



- **Future Solar Developments Inc.**

## **Acoustic Assessment Report**

**Type of Document**  
Final

**Project Name**  
Acoustic Assessment Report LP#7

**Project Location**  
9274 Union Drive, Strathroy-Caradoc, ON

**Project Number**  
WSL-00002250-A0

**Prepared By:**

**exp**  
561 Bryne Drive, Unit D  
Barrie, ON L4N 9Y3  
CANADA

**Acoustic Assessment Report, LP# 7**  
**9274 Union Drive, Strathroy-Caradoc, ON**

Prepared for  
**Future Solar Developments Inc.**  
**8-3400 Pharmacy Ave.**  
**Scarborough, ON**  
**M1W 3J8**

Prepared By:



---

Rebecca Orth, B.Sc.  
Environmental Scientist

Reviewed By:



---

Bob Jowett, B.Sc.  
Team Leader, Environmental Division

**Exp** Services Inc.  
561 Bryne Drive  
Barrie, ON  
L4N 9Y3  
T: 705.734.6222  
F: 705.734.6224  
[www.exp.com](http://www.exp.com)

**Distribution:**

3 Copies      –      Future Solar Developments Inc., Scarborough, ON

February 2012



#### Version Control

Version	Date	Revision Description	Author Initials	Reviewer Initials
1.0	February 16, 2012	Original Report	CRT	LO.

## Executive Summary

**Exp** services Inc. (**exp**) was retained by Future Solar Developments Inc. to conduct an acoustic assessment for a proposed solar facility that will be installed on the site located at 9274 Union Drive in the Township of Strathroy-Caradoc (herein referred to as the “Site”). The assessment was required for a Type 3 solar panel project under O.Reg. 359/09, Renewable Energy Approvals Under Part V.0.1 of the Act as amended by O.Reg. 521/10 and O.Reg. 231/11.

The proposed facility would comprise of a solar panel array, ground mounts for the array, twenty (20) Aurora PV Inverters (model PVI-5000-OUTD-US) to convert Direct Current (DC) energy harvested by the panels to Alternating Current (AC), and one (1) transformer to step-up the power to enable feed into the Hydro One distribution system.

The proposed facility is to be located at 9274 Union Drive in the Township of Strathroy-Caradoc in Ontario, west of Amiens Road and north of Union Drive. The solar equipment is to be located to the northwest of the existing property buildings (see Site plans in Appendix A).

In addition to project LP#7, a similar project (LP#1) is proposed for 9307 Union Drive. As these projects have the potential to impact on coincident points of reception the potential noise impact of both proposed projects operating simultaneously has been assessed within this report.

The noise assessment conducted and reported below was based on MOE guidance documentation (“Basic Comprehensive Certificates of Approval (Air) – User Guide”, MOE, 2004). The following summary presents results, conclusions, and recommendations:

Equipment to be operated at the site that has the potential to give rise to environmental noise is limited to twenty (20) inverters and one (1) transformer. The operation of solar panels does not give rise to environmental noise.

The critical noise receptors have been identified as permanent residences. Point of Reception 1 (POR1) is located approximately 160 m northeast of the Site on the north side of Union Drive and POR2 is located approximately 160 m east of the Site on the south side of Union Drive. Reported distances are between noise sources and the reception property boundary; this distance is less than the distance between the sources and any point 30 m from the POR dwelling as defined in Section 7 of NPC-232.

Potential noise impact from operation of the solar facility on the critical receptors was calculated and assessed versus criteria detailed in MOE NPC-232.

Solar facilities operate during daylight hours, the earliest sunrise at the Site is approximately 5:45 am and the latest sunset is approximately 9:10 pm. As such, it is appropriate to evaluate the project against MOE daytime (07:00 – 19:00), evening (19:00 – 23:00) and nighttime (23:00 – 07:00) hours.

Simultaneous operation of stationary sources results in a calculated maximum noise impact of 29 dBA at the permanent residences POR 1 (including stationary sources associated with the proposed solar facility LP#1), and 25 dBA at POR2 (excluding stationary sources associated

with the proposed solar facility LP#1 as this proposed facility is located at POR2). As the calculated worst predictable case noise impacts are significantly lower than the applicable MOE exclusionary limits of 45 / 40 / 40 dBA for daytime / evening /nighttime periods respectively, it is concluded that the proposed facility would be in compliance with MOE noise criteria.

*This executive summary is a brief summary of the report and should not be used as substitute for reading the report in its entirety.*

# Table of Contents

	Page
<b>Executive Summary .....</b>	<b>i</b>
<b>Table of Contents .....</b>	<b>iii</b>
<b>1 Introduction .....</b>	<b>1</b>
<b>2 Facility Description .....</b>	<b>2</b>
<b>3 Noise Source Summary .....</b>	<b>3</b>
3.1 Noise Sources .....	3
3.2 Road Traffic.....	3
3.3 Technical Information – Sources.....	3
<b>4 Points of Reception.....</b>	<b>4</b>
<b>5 Assessment Criteria (Performance Limits).....</b>	<b>4</b>
<b>6 Impact Assessment.....</b>	<b>6</b>
<b>7 Impact of Known Additional Planned Solar Facilities .....</b>	<b>7</b>
<b>8 Proposed Noise Control Measures.....</b>	<b>8</b>
<b>9 Conclusions.....</b>	<b>9</b>
<b>10 References .....</b>	<b>10</b>
<b>11 Limitations .....</b>	<b>11</b>

## List of Appendices

**Appendix A – Figures**

**Appendix B – Tables**

**Appendix C – Manufacturer's Data**

**Appendix D – Calculations**

# 1 Introduction

**Exp** services Inc. (**exp**) was retained by Future Solar Developments Inc. to prepare an acoustic assessment report (AAR) for a proposed solar facility on the site located at 9274 Union Drive in the Township of Strathroy-Caradoc (herein referred to as the "Site"). The assessment was required for a Type 3 solar panel project under O.Reg. 359/09, Renewable Energy Approvals under Part V.0.1 of the Act as amended by O.Reg. 521/10 and O.Reg. 231/11.

The proposed facility would comprise of a solar panel array, ground mounts for the array, twenty (20) Aurora PV Inverters (model PVI-5000-OUTD-US) to convert DC energy harvested by the panels to AC, and one (1) transformer to step-up the power to enable feed into the Hydro One distribution system.

The proposed facility is to be located at 9274 Union Drive in the Township of Strathroy-Caradoc in Ontario, to the southwest of Amiens Road and the northwest of Union Drive. The solar equipment is to be located to the northwest of the existing property buildings (see Site plans in Appendix A).

In addition to project LP#7, a similar operation (LP#1) is proposed for a neighbouring property (9307 Union Drive, identified as POR2 in this report). Due to the proximity of the proposed operations, the potential noise impact of both proposed facilities operating simultaneously has been assessed within this report for common points of reception.

The proposed project is considered a Type 3 Renewable Energy Project as it would have a maximum name plate capacity greater than 12 kW. The electricity produced by the solar facility is intended to be fed into a local Hydro One distribution line. Equipment to be installed at the facility complies with the Ontario manufactured percentages as required by the Ontario Power Authority's Feed-in-Tariff Program.

This report assesses noise arising from identified sources, details the anticipated impact on the nearest receptors, and evaluates the calculated impact versus MOE criteria.

In accordance with legislative requirements, a copy of this report is to be made available to interested parties including the public and the local municipality at least 60 days prior to the final public consultation meeting.



## 2 Facility Description

The proposed facility consists of a ground-mounted solar array that will produce electricity from the sun's energy. The direct current generated by the solar array will be converted into alternating current and transformed to enable power to be fed into the Hydro One Network.

The proposed solar array will be attached to mounts on concrete blocks installed in the ground and will occupy an area of approximately 66 by 37 metres. As such the facility represents a fixed system and therefore the array will not produce any noise (c.f. sun tracking arrays). The associated inverters and transformer will be located to the west side of the solar array (south of the existing farm buildings).

The surrounding land use to the south, north and west is designated as General Agriculture (A1). Zoning maps have been included in Appendix A, as well as Site Plan Aerial maps which show details of the surrounding properties. Given the existing land use and land use in the surrounding area, the project is considered to be in a rural environment. Whilst background sound measurements have not been taken in support of this assessment, the acoustical environment is expected to be dominated by natural sounds as the closest significant roads are Amiens Road approximately 900 m from the Site and Highway 402 approximately 1.5 km from the Site.

Solar facilities operate during daylight hours, the earliest sunrise at the Site is approximately 5:45 am and the latest sunset is approximately 9:10 pm. As such, it is appropriate to evaluate the project against MOE daytime (07:00 – 19:00), evening (19:00 – 23:00) and night-time (23:00 – 07:00) hours.

## 3 Noise Source Summary

The locations of all noise sources can be found in the Site Location Aerial Maps (Appendix A).

### 3.1 Noise Sources

The following noise sources were identified:

- Twenty (20) Aurora PV Inverters (model PVI-5000-OUTD-US) located northwest of the farm buildings; and,
- One (1) oil-filled step-up transformer (make and model to be confirmed) located adjacent to the inverter.

The proposed solar array is a fixed system and therefore does not include motors etc. as required with tracking systems.

### 3.2 Road Traffic

Other than construction traffic, the proposed renewable energy project will result in minimal increase in on-site road traffic associated with troubleshooting / maintenance visits as required. As such visits will be infrequent, road traffic noise associated with the proposed project is considered negligible.

### 3.3 Technical Information – Sources

Table 1 summarizes the specifications and locations of each significant stationary noise source of the proposed renewable solar energy project:

**Table 3.1. Technical Information and Locations of Noise Source**

ID	Description	Location	Make	Model #	Rating
I01 – I20	Inverters	Northwest of farm buildings, 9274 Union Drive, Strathroy-Caradoc, ON. Detailed location indicated on map in Appendix A.	Aurora	PVI-5000-OUTD-US	5000 W
T01	Transformer	Adjacent to inverter	To Be Confirmed	To Be Confirmed	To Be Confirmed

The planned locations of significant noise sources are provided in Figure 1 and approximate co-ordinates are provided in Table 5, Appendix B.

## 4 Points of Reception

Points of Reception for the approval of new sources, including verifying compliance with the Environmental Protection Act, are defined in Publication NPC-205<sup>1</sup> as premises in use, or zoned for future use, as:

- Permanent or seasonal residences;
- Hotels/motels
- Nursing/retirement homes;
- Rental residences;
- Hospitals;
- Camp grounds; and,
- Noise sensitive buildings such as schools and places of worship.

The closest points of reception to the project LP#7 are located approximately 160 m from the project. Other receptors are located >500 m from the proposed project location. Below is a description of each point of reception. The points of reception have been taken as the property boundary for each receptor; this results in a distance lower than that between the sources and a point within 30 m of a dwelling or a camping area as stipulated in Section 7 of NPC-232.

POR1: Located 168 metres northeast of the project noise sources. It is a residential and agricultural property with both a house and a barn/work shed. The property is located north of Union Drive. Source to receptor separation distances based on planned equipment locations are provided in Table 3, Appendix B.

POR2: Located approximately 161 metres east of the project noise sources. It is a residential and agricultural property located south of Union Drive. A solar facility (LP#1) is proposed for this location. Source to receptor separation distances based on planned equipment locations are provided in Table 3, Appendix B.

## 5 Assessment Criteria (Performance Limits)

The subject property is located in the Township of Strathroy-Caradoc, a rural area (Class 3 Area). Criteria for assessing the impact of noise from stationary sources are provided in the MOE Publication NPC-232 (Sound Level Limits for Stationary Sources in Class 3 Areas (Rural), October 1995, Ministry of the Environment):

**NPC-232 Table 232-1: Minimum Values of One Hour  $L_{eq}$  or  $L_{lm}$  by Time of Day**

	One Hour $L_{eq}$ (dBA) or $L_{LM}$ (dBA)
Time of Day	Class 3 Area
07:00 – 19:00	<b>45</b>
19:00 – 23:00	<b>40</b>
23:00 – 07:00	<b>40</b>

Dependent on day of the year, the facility may generate electricity between 5:45 and 21:10. Both POR1 and POR2 are located in Class 3 areas where background noise is anticipated to be dominated by natural sounds. Therefore, the appropriate limits for total equipment operation are the MOE exclusionary limits of 45 dBA / 40 dBA (Class 3 Area, 07:00 – 19:00 (daytime operation) / 19:00 – 7:00 (evening and nighttime operation)).

## 6 Impact Assessment

Noise produced by the inverters was assessed by using the sound rating given in the manufacturer's specifications for the unit. The inverter manufacturer's specifications are provided in Appendix C.

In the absence of a selected make and model number, noise produced by the transformer was assessed based on data published in Table 0.3 of NEMA Standards Publication No. TR 1-1993 (R2000). The transformer size was conservatively assumed to be in the range 101 – 300 kVA (expected size is 100 kVA).

As the noise producing stationary sources at the facility are limited to twenty (20) identical inverters and one (1) transformer, a simple assessment considering only attenuation due to geometric divergence using procedures detailed in ISO 9613 Part 2 has been conducted. This method of assessment is expected to produce a conservative estimate of noise impact as no consideration is given to attenuation through ground absorption, atmospheric absorption or barrier affects.

The predicted sound levels at the selected PORs due to operation of each noise source are summarized in Table 3 (Appendix B). Distances between each source and POR are also provided in this table.

Sample calculations are provided in Appendix D and an Acoustic Assessment Summary Table is provided as Table 4 in Appendix B.

Consideration of an additional solar facility known to be planned within 500 m of POR1 is provided in Section 7. The combined noise impact due to all of these known proposed solar facilities in simultaneous operation is summarized below.

## 7 Impact of Known Additional Planned Solar Facilities

**Exp** has been requested to conduct a noise assessment of an additional proposed solar facility, Project LP#1, to be located at 9307 Union Drive. Implementation of both LP#1 and LP#7 would result in the operation of stationary noise sources in addition to those identified above with the potential to impact the points of reception discussed in this report. To determine the predictable worst case noise impact, the potential noise arising from simultaneous operation of all stationary sources associated with proposed solar facilities located in and around 9274 Union Drive in the Township of Strathroy-Caradoc has been calculated at critical points of reception:

**Combined Impact Summary Table**

POR ID	POR Description	Time of Day	Sound Level at POR due to LP#1 (dBA)	Sound Level at POR due to LP#7 (dBA)	Total sound level at POR (dBA)	Performance Limit (dBA) Leq	Compliance with Performance Limit (Yes/No)
POR1	Permanent residence	Day	27	24	<b>29</b>	45	Yes
		Evening/night	27	24	<b>29</b>	40	Yes

## 8 Proposed Noise Control Measures

Noise control measures are not necessary for this renewable energy project since the noise resulting from the operation of the solar panels results in a noise level below the MOE exclusionary limits for daytime, evening and nighttime operation.

## 9 Conclusions

It is concluded that operation of stationary sources associated with proposed Project LP#7 at the Site located at 9274 Union Drive, in the Township of Strathroy-Caradoc, Ontario would result in noise levels at critical points of reception that are below MOE exclusionary limits for a Class 3 Area.

It is further concluded that, with respect to noise impact, operation of the proposed site would be compatible with existing land use planning guidance.

Simultaneous operation of the facility with the additional planned solar facility, LP#1, at 9307 Union Drive would result in noise levels at critical points of reception that are below MOE exclusionary limits for a Class 3 Area.



## 10References

1. International Organization for Standardization, ISO 9613-2: *Acoustics – Attenuation of Sound During Propagation Outdoors Part 2: General Method of Calculation*, Geneva, Switzerland, 1996.
2. Ontario Ministry of the Environment, *Publication NPC-232: Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)*, October 1995.
3. Ontario Ministry of the Environment, *Publication NPC-233: Information to be Submitted for Approval of Stationary Sources of Sound*, October 1995.
4. Ontario Ministry of the Environment, *Model Municipal Noise Control by-Law Publication NPC-103*, August 1978.
5. Ontario Ministry of the Environment, *Model Municipal Noise Control By-Law Publication NPC-104*, August 1978.
6. Ontario Ministry of the Environment, Environmental Assessment and Approvals Branch, *Basic Comprehensive Certificates of Approval (Air) User Guide Version 2.0*, April 2004.

## 11 Limitations

The objective of this report was to assess noise impact from operation of equipment and processes within the context of our contract with respect to existing Regulations and Guidelines within the applicable jurisdiction. Compliance of past and current owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services.

The conclusions of this report are based, in part, on the information provided by others and any testing and analyses described in the report. The possibility remains that unexpected environmental conditions may be encountered. Should such an event occur, **exp** should be notified in order that we may determine if modifications to our conclusions are necessary.

This report has been prepared for the exclusive use of Future Solar Developments Inc. in accordance with accepted environmental study and/or engineering practices for a Noise Study. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of the Survey and included in this report. Any use which a third party makes of this report, or any part hereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

## **Appendix A – Figures**



Exp Services Inc.

561 Bryne Drive, Barrie, Ontario L4N 9Y3  
(705) 734-6222



Drawing Title: Site Plan Closest Receptors LP7

Prepared By: Rebecca Orth

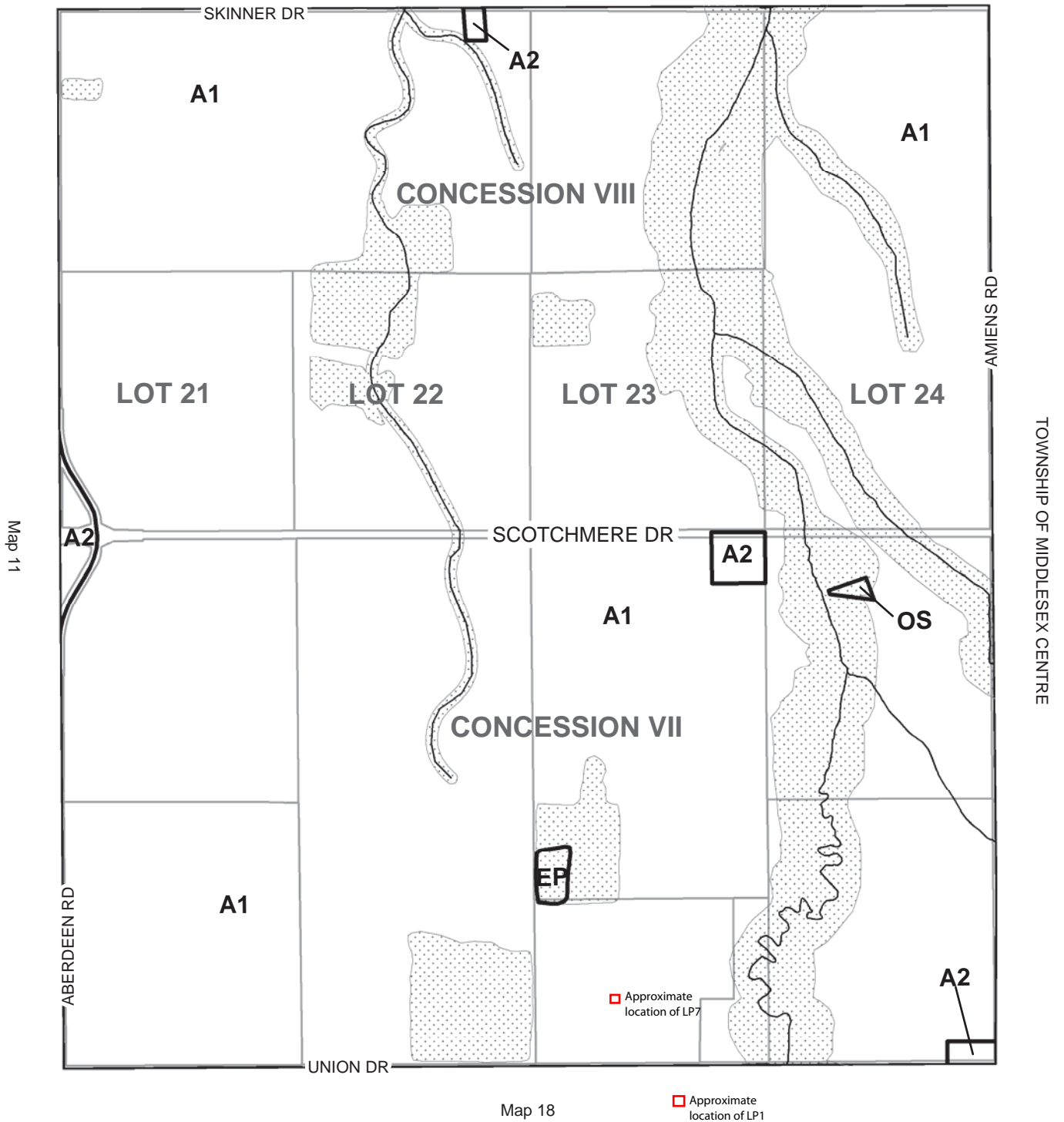
Date: February 2012

Project No.: WSL-00002250-00

Acoustic Assessment, LP7

Future Solar Developments Inc.  
8-3400 Pharmacy Ave.  
Scarborough, Ontario M1W 3J8

Map 6




Map 18

Approximate location of LP1



**MUNICIPALITY OF STRATHROY-CARADOC BY-LAW No. 43-08**

**LEGEND**

 Natural Environment Overlay

**1:15,000**

0 145 290 580

Metres

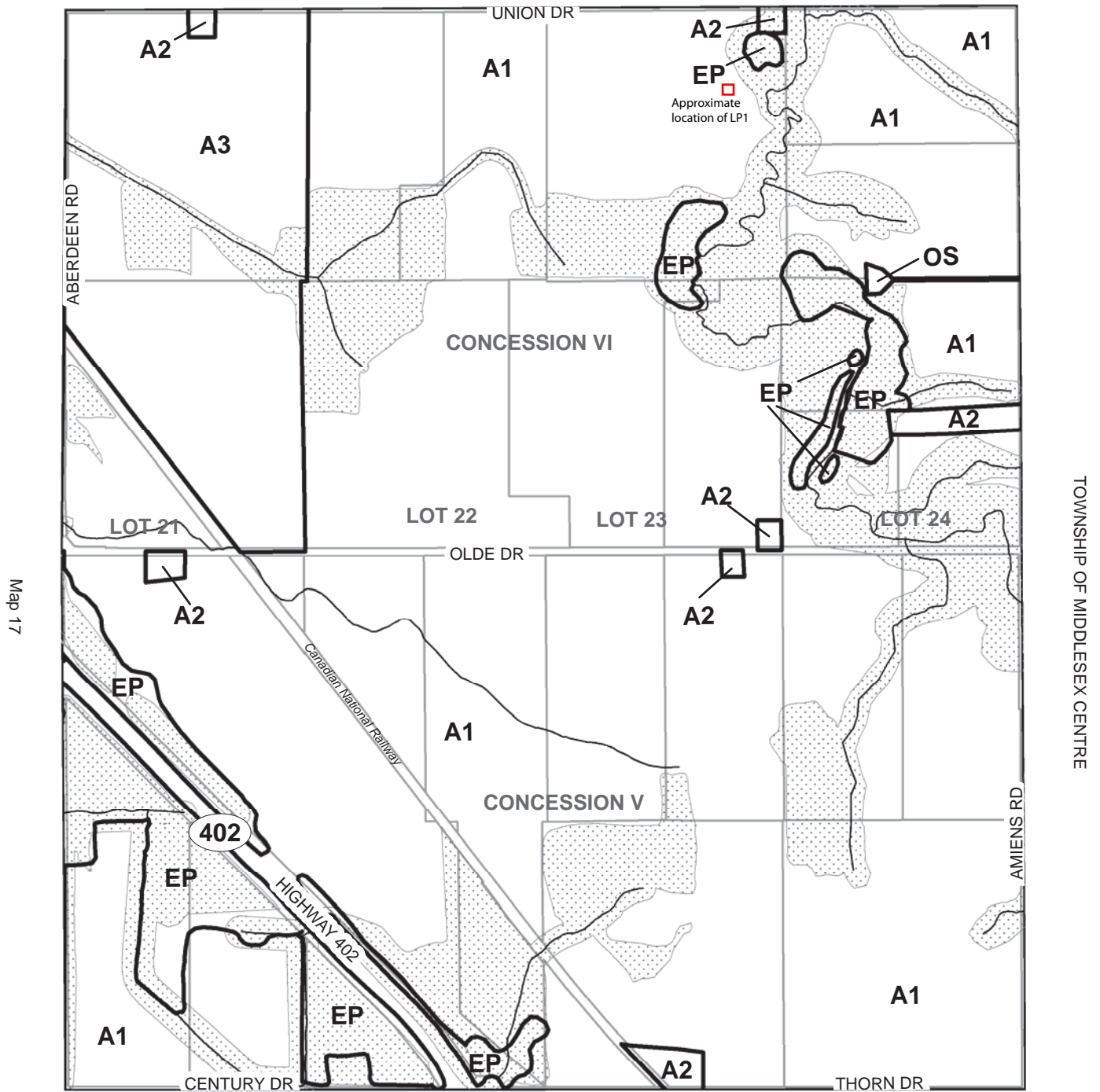


**SCHEDULE 'A'**  
**MAP #12**



Map 12

Approximate location of LP7



Map 17


TOWNSHIP OF MIDDLESEX CENTRE

Map 24



MUNICIPALITY OF STRATHROY-CARADOC BY-LAW No. 43-08

LEGEND

 Natural Environment Overlay

1:15,000

0 150 300 600

Metres



SCHEDULE 'A'  
MAP #18



DRAFT



LEGEND

- ⊗ POINT OF CONNECTION
- PROPERTY LIMIT
- APPROX. SCRPA REGULATION BOUNDARY




STATISTICS:

NUMBER OF MODULES: 507  
NUMBER OF MODULES PER STRING: 13  
NUMBER OF STRINGS: 39  
PANEL TYPE: CANADIAN SOLAR CS6P-230  
FEEDER NAME: M24  
CONNECTION VOLTAGE: 16kV

NOTE:  
AERIAL IMAGERY, TOPOGRAPHIC INFORMATION, AND PROPERTY LIMITS SHOWN AS SUPPLIED BY FIRST BASE SOLUTIONS.

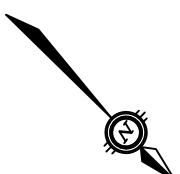
NOTES  
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMANS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THIS PLAN. THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, CONTRACTORS SHALL VERIFY THE LOCATION OF ALL UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

PRELIMINARY  
NOT FOR CONSTRUCTION

										SCALE		DESIGNED BY		REVIEWED BY		CLIENT																	
										HOZ 1:750 VERT 1:30						FUTURE SOLAR DEVELOPMENTS INC.																	
																3400 PHARMACY AVE., SCARBOROUGH, ON																	
REVISION DESCRIPTION										DATE		BY		APP'D NO.		ISSUED FOR 777777		DATE		BY		APP'D		PROJECT									
1																								FUTURE SOLAR									
																								9274 UNION DR., STRATHROY, ON									
																								PRELIMINARY SITE PLAN									
																								LP7									
																								SP 3									






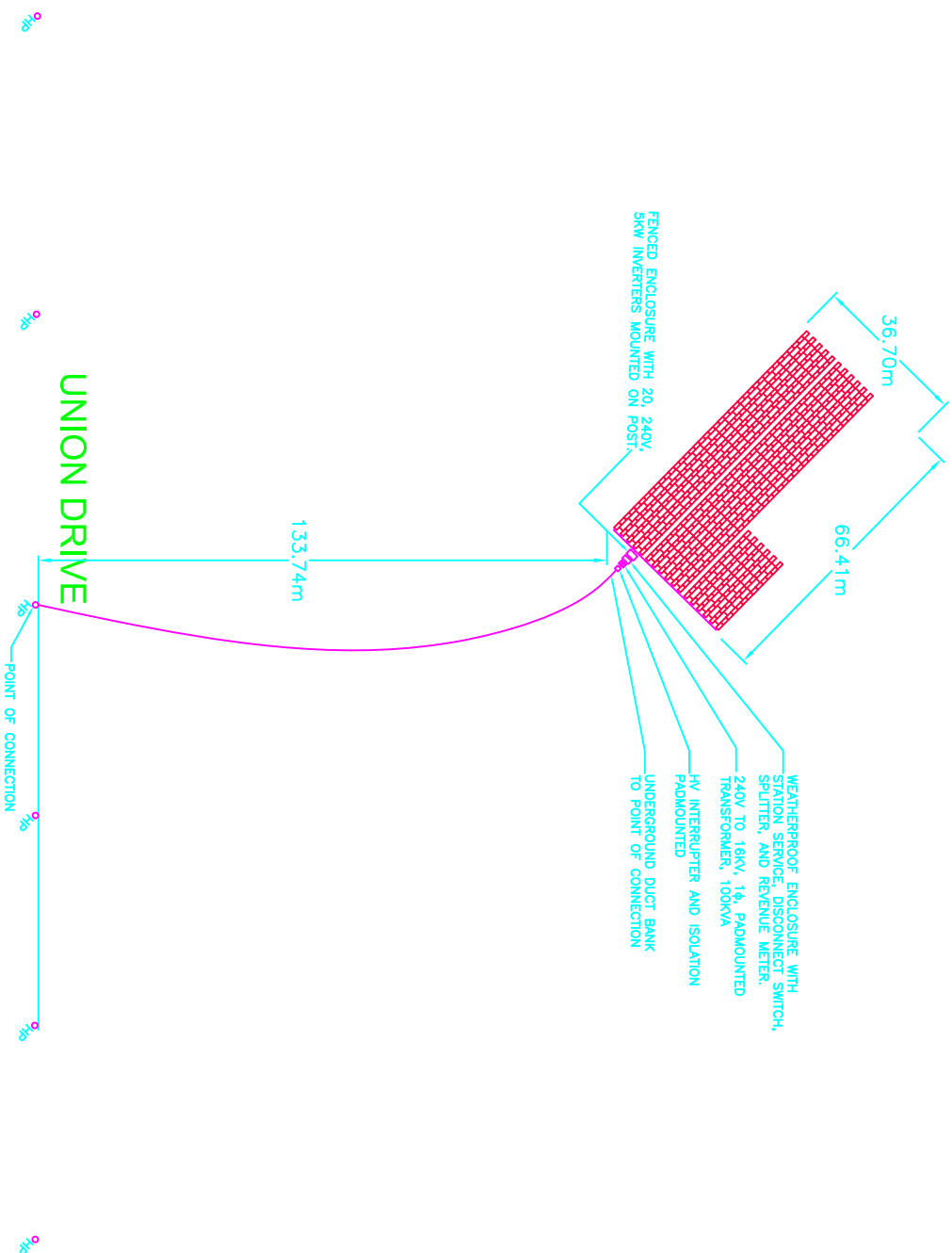
DRAFT



## KEY PLAN

### LEGEND

-  POINT OF CONNECTION  
 PROPERTY LIMIT  
 APPROX. SCIRCA REGULATION BOUNDARY



## STATISTICS:

NUMBER OF MODULES: 507  
NUMBER OF MODULES PER STRING: 13  
NUMBER OF STRINGS: 39  
PANEL TYPE: CANADIAN SOLAR CS6P-230  
FEEDER NAME: M24  
CONNECTION VOLTAGE: 16kV


NOTE: AERIAL IMAGERY, TOPOGRAPHIC INFORMATION, AND PROPERTY LIMITS SHOWN AS SUPPLIED BY FIRST BASE SOLUTIONS.

## NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMANS, SPINNERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES, AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.


**PRELIMINARY**  
**NOT FOR CONSTRUCTION**

[illegible]

<p><b>SCALE</b></p> <p><b>HORIZ 1:750</b> <b>VERT 1:50</b></p> 
---

03/26/2010

and conclude

 <b>FUTURE SOLAR DEVELOPMENTS, INC.</b> 3400 PHARMACY AVE., SCARBOROUGH, ON		<b>INDUSTRIAL</b> KCH J.W. J.W.		<b>PRODUCT</b> FUTURE SOLAR 9274 UNION DR., STRATHROY, ON		<b>PROJ. NO.</b> 11-080 <b>SKETCH</b> FTS <b>DATE</b> OCT. 7, 2011	
<b>HAZARDOUS WASTE CONSULTING &amp; OFFICE INC.</b> 60 Leavelle Road, Toronto, Ontario Canada M8T 2T8 Tel: (416) 444-1063 E: info@hwi.ca		<b>CD</b> SCG PROJ. NO. 11-080 PREPARED BY B.B.		<b>TITLE</b> PRELIMINARY SITE PLAN LP7		<b>DRAWN BY</b> ES-3	



## **Appendix B – Tables**

**Table 1: Noise Summary Table**

<b>Source</b>	<b>Sound Power Level (dBA)</b>	<b>Location</b>	<b>Sound Characteristics</b>	<b>Existing Noise Control Measures</b>
I01 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I02 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I03 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I04 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I05 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I06 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I07 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I08 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I09 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I10 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I11 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I12 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I13 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I14 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I15– Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I16 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I17 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I18– Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I19 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
I20 – Aurora PVI	66.0 <sup>a</sup>	O	S, T	U
Transformer (liquid filled)	71.0 <sup>a</sup>	O	S, T	U

<sup>a</sup> A 5 dB penalty has been applied to these sources as required by the MOE publication NPC 104, and included in the Sound Power Level provided in this table.

Location	Sound Characteristics	Existing Noise Control Measures
O – Outside building I – Inside building	S – Steady QSI – quasi-steady impulsive I – Impulsive B – Buzzing T – Tonal C – Cyclic	S – Silencer A – Acoustic Lining B – Barrier L - Lagging E – Enclosure O – Other U – Uncontrolled

**Table 2: Performance Limits Summary Table**

Point of Reception ID	MOE Designation	Performance Limit (dBA)	
		Day-time	Evening / Night-time
POR1	Class 3	45	40
POR2	Class 3	45	40
POR3	Class 3	45	40

**Table 3: Point of Reception Noise Impact Table**

Source ID	POR1			POR3		
	Distance <sup>a</sup> (m)	Sound Level (dBA)		Distance <sup>a</sup> (m)	Sound Level (dBA)	
		Day	Evening /Night		Day	Evening /Night
I01 – Aurora PVI	168	10	11	11	11	11
I02 – Aurora PVI	167	11	11	11	11	11
I03 – Aurora PVI	166	11	11	11	11	11
I04 – Aurora PVI	165	11	11	11	11	11
I05 – Aurora PVI	164	11	11	11	11	11
I06 – Aurora PVI	168	11	11	11	11	11
I07 – Aurora PVI	167	11	11	11	11	11
I08 – Aurora PVI	166	11	11	11	11	11
I09 – Aurora PVI	165	11	11	11	11	11
I10 – Aurora PVI	164	11	11	11	11	11
I11 – Aurora PVI	167	11	11	11	11	11
I12 – Aurora PVI	166	11	11	11	11	11

Source ID	POR1			POR3		
	Distance <sup>a</sup> (m)	Sound Level (dBA)		Distance <sup>a</sup> (m)	Sound Level (dBA)	
		Day	Evening /Night		Day	Evening /Night
I13 – Aurora PVI	165	11	11	11	11	11
I14 – Aurora PVI	165	11	11	11	11	11
I15 – Aurora PVI	164	11	11	11	11	11
I16 – Aurora PVI	167	11	11	11	11	11
I17 – Aurora PVI	166	11	11	11	11	11
I18 – Aurora PVI	165	11	11	11	11	11
I19 – Aurora PVI	164	11	11	11	11	11
I20 – Aurora PVI	163	11	11	11	11	11
T01	162	16	16	16	16	16

<sup>a</sup> Calculated distances are based on best available data regarding source locations.

**Table 4: Acoustic Assessment Summary Table**

POR ID	POR Description	Time of Day	Sound Level at POR (dBA)	Verified by Acoustic Audit? (Yes/No)	Performance Limit (dBA) Leq	Compliance with Performance Limit (Yes/No)
POR1	Permanent residence	Day	24	No	45	Yes
		Evening/ night	24	No	40	Yes
POR2	Permanent residence	Day	25	No	45	Yes
		Evening/ night	25	No	40	Yes

**Table 5: Source and Receptor Co-ordinates**

Item	Identifier	UTM Easting <sup>1</sup>	UTM Northing
Source	I01	457852	4757070
	I02	457853	4757070
	I03	457854	4757070
	I04	457855	4757070
	I05	457856	4757070

Item	Identifier	UTM Easting <sup>1</sup>	UTM Northing
	I06	457852	4757071
	I07	457853	4757071
	I08	457854	4757071
	I09	457855	4757071
	I10	457856	4757071
	I11	457852	4757072
	I12	457853	4757072
	I13	457854	4757072
	I14	457855	4757072
	I15	457856	4757072
	I16	457852	4757073
	I17	457853	4757073
	I18	457854	4757073
	I19	457855	4757073
	I20	457856	4757073
	T01	457857	4757074
Receptor	POR1	458007	4757135
	POR2	458011	4757042

<sup>1</sup> Zone 17

## **Appendix C – Manufacturer's Data**

## PVI-5000-OUTD-US PVI-6000-OUTD-US

### GENERAL SPECIFICATIONS OUTDOOR MODELS

Designed for residential and small commercial PV installations, this inverter fills a specific niche in the Aurora product line to cater for those installations producing between 5kW and 20kW.

This inverter has all the usual Aurora benefits, including dual input section to process two strings with independent MPPT, high speed and precise MPPT algorithm for real-time power tracking and energy harvesting, as well as transformerless operation for high performance efficiencies of up to 97.1%.

The wide input voltage range makes the inverter suitable to low power installations with reduced string size. This outdoor inverter has been designed as a completely sealed unit to withstand the harshest environmental conditions.

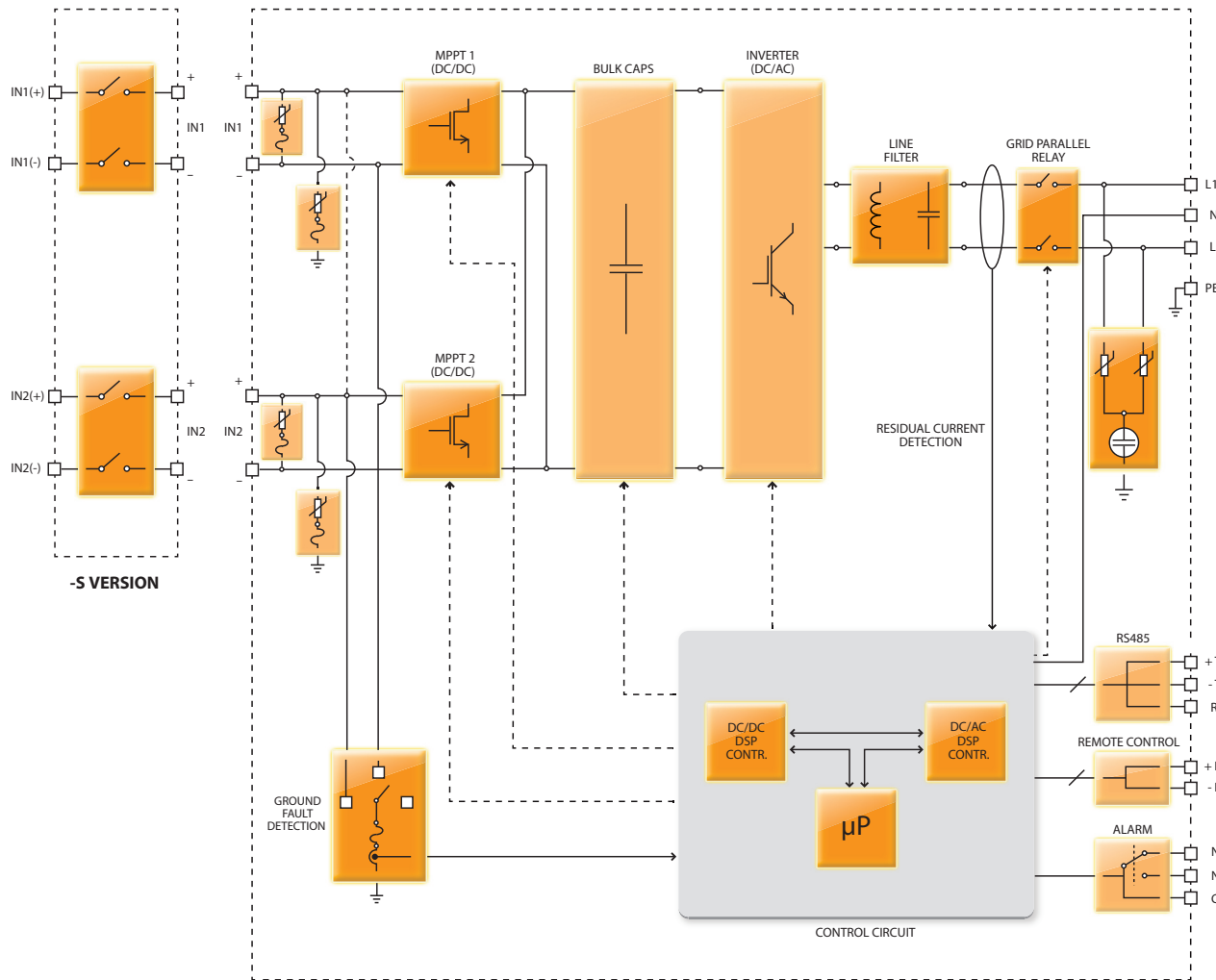


AURORA UNO

## Features

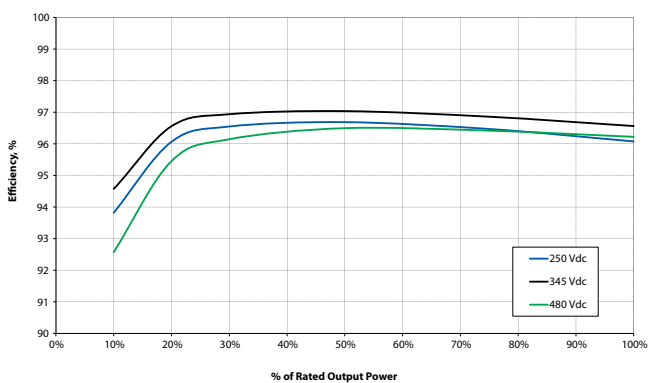
- Each inverter is set on specific grid codes which can be selected in the field
- Single phase output
- Dual input sections with independent MPP tracking, allows optimal energy harvesting from two sub-arrays oriented in different directions
- Wide input range
- High speed and precise MPPT algorithm for real time power tracking and improved energy harvesting
- Flat efficiency curves ensure high efficiency at all output levels ensuring consistent and stable performance across the entire input voltage and output power range
- Outdoor enclosure for unrestricted use under any environmental conditions
- RS-485 communication interface (for connection to laptop or datalogger)
- Compatible with PVI-RADIOMODULE for wireless communication with Aurora PVI-DESKTOP

## BLOCK DIAGRAM OF PVI-5000-OUTD AND PVI-6000-OUTD FOR NORTH AMERICA

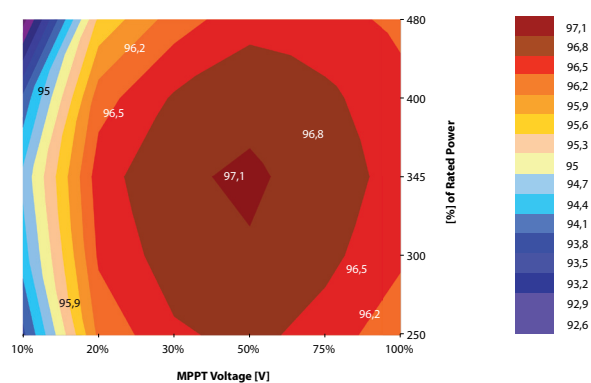


## Block Diagram and Efficiency Curves

PVI-6000-OUTD-US



PVI-6000-OUTD-US





PARAMETER	PVI-5000-OUTD-US			PVI-6000-OUTD-US		
Input Side						
Absolute Maximum DC Input Voltage (V <sub>max,abs</sub> )	600 V					
Start-up DC Input Voltage (V <sub>start</sub> )	200 V (adj. 120...350 V)					
Operating DC Input Voltage Range (V <sub>dcmín...V<sub>dcmax</sub></sub> )	0.7 x V <sub>start</sub> ...580 V					
Rated DC Input Power (P <sub>dcr</sub> )	5150 W			6180 W		
Number of Independent MPPT	2					
Maximum DC Input Power for each MPPT (P <sub>MPPTmax</sub> )	4000 W					
DC Input Voltage Range with Parallel Configuration of MPPT at P <sub>acr</sub>	200...530 V					
DC Power Limitation with Parallel Configuration of MPPT	Linear Derating From MAX to Null [530V≤V <sub>MPPT</sub> ≤580V]					
DC Power Limitation for each MPPT with Independent Configuration of MPPT at P <sub>acr</sub> , max unbalance example	4000 W [225V≤V <sub>MPPT</sub> ≤530V] the other channel: P <sub>dcr</sub> -4000W [90V≤V <sub>MPPT</sub> ≤530V]			4000 W [230V≤V <sub>MPPT</sub> ≤530V] the other channel: P <sub>dcr</sub> -4000W [120V≤V <sub>MPPT</sub> ≤530V]		
Maximum DC Input Current (I <sub>dcmáx</sub> ) / for each MPPT (I <sub>MPPTmax</sub> )	36.0 A / 18.0 A					
Maximum Input Short Circuit Current for each MPPT	22.0 A					
Number of DC Inputs Pairs for each MPPT	1					
DC Connection Type	Screw Terminal Block, 3 Knock-Outs: 1 ½" or 1" (w/ Ring Reducer)					
Input Protection						
Reverse Polarity protection	Yes, from limited current source					
Input Over Voltage Protection for each MPPT - Varistor	2					
Photovoltaic Array Isolation Control	GFDI (for use with either Positive or Negative Grounded Arrays)					
DC Switch Rating for each MPPT (-S Version)	25 A / 600 V					
Output Side						
AC Grid Connection Type	208 V	240 V	277 V	208 V	240 V	277 V
Rated AC Power (P <sub>acr</sub> )	Single phase / Split phase					
Maximum AC Output Power (P <sub>acmáx</sub> )	5000 W			6000 W		
Rated AC Grid Voltage (V <sub>acr</sub> )	208 V	240 V	277 V	208 V	240 V	277 V
AC Voltage Range	183...228 V	211...264 V	244...304 V	183...228 V	211...264 V	244...304 V
Maximum AC Output Current (I <sub>ac,máx</sub> )	27.0 A	23.0 A	20.0 A	30.0 A	28.0 A	24.0 A
Rated Output Frequency (f <sub>r</sub> )	60 Hz					
Output Frequency Range (f <sub>mín...f<sub>máx</sub></sub> )	59.3...60.5 Hz					
Nominal Power Factor (Cosphi <sub>acr</sub> )	> 0.995					
Total Current Harmonic Distortion	< 2%					
AC Connection Type	Screw terminal block					
Output Protection						
Anti-Islanding Protection	208 V	240 V	277 V	208 V	240 V	277 V
Maximum AC Overcurrent Protection	According to UL 1741/IEE1547					
Output Overvoltage Protection - Varistor	35.0 A	30.0 A	25.0 A	40.0 A	35.0 A	30.0 A
Operating Performance	2 (L1 - L2 / L1 - PE)					
Maximum Efficiency (η <sub>máx</sub> )	208 V	240 V	277 V	208 V	240 V	277 V
Weighted Efficiency (EURO/CEC)	97.1%			97.1%		
Feed In Power Threshold	96.0%	96.5%	96.5%	96.0%	96.5%	96.5%
Stand-by Consumption	20.0 W					
Communication	< 8.0 W					
Wired Local Monitoring						
Remote Monitoring	PVI-USB-RS485_232 (opt.), PVI-DESKTOP (opt.)					
Wireless Local Monitoring	PVI-AEC-EVO (opt.), AURORA-UNIVERSAL (opt.)					
User Interface	PVI-DESKTOP (opt.) with PVI-RADIOMODULE (opt.)					
Environmental	16 characters x 2 lines LCD display					
Ambient Temperature Range	-25...+60°C (-13...+ 140°F) with derating above 50°C (122°F)					
Relative Humidity	0...100% condensing					
Noise Emission	<50 db(A) @ 1 m					
Maximum Operating Altitude without Derating	2000 m / 6560 ft					
Physical						
Environmental Protection Rating	IP 65					
Cooling	Natural					
Dimension (H x W x D)	1052mm x 325mm x222mm / 41.4" x 12.8" x 8.7"					
Weight	< 27.0 kg / 59.5 lb					
Mounting System	Wall bracket					
Safety						
Isolation Level	Transformerless					
Marking	cCSAus					
Safety and EMC Standard	UL 1741, CSA - C22.2 N. 107.1-01					
Grid Standard	IEEE 1547					
Available Products Variants						
With DC Switch	PVI-5000-OUTD-US			PVI-6000-OUTD-US		



[www.power-one.com](http://www.power-one.com)

**Power-One Renewable Energy Worldwide Sales Offices**

<u>Country</u>	<u>Name/Region</u>	<u>Telephone</u>	<u>Email</u>
<b>Australia</b>	Asia Pacific	+61 2 9735 3111	<a href="mailto:sales.australia@power-one.com">sales.australia@power-one.com</a>
<b>China</b>	Asia Pacific	+86 755 2988 5888 ext.5588	<a href="mailto:sales.china@power-one.com">sales.china@power-one.com</a>
<b>Singapore</b>	Asia Pacific	+65 6896 3363	<a href="mailto:sales.singapore@power-one.com">sales.singapore@power-one.com</a>
<b>France</b>	Europe	00 800 00287672 Choix n°4	<a href="mailto:sales.france@power-one.com">sales.france@power-one.com</a>
<b>Germany</b>	Europe	+49 7641 955 2020	<a href="mailto:sales.germany@power-one.com">sales.germany@power-one.com</a>
<b>Italy</b>	Europe	+39 055 9195 396	<a href="mailto:sales.italy@power-one.com">sales.italy@power-one.com</a>
<b>Spain</b>	Europe	+34 629253564	<a href="mailto:sales.spain@power-one.com">sales.spain@power-one.com</a>
<b>United Kingdom</b>	Europe	+44 1903 823 323	<a href="mailto:sales.UK@power-one.com">sales.UK@power-one.com</a>
<b>Dubai</b>	Middle East	+971 50 100 4142	<a href="mailto:sales.dubai@power-one.com">sales.dubai@power-one.com</a>
<b>Canada</b>	North America	+1 877 261-1374	<a href="mailto:sales.canada@power-one.com">sales.canada@power-one.com</a>
<b>USA East</b>	North America	+1 877 261-1374	<a href="mailto:sales.usaeast@power-one.com">sales.usaeast@power-one.com</a>
<b>USA Central</b>	North America	+1 877 261-1374	<a href="mailto:sales.usacentral@power-one.com">sales.usacentral@power-one.com</a>
<b>USA West</b>	North America	+1 877 261-1374	<a href="mailto:sales.usawest@power-one.com">sales.usawest@power-one.com</a>

## **Appendix D –Calculations**

## Calculation of Sound Power Levels

### ***Inverter***

Aurora PVI specifications indicate a sound pressure level of <50 dB(A) at a distance of 1 m. Sound power level for the inverter has been calculated using the following equation:

$$L_w = L_p - \log(d_r/d_t) + 11$$

Where:

$L_w$  = sound power (dBA)

$d_r$  = Reference distance (1 m)

$d_t$  = Test distance

$$L_w = 51 - \log(1/1) + 11 = 61.0 \text{ dB(A)}$$

In the absence of frequency spectra for the inverter it has been assumed that noise from the inverter is tonal and a 5 dB penalty has therefore been applied as required by Section 4 of NPC-104.

### ***Transformer***

In the absence of a transformer make and model number, sound pressure has been calculated using data published in NEMA TR 1 – 1993 (R2000) Table 0.3. From Table 0.3, for an immersed transformer:

Transformer Size	Average Sound Pressure (at $\leq 1$ m)
51 – 100 kVA	51 dB
101 – 300 kVA	55 dB

Anticipated transformer size is 100 kVA, as this size is at the limit of a size range the average sound pressure (at  $\leq 1$ m) for the next highest size range has been conservatively applied. The sound power level for the transformer has been calculated using the following equation:

$$L_w = L_p - \log(d_r/d_t) + 11$$

Where:

$L_w$  = sound power (dBA)

$d_r$  = Reference distance (1 m)

$d_t$  = Test distance

$$L_w = 55 - \log(1/1) + 11 = 66.0 \text{ dB(A)}$$

In the absence of frequency spectra for the inverter it has been assumed that noise from the transformer is tonal and a 5 dB penalty has therefore been applied as required by Section 4 of NPC-104.

### ***Sound Pressure Levels***

Sound pressure levels have been calculated conservatively assuming that sound attenuation between the source and the PORs was due solely to geometric divergence (atmospheric absorption, barriers and absorptive ground were not taken into consideration).

The on-site road traffic associated to the renewable energy project will be restricted to occasional visits for maintenance or engineering purposes. As such traffic will be infrequent and so excluded as per Annex to Publication NPC-232 section A.3 (2).

The following equations were employed to calculate sound pressure at points of reception from source power levels including attenuation due to geometric divergence only (from ISO 9613 (Part 2)) and to calculate the total sound pressure level at points of reception due to operation of multiple stationary sources:

$$Lp2 = Lp1 - 20 \log \left( \frac{d}{do} \right)$$

Where:

$do$  = reference distance (1 m)

$d$  = distance between source and receptor

$Lp1$  = Sound pressure level at  $do$

$Lp2$  = Sound pressure level at  $d$

$$L_{tot} = 10 \log \left( \sum_{i=1}^n \text{antilog} \frac{Ln}{10} \right)$$

Where:

$L_{tot}$  = total sound pressure at POR for all sources

$Ln$  = sound pressure level at POR from source  $n$

#### *Example Calculations:*

I01 – Inverter is located 168 m from POR1 and generates a sound pressure of <50 dBA at a distance of 1 m (manufacturer's specifications). In the absence of frequency data a penalty of 5 dBA has been applied for possible tonality.

Sound pressure at 1 m = 55 dBA

$$Lp2 = Lp1 - 20 \log \left( \frac{d}{do} \right)$$

$$Lp2 = 55 - 20 \log \left( \frac{168}{1} \right) = 10.5$$

As each inverter generates the same sound pressure level at 1 m and is approximately the same distance from POR1:

$$L_{tot} = 10 \log \left( \sum_{i=1}^n \text{antilog} \frac{Ln}{10} \right)$$

$$L_{tot} = 10 \log \left( 20 \left( \text{antilog} \frac{10.5}{10} \right) + \text{antilog} \frac{15.8}{10} \right) = 24$$

Tables 3 and 4 in Appendix B summarize results obtained through application of the above equations.