			Correction			Height	Coordinates		
	Day (dBA)	Evening (dBA)	Night (dBA)	Day dB(A)	Evening dB(A)	Night dB(A)	(m)	X (m)	Y (m)	Z (m)
Subs. Transformer – 10 MVA	93.3	93.3	93.3	5	5	5	5.3	420459	4969758	117.6
Inverter Cluster #1 – 2.5 MW	100.4	100.4	0	5	5	5	2.0	420556	4969617	113.1
Inverter Cluster #2 – 2.5 MW	100.4	100.4	0	5	5	5	2.0	420544	4969444	113.6
Inverter Cluster #3 – 2.5 MW	100.4	100.4	0	5	5	5	2.0	420965	4969078	112.0
Inverter Cluster #4 – 2.5 MW	100.4	100.4	0	5	5	5	2.0	420995	4968887	112.0
Transformer Cluster-1 – 2.5 MVA	91.7	91.7	91.7	5	5	5	2.3	420561	4969617	113.3
Transformer Cluster-2 – 2.5 MVA	91.7	91.7	91.7	5	5	5	2.3	420549	4969444	113.8
Transformer Cluster-3 – 2.5 MVA	91.7	91.7	91.7	5	5	5	2.3	420970	4969078	112.3
Transformer Cluster-4 – 2.5 MVA	91.7	91.7	91.7	5	5	5	2.3	421000	4968887	112.3

Table B2 Frequency Spectra Use for Modelling the Noise Sources, Not Including Tonality Penalty

Name	Type	Octave Spectrum (dBA)										
		31.5	63	125	250	500	1000	2000	4000	8000	A	lin
10 MVA Substation Transformer	**Lw**	45.5	64.7	76.8	79.3	84.7	81.9	78.1	72.9	63.8	88.3	96.9
Inverter 2.5 MW	**Lw**	11.8	59.5	77.1	84.5	86.4	90	85.8	80.8	90.9	95.4	99.2
Transformer 2.5 MVA	**Lw**	43.9	63.1	75.2	77.7	83.1	80.3	76.5	71.3	62.2	86.7	95.3

Table B3 Absorption Coefficient α for the Barrier

Name	Octave Spectrum (dBA)									
	31.5	63	125	250	500	1000	2000	4000	8000	Aw
Barrier	0.00	0.00	0.01	0.05	0.05	0.04	0.04	0.04	0.00	0.05

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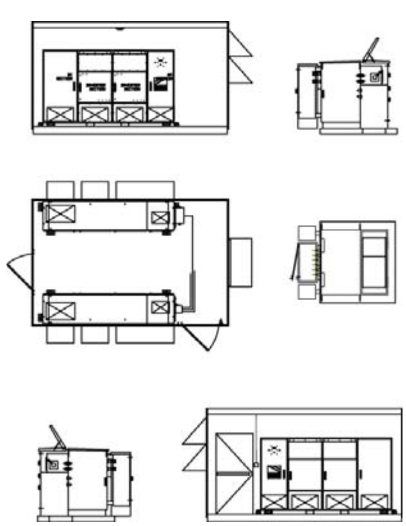
Satcon Prism 1 MW Medium Voltage Solution

Satcon Prism a fully integrated one megawatt medium voltage (MV) solution optimized for utility scale solar PV installations. Leveraging Satcon's industry standard setting PowerGate® Plus 500kW solar PV inverters, Prism is a utility grade one megawatt platform, complete with factory integrated step-up transformers, MV disconnect switches, and power conversion electronics.

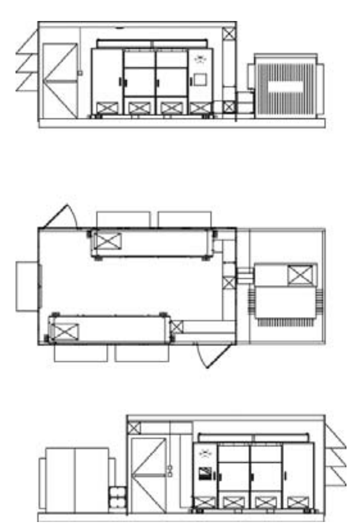
The solution is delivered in two configurations; both complete with an all-climate outdoor enclosure and ready to connect to the PV array and utility grid, enabling rapid installation through a modular prepackaged design.

Satcon Prism MVP 1



Two-Piece, pre-packaged MV system for grounded 900 VDC array systems

Satcon Prism MVP 2



Pre-packaged, 1MW, integrated, one – piece MV solution for grounded, 900 VDC PV array systems

Prism MVP 1

Two-piece, pre-packaged MV system for grounded 900 VDC arrays:

- 2 x PVS-500 kW NEMA 1 inverters
- Prefabricated weather-tight outdoor enclosure with dual entrances houses inverters
- Corresponding 1000 kVA transformer with dual low voltage-side windings and integral MV disconnect switch
- Transformer configurable to meet any voltage up to 43.8 kV
- Two-piece installation allows for separation of the inverter and transformer to suit site requirements

Prism MVP 2

One piece, factory integrated MV system for grounded 900 VDC arrays:

- 2 x PVS-500 kW NEMA 1 inverters
- Prefabricated weather-tight outdoor enclosure with dual entrances houses inverters
- Corresponding 1000 kVA transformer with dual low voltage-side windings and integral MV disconnect switch
- Transformer configurable to meet any voltage up to 43.8 kV
- One piece design with inverter and transformer on same transportable chassis allows for "ship and drop" installation with minimal site preparation

Satcon PRISM

Edge MPPT

- Provides rapid and accurate control that boosts PV plant kilowatt yield
- Provides a wide range of operation across all photovoltaic cell technologies

Printed Circuit Board Durability

- Wide thermal operating range: -40° C (-40° F) to 85° C (185° F)
- Conformal coated to withstand extreme humidity and air-pollution levels

Proven Reliability

Rugged and reliable, PowerGate Plus PV inverters are engineered from the ground up to meet the demands of large-scale installations.

Low Maintenance

- Modular components make service efficient
- Dual cooling fans

Safety

- Seismic Zone Compliant (IBC, ASCE 7, ICC ES AC156 seismic acceptance criteria)
- Integrated DC two-pole disconnect switch isolates the inverter (with the exception of the GFDI circuit) from the photovoltaic power system to allow inspection and maintenance
- Isolation provided by MV transformer
- Protective covers over exposed power connections

Prism - 1,000 kW MV System Electrical Specifications			UL/CSA
Input Parameters			
PV Array Configuration		Positive Ground	○
		Negative Ground	●
Maximum Array Input Voltage		900 VDC	●
Input Voltage Range (MPPT; Full Power)		420 VDC to 850 VDC	●
Maximum Input Current		1,228A (per 500 kW power block)	●
		2,456A Total	
Combiner Option		15 inputs @ 200 A per 500 kW power block (30 inputs total per 1 MW)	○
Output Parameters			
Inverter Output Voltage Range	265 VAC	233 VAC - 292 VAC	●
Transformer - High Voltage Side (nominal)		To be specified by Customer	
Output Frequency Range		59.3Hz - 60.5Hz	●
Maximum Output Current per Phase	265 VAC	1,090 A per 500 kW power block (2,180 A total)	●
		Typical @ 12.47 kV = 46.32 A per 1 MW power block	
		46.32 A total	
CEC-Weighted Efficiency		96%	●
Maximum Continuous Output Power		1,000 kW	●
Power Factor at Full Load		>0.99	●
Harmonic Distortion		<3% THD	●
Temperature			
Operating Ambient Temperature Range (Full Power)		-20° C to +50° C	●
Cooling		Forced Air	●
Heater			○
Auxiliary Transformers			
480V, 120V			○
Warranty			
Five Years			●
Extended Warranty (Up to 10, 15 or 20 Years)			○
Extended Service Agreement			○
Uptime Guarantee			○
Intelligent Montoring			
Satcon PV View® Plus			○
Satcon PV Zone			○
Third-Party Compatibility			●

● Standard
○ Optional

Note: Specifications are subject to change.

Streamlined Design

With all components encased in a single, space-saving enclosure, PowerGate Plus PV inverters are easy to install, operate, and maintain.

Single Cabinet with Small Footprint

Convenient access to all components

Large in-floor cable glands make access to DC and AC cables easy

Rugged Construction

Engineered for outdoor environments

Medium Voltage Transformer

Provides galvanic isolation

Steps up output voltage of the PV inverter to the grid

Quiet Operation

65 dB(A) standard

E-House Enclosure Specifications:

Satcon Prism is housed in a NEMA 3R outdoor rated enclosure which is designed and constructed to ensure a robust package capable of maintaining weather-tightness over a wide range of environmental conditions in addition to security for the power conditioning system.

Baseframe:

Base frame is constructed of structural steel, shop welded, and in full conformance with ASTM A 36 standards. It is designed to handle uniform and concentrated loads during shipping, handling, and rigging, with strategically located lifting lugs.

Flooring:

The flooring is made up of tightly fitting, non-conducting, of ¾" Fire Rated plywood covered with a non-skid surface

Walls:

Wall posts are 14 gauge galvanized (minimum), shop welded to both the structural steel base frame and roof z-bracket to form a rigid framework which is capable of transmitting full roof load into the base frame. All walls are insulated with CertainTeed Fiber Glass Duct Board System for an R value 4.3.

Steel Doors and Hardware:

The two steel doors are 20 gauge with R 2.4 insulation. They each have an interior panic bar and door closer as standard.

Siding:

Siding panels are tight fitting, full length, panels that provide a continuous weathertight, waterproof exterior. The panels are made of 22 gauge Factory Painted Stucco Aluminum, fastened to the vertical wall posts with zinc plated fasteners that resist galvanic reaction. The siding is designed to exceed a wind load of 90mph.

Roof:

The enclosure roof is comprised of tight fitting, robust, weathertight, waterproof, EPDM membrane. The roof has a minimum pitch of 1" across the enclosure width for best water run-off. The roof is insulated to an R value of 4.3.

Lighting:

Standard interior fluorescent lighting is 4' T8 High Output light fixtures.

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PVS-500 (MVT)

PVS-500 (480 V)

PVS-500 (265 V) CE

Peak Efficiency 97.6%

Power Efficiency

Power Level	Output Power[1]	Efficiency[2]
10%	50 kW	92.2%
20%	100 kW	95.6%
30%	150 kW	96.2%
50%	250 kW	96.5%
75%	375 kW	96.4%
100%	500 kW	96.0%

[1] 320V minimum [2] 480V model

Power Efficiency without Transformer

Power Level	Output Power[1]	Efficiency
10%	50 kW	97.08%
20%	100 kW	97.52%
30%	150 kW	97.58%
50%	250 kW	97.46%
75%	375 kW	97.09%
100%	500 kW	96.52%

[1] 310V minimum

Unparalleled Performance

With their advanced system intelligence, next-generation Edge™ MPPT technology, and industrial-grade engineering, PowerGate Plus inverters maximize system uptime and power production, even in cloudy conditions.

Edge MPPT

- Provides rapid and accurate control that boosts PV plant kilowatt yield
- Provides a wide range of operation across all photovoltaic cell technologies

Printed Circuit Board Durability

- Wide thermal operating range: -40° C (-40° F) to 85° C (185° F)
- Conformal coated to withstand extreme humidity and air-pollution levels

PV Inverters | PowerGate® Plus 500 kW

Profitable PV Power

The Satcon® PowerGate® Plus 500 kW PV inverter has a significant impact on the profitability dynamic of large-scale solar PV systems. With its unparalleled system intelligence, next-generation Edge™ MPPT technology, and industrial-grade engineering, the PowerGate Plus 500 kW inverter maximizes system uptime and power production, even in the harshest environments.

Commercial and Utility Scale

The world's largest solar power installations depend on Satcon PowerGate Plus PV inverters to provide efficient and stable power—even in the harshest climates.

Advanced, Rugged, and Reliable

Engineered from the ground up to meet the demands of large-scale installations, Satcon PV inverters feature an outdoor-rated enclosure, advanced monitoring and control capabilities, and Edge,™ Satcon's next-generation MPPT solution.

Proven Performance

The proven leader in solar PV inverter solutions for commercial installations, Satcon sets the standards for efficient large-scale power conversion.

Increased PV Plant Yield

At the heart of PowerGate Plus is Edge, Satcon's next-generation power optimization solution. With rapid and accurate MPPT control, Edge increases PV plant kilowatt yield by extending the production window of arrays, enabling them to operate at optimal voltage and current levels for longer periods of time—even in varied sun conditions. To maximize efficiency, Edge improves the performance of all PV technologies, including fixed and tracking solar arrays, enabling you to get the most from your investment.

Satcon®

PowerGate® Plus 500 kW

Proven Reliability

Rugged and reliable, PowerGate Plus PV inverters are engineered from the ground up to meet the demands of large-scale installations.

Low Maintenance

- Modular components make service efficient
- Dual cooling fans

Safety

- UBC Seismic Zone 4 compliant
- Built-in DC and AC disconnect switches
- Integrated DC two-pole disconnect switch isolates the inverter (with the exception of the GFDI circuit) from the photovoltaic power system to allow inspection and maintenance
- Protective covers over exposed power connections

PowerGate Plus 500 kW Specifications			UL/CSA	CE
Input Parameters				
Maximum Array Input Voltage	600 VDC		●	
	900 VDC			●
PV Array Configuration	Positive Ground		○	○
	Negative Ground		●	○
	Floating			●
Input Voltage Range (MPPT; Full Power)	320/333–600 VDC	200/208 VAC[1]	●	
	420–850 VDC	265 VAC[1]		●
	320–600 VDC	480 VAC	●	
Maximum Input Current	1,628 ADC/ 1,565 ADC	200/208 VAC[1]	●	
	1,228 ADC	265 VAC[1]		●
	1,628 ADC	480 VAC	●	
Output Parameters				
Output Voltage Range (L-L)	176–220 VAC/ 183-229 VAC	200/208 VAC[1]	●	
	233–292 VAC	265 VAC[1]		●
	422–528 VAC	480 VAC	●	
Nominal Output Voltage	200/208 VAC[1]		●	
	265 VAC[1]			●
	480 VAC		●	
Output Frequency Range	59.3–60.5 Hz		●	
	49.3–50.5 Hz			●
AC Voltage Range (Standard)	-12%/+10%		●	●
Nominal Output Frequency	60 Hz		●	
	50 Hz			●
Number of Phases	3		●	●
Maximum Output Current per Phase	1,443/1,388 A	200/208 VAC[1]	●	
	1090 A	265 VAC[1]		●
	602 A	480 VAC	●	

● Standard ○ Optional


The integrated external transformer is standard on the 480 VAC models only; custom transformer solutions are also available.

Satcon

PowerGate® Plus 500 kW

Streamlined Design

With all components encased in a single, space-saving enclosure, PowerGate Plus PV inverters are easy to install, operate, and maintain.

Single Cabinet with Small Footprint

Convenient access to all components

Large in-floor cable glands make access to DC and AC cables easy

Rugged Construction

Engineered for outdoor environments

Output Transformer

Provides galvanic isolation

Matches the output voltage of the PV inverter to the grid

Quiet Operation

65 dB(A) standard

PowerGate Plus 500 kW Specifications			UL/CSA	CE
Peak Efficiency	**97.6%**			
CEC-Weighted Efficiency[3]	97%	200/208 VAC[1]	•	
	97%	265 VAC[1]		•
	96%	480 VAC	•	
Maximum Continuous Output Power	500 kW (500 kVA)		•	•
Tare Losses	138.12 W	200/208 VAC[1]	•	
	170 W	265 VAC[1]		•
	138.12 W	480 VAC	•	
Power Factor at Full Load	>0.99		•	•
Harmonic Distortion	<3% THD		•	•
Temperature				
Operating Ambient Temperature Range (Full Power)	-20° C to +50° C		•	•
Storage Temperature Range	-30° C to +70° C		•	•
Cooling	Forced Air		•	•
Noise				
Noise Level	<65 dB(A)		•	•
Combiner				
Number of Inputs and Fuse Rating (2 fuses/input for floating)	20 (160 ADC)		○	
	30 (100 ADC)		○	
	20 (160 ADC)			○
	20 (125 ADC)			○
Transformer				
Integrated External Transformer		480 VAC	•	
Low Tap Voltage[2]	20%		•	
External Transformer[2]			○	○
Inverter and Integrated External Transformer Cabinets				
Enclosure Rating	NEMA 3R		•	
	IP54			•
Enclosure Finish (11 Gauge CRS, painted, base zinc coated)	RAL-7032		•	•
Stainless Steel Finish			○	○
Cabinet Dimensions (Height x Width x Depth)	Inverter		92.6″ x 138.8″ x 43.1″ (235 cm x 352 cm x 109 cm)	92.6″ x 153.8″ x 43.1″ (235 cm x 391 cm x 109 cm)
	Transformer	480 VAC	77″ x 49″ x 30.5″ (195.58 cm x 124.46 cm x 77.47 cm)	
Cabinet Weight	Inverter		5,900 lbs.	2,676 kg
	Transformer	480 VAC	3,200 lbs.	1,451 kg

• Standard ○ Optional

Satcon®

PowerGate® Plus 500 kW

Output Options

PowerGate Plus 500 kW	
UL/CSA	208 VAC[1] Output
	480 VAC Output
CE	265 VAC[1] Output

[1] External transformer

PowerGate Plus 500 kW Specifications	UL/CSA	CE
Testing and Certification		
UL1741, CSA 107.1-01, IEEE 1547, IEEE C62.41.2, IEEE C62.45, IEEE C37.90.1, IEEE C37.90.2	●	
CE Certification (EN 50178, EN 61000-6-2, EN 61000-6-4)		●
UBC Zone 4 Seismic Rating	●	●
Warranty		
Five Years	●	●
Extended Warranty (up to 10, 15, or 20 years)	○	○
Extended Service Agreement	○	○
Uptime Guarantee	○	○
Intelligent Monitoring		
Satcon PV View® Plus	○	○
Satcon PV Zone	○	○
Third-Party Compatibility	●	●

● Standard
○ Optional

[1] Options designed to be used with external transformer.

[2] The 20% boost tap on the isolation transformer increases the AC voltage output range for applications where the solar array DC operating voltage is at or near the lower end of the DC input range. This boost allows for continued inverter operation at lower DC voltage input levels.

[3] For 265 VAC and 200/208 VAC models efficiency is listed as "Inverter Only" efficiency.

Note: Specifications are subject to change.

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Memorandum

Date:	20 July 2009		
To:	Tony Fuertsch	**Email:**	Tony.Fuertsch@Xantrex.com
From:	J. Byron Davis, VACC	**Email:**	byron@va-consult.com
Subject:	Xantrex Power Inverter – Sound Power Measurements (00485)		

Dear Tony,

We are pleased to submit this report regarding the recent testing of a Xantrex GT500 inverter.

Background

As we understand it, Xantrex has a client that requires detailed noise testing of the GT500, a 500kW power inverter for solar applications. Xantrex requested that we perform the noise testing to satisfy this and future client requests.

We visited Xantrex's facility in Livermore, CA on Wednesday 8 July 2009 to perform testing. The testing space was a large, high-bay warehouse-type setting, illustrated in Figure 1. The ceiling was lined with exposed fiberglass insulation, resulting in less reverberation than expected for this type of room. Adjacent equipment not included in the package included a DC power supply simulator and a large freestanding transformer. We chose to develop sound power data using the sound intensity method in order to minimize contamination from adjacent sources.

Since sound power is a property of the source being tested (rather than the cumulative result of multiple sources interacting with the environment), these data are applicable to many different installation conditions. In this document, we report the measured sound power levels and sound pressure levels and provide commentary on how we would insert this source into computer-based noise propagation models.

Test Conditions

We measured sound power using our standard testing suite:

Instrument	Make / Model	Identification
Signal Analyzer	Larson-Davis 3000	S/N 175
Intensity Probe	Gras I50AIC	S/N 6637
Paired Microphones	Gras 40AI	S/N 23083 & 23089
Paired Microphone Preamps	Gras 6AA	S/N 15082 & 15083
Residual Intensity Calibrator	Larson-Davis CAL291	S/N 156
SPL Calibrator	Bruel & Kjaer 4231	S/N 2292439

The instrument was calibrated in the field. We performed testing using the "rectangular prism" moving microphone method. Intensity and power data were computed by the Larson-Davis built-in intensity module. Temperature was estimated at about 25°C; barometric pressure was measured to be about 1005mbar. Background noise levels were modest and consistent. In the majority of 1/3 octave bands, the ambient condition (ex power supply and transformer) was 10dB or more below the test (forced) condition. In the lowest 1/3 octave bands of 50~80Hz and in the 250Hz and 400Hz bands, background levels were 3~8dB below the minimum-observed forced condition. No significant transients occurred during testing; however, irrelevant noise due to the DC power supply simulator changed somewhat with the different test configurations.

We measured the inverter under three input voltage conditions: 305V, 345V, and 408V. In all cases, the inverter was loaded to 100% at the given voltage. Our understanding is that the 408V@100% condition is the highest-load condition.

Xantrex requested data across the frequency spectrum from the 63Hz octave band through the 6.3kHz. It was anticipated that significant sound power would be present in the 6.3kHz band due to the internal electronics switching frequency within that band. We therefore performed the measurement twice for each voltage condition: the first (low-frequency) measurement was performed using the 100mm spacer between the probe microphones, while the second (high-frequency) measurement was performed using the 25mm spacer.

Data Reporting

Data were collected in 1/3 octave bands. We overlapped the data, taking our 50~200Hz data from the "long spacer" measurement and the 800Hz~10kHz data from the "short-spacer" measurement. Data from 250~630Hz were taken as the average of the "long-spacer" and "short-spacer" data sets. Data in the overlap regime of 250~630Hz differed by 1dB or less in each 1/3 octave band. To quantify directionality, we also present average sound pressure level data taken along the front, back, sides, and top of the unit.

We considered the good agreement in the 250~630Hz bands to be indicative of good data. In addition, the consistency of reported PWL (despite changing SPLs due to more-or-less noise being generated by the power supply and transformer) also give us confidence in the results.

The results are presented in Tables 1~4 in terms of sound power levels, PWL, in decibels referenced to 1×10^{-12}W and sound pressure levels, SPL, in decibels referenced to 20μPa. All figures are unweighted.

Discussion

From test condition to test condition, the data indicate very stable noise performance at most frequencies. This is consistent with our qualitative observation that cooling fan noise dominates in most frequency bands. As illustrated in Table 1, the reported sound power level is the same (to within 1dB) from 50Hz through the 3.15kHz band.

High frequency noise becomes considerably more apparent at higher input voltages. As the system voltage increases to 408V, a tone emerges in the 6.3kHz band. Xantrex staff speculate that this is due to the switching frequency of the internal DC-to-AC electronics.

The directionality in the noise generation appears to be modest. Fan noise is most prominent at the rear of the unit, at the intake for the cooling fans. Over the entire spectrum, SPLs measured at the rear of the unit were typically 3~5dB higher than at the front of the unit. This includes not only the broadband fan noise but the high-frequency switching noise, as well.

From the perspective of sound propagation modeling, we would consider modeling the unit as a box with one rear noise source at an elevation of about 42" (the elevation of the opening in the intake shroud) and a front noise source at an elevation of about 80" (the elevation of the opening along the top front of the unit for exhaust.

• • •

Please feel free to call if you have any questions; we may be reached in our San Francisco office by telephone at (+1) 415-693-0424 or via email at byron@va-consult.com.

Sincerely,

J. Byron Davis
Vibro-Acoustic Consultants

Figure 1: Xantrex GT500 Sound Power Measurements – July 2009
Photograph of test unit and surrounding area; the front of the unit is to the right

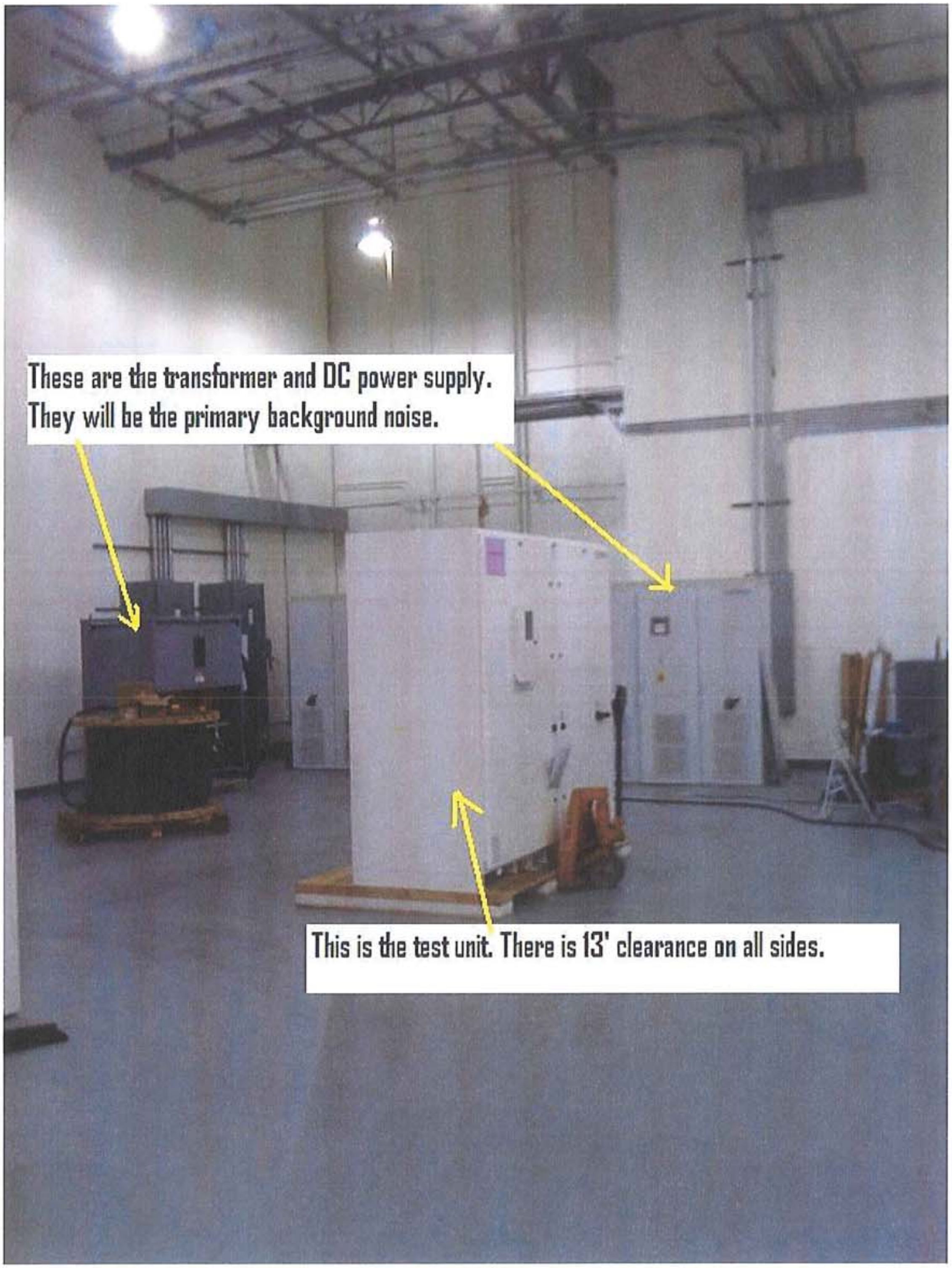


Figure 2: Xantrex GT500 Sound Power Measurements – July 2009
Schematic diagram of GT500 Inverter case outline, with dimensions indicated

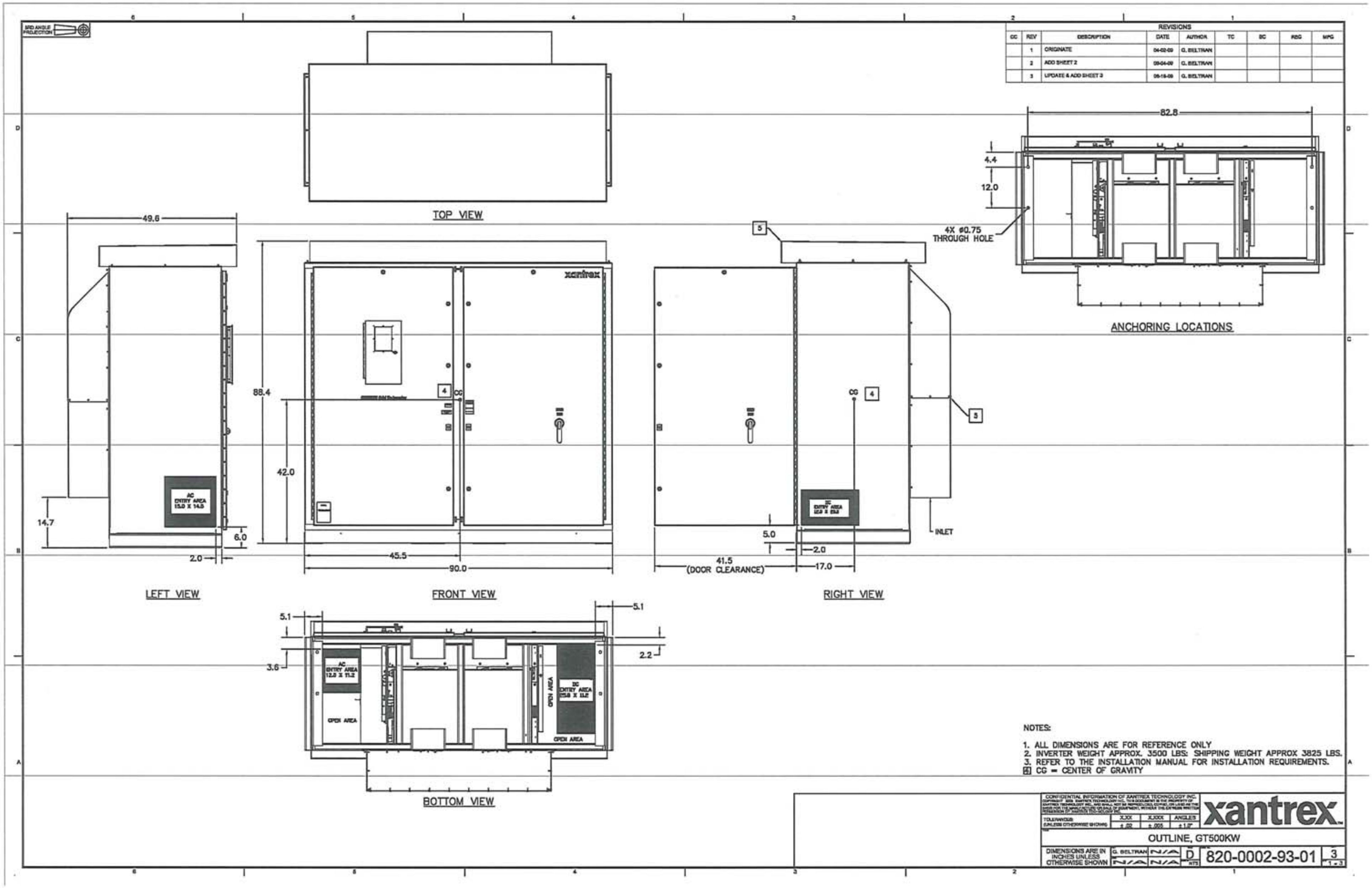


Table 1: Xantrex GT500 Sound Power Measurements – Overall Sound Power Level Data, PWL in dB re: 1×10^{-12}W

1/3 octave band frequency -->	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
Total PWL, 305V, 100% Load	69	77	71	73	84	78	79	80	83	80	77	75	82	74	72	73	72	71	68	65	64	72	56	50
Total PWL, 345V, 100% Load	68	77	71	74	83	78	79	81	82	80	77	75	82	73	72	73	73	71	68	66	66	78	60	48
Total PWL, 480V, 100% Load	69	77	72	74	85	79	79	81	83	80	77	75	82	74	72	74	73	71	68	67	69	85	66	47

Table 2: Xantrex GT500 Sound Power Measurements – 305V/100% Load PWL in dB re: 1×10^{-12}W and SPL in dB re: 20µPa

1/3 octave band frequency -->	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
Total PWL, 305V, 100% Load	69	77	71	73	84	78	79	80	83	80	77	75	82	74	72	73	72	71	68	65	64	72	56	50
Average SPL, Front, 1.2m setback	52	62	55	57	71	63	65	67	68	66	62	62	66	58	57	56	55	55	53	51	52	63	50	39
Average SPL, Rear, 1.2m setback	59	65	59	61	73	66	67	69	71	67	66	65	68	63	61	63	62	61	60	57	56	66	54	46
Average SPL, Left, 1.2m setback	56	64	56	57	71	61	61	64	66	64	62	61	65	59	58	58	58	56	54	52	52	61	48	38
Average SPL, Right, 1.2m setback	56	64	56	57	73	61	63	66	68	65	63	62	66	60	59	59	59	58	56	54	53	62	50	41
Average SPL, Top, 1.2m setback	54	62	56	58	69	61	62	66	69	65	64	63	67	60	59	59	59	58	55	53	53	62	49	40
Average SPL, Front, 2.0m setback	53	61	56	59	69	62	64	66	68	65	61	61	64	58	57	56	56	55	54	52	53	63	53	44
Average SPL, Rear, 2.0m setback	60	64	60	64	75	67	67	68	69	67	64	64	68	62	59	61	61	60	59	57	57	67	58	49
Average SPL, Left, 2.0m setback	55	62	56	59	71	61	61	64	64	61	59	59	63	57	56	56	56	55	53	52	51	60	50	41
Average SPL, Right, 2.0m setback	56	62	55	60	70	60	62	64	67	63	62	63	65	60	59	59	58	57	56	54	53	61	52	44

Table 3: Xantrex GT500 Sound Power Measurements – 345V/100% Load PWL in dB re: 1×10^{-12}W and SPL in dB re: 20µPa

1/3 octave band frequency -->	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
Total PWL, 345V, 100% Load	68	77	71	74	83	78	79	81	82	80	77	75	82	73	72	73	73	71	68	66	66	78	60	48
Average SPL, Front, 1.2m setback	53	63	56	57	69	63	65	67	68	65	62	61	67	59	58	57	57	56	55	54	54	68	51	45
Average SPL, Rear, 1.2m setback	60	65	60	61	71	66	67	69	70	67	65	63	69	63	61	63	63	61	59	58	58	71	55	47
Average SPL, Left, 1.2m setback	56	64	56	58	69	61	61	64	65	63	61	60	66	59	58	58	58	57	55	54	53	66	50	41
Average SPL, Right, 1.2m setback	56	64	56	57	70	61	62	66	67	64	62	61	67	60	59	59	59	58	57	55	55	67	53	47
Average SPL, Top, 1.2m setback	54	62	56	59	67	62	62	67	68	65	63	62	68	60	59	59	59	58	56	54	54	67	51	43

Table 4: Xantrex GT500 Sound Power Measurements –408V/100% Load PWL in dB re: 1×10^{-12}W and SPL in dB re: 20µPa

1/3 octave band frequency -->	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
Total PWL, 480V, 100% Load	69	77	72	74	85	79	79	81	83	80	77	75	82	74	72	74	73	71	68	67	69	85	66	47
Average SPL, Front, 1.2m setback	54	63	56	57	71	63	65	67	68	65	63	63	67	60	59	59	58	57	56	56	59	77	58	47
Average SPL, Rear, 1.2m setback	60	66	60	62	73	67	67	69	72	67	65	66	69	63	62	64	63	62	60	60	62	80	64	51
Average SPL, Left, 1.2m setback	56	62	56	57	71	61	61	64	65	63	62	62	66	59	58	59	58	57	55	55	57	74	57	44
Average SPL, Right, 1.2m setback	56	63	56	57	72	61	63	67	68	65	63	65	67	61	59	60	60	60	59	58	59	75	59	49
Average SPL, Top, 1.2m setback	55	61	57	59	68	62	62	67	69	65	64	65	68	62	60	60	60	59	57	56	58	75	59	46
Average SPL, Rear, 2.0m setback	60	63	60	63	73	66	67	68	69	66	65	65	69	63	61	62	61	60	59	60	63	79	68	56

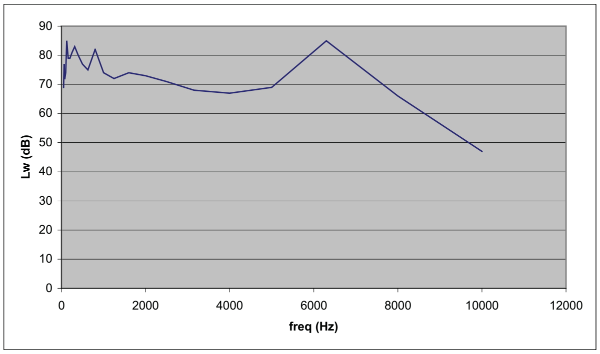
TOTAL PWL FOR 480V, 100% LOAD
Provided by Aercoustics, June 07/2010

Third Octave	
Freq (Hz)	**LwA (dB)**
25	
31.5	
40	
50	69
63	77
80	72
100	74
125	85
160	79
200	79
250	81
315	83
400	80
500	77
630	75
800	82
1000	74
1250	72
1600	74
2000	73
2500	71
3150	68
4000	67
5000	69
6300	85
8000	66
10000	47

Full Octave	
Freq (Hz)	LwA (dB)
31.5	4.8
63	78.7
125	86.2
250	86.1
500	82.6
1000	83.0
2000	77.6
4000	72.8
8000	85.1
Total Lw	**92.2**

A_WEIGHTED

Full Octave	
Freq (Hz)	LwA (dBA)
31.5	4.8
63	52.5
125	70.1
250	77.5
500	79.4
1000	83.0
2000	78.8
4000	73.8
8000	84.0
Total LwA	**88.5**



RECURRENT ENERGY - SMITH FALLS 1
SOUND POWER SPECTRA

10 MVA STEP-UP TRANFORMER (SUBSTATION)

Average LpA	70	dBA	**Based on NEMA TR1-1993 (2000), ONAN/ONAF 7.5/10MVA**
Area	39.0	m2	**Based on drawings provided by Wardrop (20May10, Northern Transformer, drawing 2029-010C, 10,000/13,333**

Frequency Band Centre (Hz)	31	63	125	250	500	1000	2000	4000	8000	Combined
Sound Power (dB)	84.9	90.9	92.9	87.9	87.9	81.9	76.9	71.9	64.9	**97.0**
Sound Power (dBA)	45.5	64.7	76.8	79.3	84.7	81.9	78.1	72.9	63.8	**88.3**

2.5 MW INVERTER CLUSTERS

BASED ON TRANSFORMER FREQUENCY SPECTRUM, DRY-TYPE 1-MVA, NEMA TR1-1993:2000. Table 0-4

Transf Sound Pressure Level	71	dBA	**Forced Air Cooled**
Transf Sound Power Level	84.7	dBA	**Estimated, assuming a total area of 21.6 m2**
500 kW Inverter Sound Power Level	88.5	dBA	**Provided by Aercoustics for Xantrex 500kW - June 07/2010**
Number of Inverters per Cluster	5.0	-	

Frequency Band Centre (Hz)	31	63	125	250	500	1000	2000	4000	8000	Combined
Sound Power Transf. (dBA)	41.9	61.1	73.2	75.7	81.1	78.3	74.5	69.3	60.2	**84.7**
Sound Power Inverter 1 (dBA)	4.8	52.5	70.1	77.5	79.4	83.0	78.8	73.8	84.0	**88.5**
Sound Power Inverter 2 (dBA)	4.8	52.5	70.1	77.5	79.4	83.0	78.8	73.8	84.0	**88.5**
Sound Power Inverter 3 (dBA)	4.8	52.5	70.1	77.5	79.4	83.0	78.8	73.8	84.0	**88.5**
Sound Power Inverter 4 (dBA)	4.8	52.5	70.1	77.5	79.4	83.0	78.8	73.8	84.0	**88.5**
Sound Power Inverter 4 (dBA)	4.8	52.5	70.1	77.5	79.4	83.0	78.8	73.8	84.0	**88.5**
Total Inverter Sound Power Level (dBA)	11.8	59.5	77.1	84.5	86.4	90.0	85.8	80.8	90.9	**95.5**

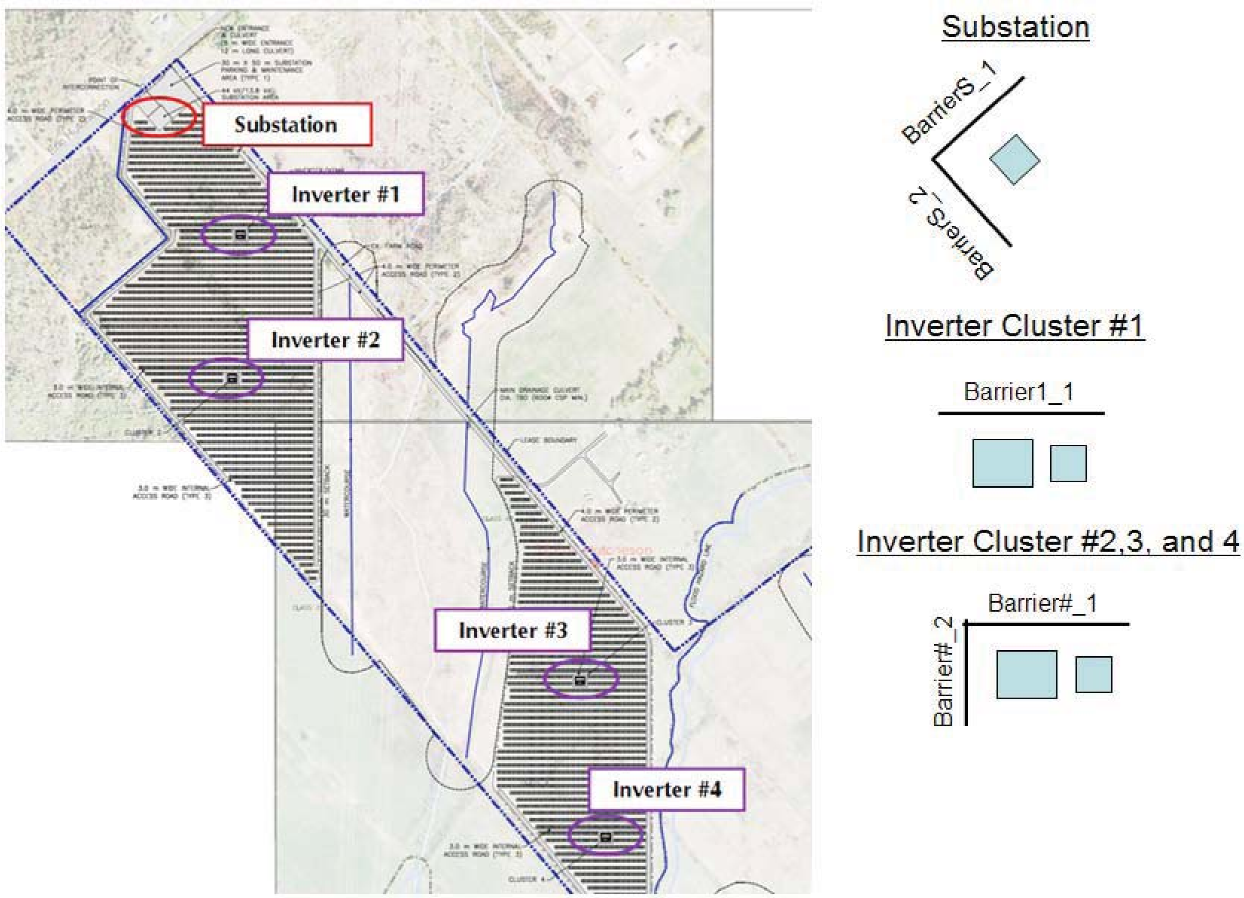


Figure B1 Location and ID of Proposed Sound Barriers

Appendix C

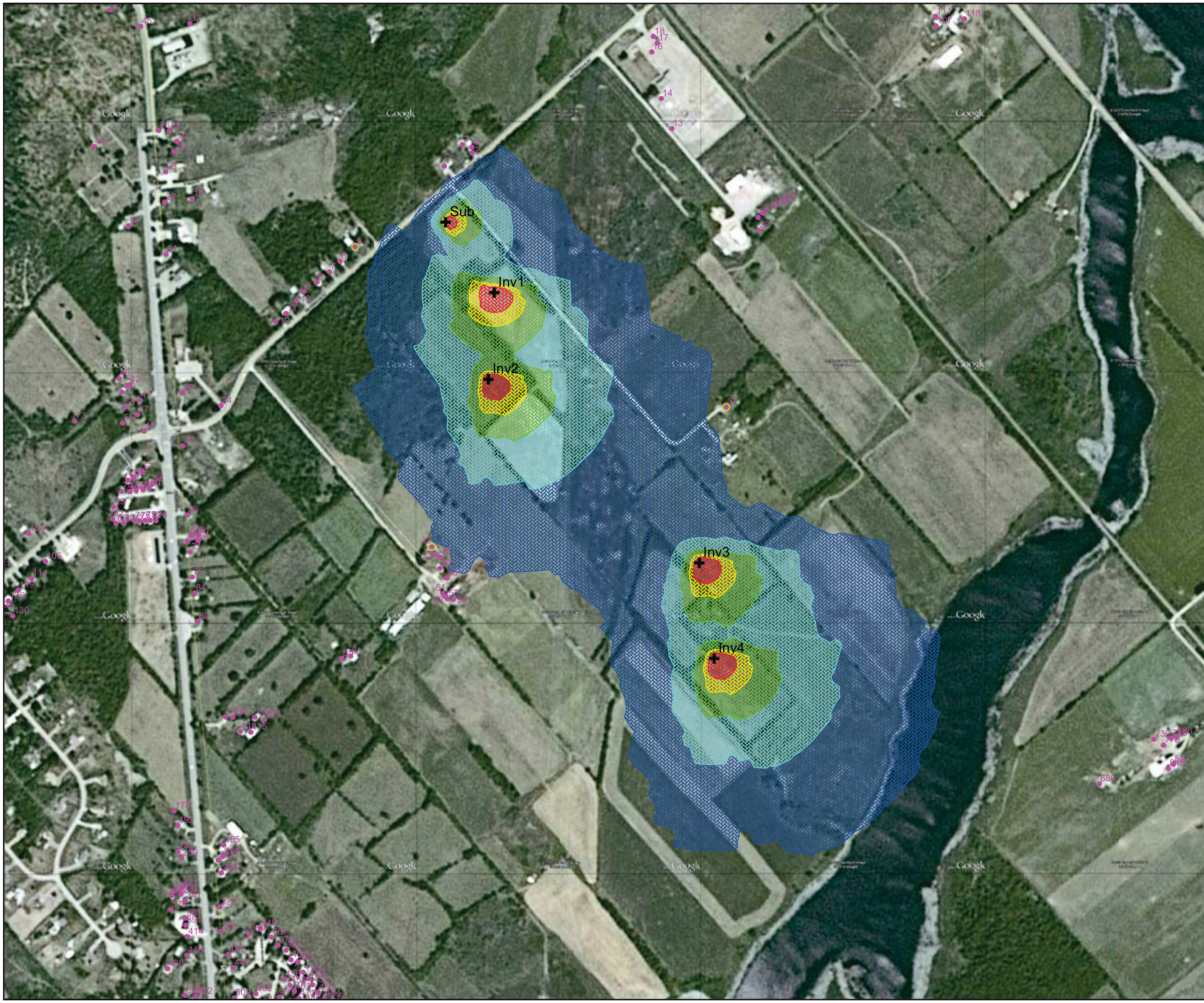
Sound Pressure Levels for Points of Reception, Noise Maps from CADNA-A

Table C1 Sound Pressure Levels for POR (shaded rows correspond to representative POR)

ID	Level Lp		Limit. Value		Noise Type	Height	Coordinates		
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)		(m)	X (m)	Y (m)	Z (m)
1	37.6	36.7	45.0	40.0	Total	4.5	420456	4969870	116.1
2	37.6	36.9	45.0	40.0	Total	4.5	420511	4969896	115.1
3	36.1	35.1	45.0	40.0	Total	4.5	420492	4969913	115.4
4	36.9	36.0	45.0	40.0	Total	4.5	420511	4969908	115.1
5	38.5	31.4	45.0	40.0	Total	4.5	420278	4969709	119.5
6	38.1	32.0	45.0	40.0	Total	4.5	420248	4969680	119.5
7	37.6	31.4	45.0	40.0	Total	4.5	420227	4969659	119.8
8	37.0	30.8	45.0	40.0	Total	4.5	420202	4969638	120.3
9	36.3	30.2	45.0	40.0	Total	4.5	420176	4969620	120.9
10	36.0	29.8	45.0	40.0	Total	4.5	420161	4969602	121.2
11	35.5	29.4	45.0	40.0	Total	4.5	420140	4969576	121.7
12	35.0	29.0	45.0	40.0	Total	4.5	420120	4969560	122.1
13	32.9	31.7	45.0	40.0	Total	4.5	420910	4969945	114.5
14	32.4	31.3	45.0	40.0	Total	4.5	420889	4970005	114.5
15	31.2	24.5	45.0	40.0	Total	4.5	419953	4969805	127.6
16	31.5	30.5	45.0	40.0	Total	4.5	420870	4970098	114.5
17	31.2	30.2	45.0	40.0	Total	4.5	420881	4970116	114.5
18	31.1	30.1	45.0	40.0	Total	4.5	420873	4970129	114.5
19	30.1	23.1	45.0	40.0	Total	4.5	419918	4969899	129.5
20	30.0	22.9	45.0	40.0	Total	4.5	419922	4969920	129.5
21	31.0	25.3	45.0	40.0	Total	4.5	419901	4969694	126.0
22	30.4	24.0	45.0	40.0	Total	4.5	419898	4969798	128.7
23	30.1	23.3	45.0	40.0	Total	4.5	419900	4969859	129.5
24	32.8	28.1	45.0	40.0	Total	4.5	420010	4969392	125.1
25	29.6	22.6	45.0	40.0	Total	4.5	419907	4969940	129.5
26	29.4	22.4	45.0	40.0	Total	4.5	419886	4969941	129.5
27	34.1	31.7	45.0	40.0	Total	4.5	421082	4969768	114.5
28	34.5	31.8	45.0	40.0	Total	4.5	421083	4969742	114.5
29	31.7	27.1	45.0	40.0	Total	4.5	419933	4969417	127.5
30	29.8	24.2	45.0	40.0	Total	4.5	419826	4969751	128.8
31	33.9	31.6	45.0	40.0	Total	4.5	421092	4969776	114.5
32	26.2	21.1	45.0	40.0	Total	4.5	419948	4970155	135.8
33	39.7	33.7	45.0	40.0	Total	4.5	420431	4969110	119.5
34	33.4	31.1	45.0	40.0	Total	4.5	421117	4969794	114.5
35	39.5	33.5	45.0	40.0	Total	4.5	420437	4969095	119.5
36	39.5	33.5	45.0	40.0	Total	4.5	420448	4969090	119.4
37	39.3	32.6	45.0	40.0	Total	4.5	421019	4969389	114.5
38	33.2	30.9	45.0	40.0	Total	4.5	421135	4969798	114.5
39	31.3	26.6	45.0	40.0	Total	4.5	419934	4969312	129.3
40	39.0	33.0	45.0	40.0	Total	4.5	420447	4969067	119.5
41	30.5	25.9	45.0	40.0	Total	4.5	419849	4969403	128.3
42	30.0	24.7	45.0	40.0	Total	4.5	419827	4969434	128.1
43	39.7	32.8	45.0	40.0	Total	4.5	420461	4969048	119.2
44	25.6	21.4	45.0	40.0	Total	4.5	419757	4969909	130.0

ID	Level Lp		Limit. Value		Noise Type	Height	Coordinates		
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)		(m)	X (m)	Y (m)	Z (m)
45	25.9	20.4	45.0	40.0	Total	4.5	419850	4970149	139.5
46	29.8	24.5	45.0	40.0	Total	4.5	419807	4969446	128.2
47	30.3	25.7	45.0	40.0	Total	4.5	419844	4969374	129.3
48	29.8	24.5	45.0	40.0	Total	4.5	419813	4969419	128.5
49	30.4	25.8	45.0	40.0	Total	4.5	419857	4969341	129.5
50	30.0	25.4	45.0	40.0	Total	4.5	419817	4969388	128.9
51	38.1	32.2	45.0	40.0	Total	4.5	420453	4969017	119.5
52	38.9	32.1	45.0	40.0	Total	4.5	420458	4969011	119.5
53	38.9	32.1	45.0	40.0	Total	4.5	420462	4969007	119.4
54	38.9	32.1	45.0	40.0	Total	4.5	420474	4969005	119.0
55	29.9	25.3	45.0	40.0	Total	4.5	419814	4969357	129.5
56	32.4	26.6	45.0	40.0	Total	4.5	419943	4969174	129.5
57	30.1	25.6	45.0	40.0	Total	4.5	419854	4969260	129.5
58	30.3	26.0	45.0	40.0	Total	4.5	419874	4969236	129.5
59	21.9	16.5	45.0	40.0	Total	4.5	419790	4970182	134.5
60	30.1	25.9	45.0	40.0	Total	4.5	419867	4969227	129.5
61	32.4	26.9	45.0	40.0	Total	4.5	419966	4969133	129.1
62	29.8	25.4	45.0	40.0	Total	4.5	419836	4969249	129.5
63	30.0	25.8	45.0	40.0	Total	4.5	419855	4969225	129.5
64	32.3	26.8	45.0	40.0	Total	4.5	419965	4969122	129.2
65	32.2	26.7	45.0	40.0	Total	4.5	419951	4969133	129.5
66	29.0	23.3	45.0	40.0	Total	4.5	419825	4969243	129.5
67	29.2	23.9	45.0	40.0	Total	4.5	419841	4969223	129.5
68	32.0	26.5	45.0	40.0	Total	4.5	419943	4969121	129.5
69	27.4	23.6	45.0	40.0	Total	4.5	419829	4969221	129.5
70	31.6	25.8	45.0	40.0	Total	4.5	419881	4969162	129.5
71	32.0	26.5	45.0	40.0	Total	4.5	419949	4969100	129.5
72	29.8	25.7	45.0	40.0	Total	4.5	419869	4969163	129.5
73	28.7	24.2	45.0	40.0	Total	4.5	419719	4969361	130.1
74	27.0	23.3	45.0	40.0	Total	4.5	419812	4969221	129.5
75	29.7	25.6	45.0	40.0	Total	4.5	419859	4969163	129.5
76	29.0	23.7	45.0	40.0	Total	4.5	419848	4969162	129.5
77	27.2	23.5	45.0	40.0	Total	4.5	419837	4969162	129.5
78	31.8	26.7	45.0	40.0	Total	4.5	419953	4969050	129.5
79	26.5	22.9	45.0	40.0	Total	4.5	419796	4969190	129.5
80	26.7	23.1	45.0	40.0	Total	4.5	419816	4969157	129.5
81	34.0	29.1	45.0	40.0	Total	4.5	420269	4968892	123.0
82	26.3	22.8	45.0	40.0	Total	4.5	419794	4969166	129.5
83	26.4	22.9	45.0	40.0	Total	4.5	419801	4969157	129.5
84	31.6	26.5	45.0	40.0	Total	4.5	419958	4969018	129.5
85	33.8	28.9	45.0	40.0	Total	4.5	420252	4968888	123.3
86	17.7	14.4	45.0	40.0	Total	4.5	419721	4970276	134.5
87	25.2	23.6	45.0	40.0	Total	4.5	420975	4970514	114.5
88	26.3	25.1	45.0	40.0	Total	4.5	421029	4970495	114.5
89	31.2	26.1	45.0	40.0	Total	4.5	419964	4968961	129.5

ID	Level Lp		Limit. Value		Noise Type	Height	Coordinates		
	Day (dBA)	Night (dBA)	Day (dBA)	Night (dBA)		(m)	X (m)	Y (m)	Z (m)
90	17.4	14.1	45.0	40.0	Total	4.5	419692	4970307	134.5
91	17.1	14.1	45.0	40.0	Total	4.5	419992	4970578	129.6
92	26.0	24.7	45.0	40.0	Total	4.5	421058	4970505	114.5
93	16.9	13.9	45.0	40.0	Total	4.5	419958	4970579	130.2
94	16.9	13.9	45.0	40.0	Total	4.5	419972	4970592	129.9
95	16.9	13.9	45.0	40.0	Total	4.5	419986	4970605	129.7
96	16.9	13.9	45.0	40.0	Total	4.5	420002	4970616	129.5
97	16.9	14.0	45.0	40.0	Total	4.5	420035	4970638	129.5
98	16.4	13.6	45.0	40.0	Total	4.5	420045	4970650	129.5
99	16.4	13.7	45.0	40.0	Total	4.5	420060	4970665	129.5
100	16.1	13.0	45.0	40.0	Total	4.5	420071	4970681	129.5



N

Sub Substation Transformer

Inv# Inverter Cluster

Noise Receptor

Representative Noise Receptor

From 40 to 45 dBA

From 45 to 50 dBA

From 50 to 55 dBA

From 55 to 60 dBA

Over 60 dBA

RE Smiths Falls 1 ULC

RE Smiths Falls 1 Solar Project – Noise Map at 4.5m during Day Time

0 120 240 360 480 600 m

SCALE 1:7,500

Figure C1

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RE Smiths Falls 1 ULC

RE Smiths Falls 1 Solar Project – Noise Map at 4.5m during Night Time

Figure C2

HATCH™

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