



Bright Meadows Solar

Noise Impact Assessment

Client: Revolve Meadows Solar GP Inc.

Reference: 24-052

Version 1.0

November 2024

Report Prepared for:

Revolve Meadows Solar GP Inc.

Issue History	Date	Details
V1.0	November 22, 2024	Final issue for client review.

Version History	Author	Reviewed by	Approved by	Issue Date
V1.0	Sarah Forman (November 7, 2024)	Justin Lee (November 8, 2024)	Cameron Sutherland (November 19, 2024)	November 22, 2024

This document has been prepared by Green Cat Renewables Canada Corporation. The material and data in this report were prepared under the supervision and direction of the undersigned.



Nov 22, 2024

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PERMIT NUMBER: P14302 The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

The noise impact assessment is being issued with professional engineering authentication. The information contained in this report, to which the engineering authentication is applied, is deemed complete for the intended purpose.

Disclaimer

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Executive Summary

Revolve Meadows Solar GP Inc. (Revolve) propose to construct and operate a solar photovoltaic (PV) electricity generating facility of up to 15.7-megawatts (MW_{AC}) located approximately 4km north of the Hamlet of Falun, Alberta, called Bright Meadows Solar Project (the Project).

Revolve retained Green Cat Renewables Canada Corporation (GCR) to conduct a noise impact assessment (NIA) for the Project, which will consist of ground-mounted PV panels, single axis trackers and associated motors, six (6) inverter/transformer stations, and a Project substation including one (1) 1MVA grounding system transformer. The inverter/transformer stations are anticipated to be the only significant noise producing Project elements and no other Project elements were considered in this assessment. For the purpose of the noise assessment, the inverter/transformer stations are assumed to operate at full load.

GCR reviewed aerial imagery of the site, identifying ten (10) receptors as having the potential to be affected by the noise from the proposed Project. The area was also checked for regulated third-party energy-related facilities that may produce noise within the vicinity of the Project.

A software model was used to predict sound levels from the Project to determine compliance with the Alberta Utilities Commission (AUC) Rule 012: Noise Control Requirements. The cumulative sound level for one of the assessed receptors was found to be less than 3dB below the Permissible Sound Level (PSL) for night-time periods, so a detailed noise assessment was carried out as per the AUC Rule 012, Appendix 3 – Summary report, recommendations.

Predictions of sound levels from solar farms in Alberta provide an inherently conservative assessment of compliance with Rule 012 Permissible Sound Levels because they assume operation at full power during night-time periods, which is not possible in reality. In addition to this inherent conservatism, other conservatisms were incorporated into the noise model, including the assumption that all receptors are two-storeys in height, and using the available sound power data for the SG4400UD-MV inverter in place of the SG3150UD-MV inverter. Since site validation was not completed, modelling receptors at two-storeys provides a worst-case model assumption. Additionally, the SG4400UD-MV has a larger electrical power output and contains an extra inverter cabinet relative to the smaller SG3150UD-MV, and therefore produces a higher sound output, making the results conservative in nature compared with the inverter specified for the project.

Where applicable, cumulative sound levels incorporated sound from: existing and approved regulated third-party energy-related facilities; the proposed Project; and ambient sources. The assessment concluded that cumulative sound levels would be compliant with permissible sound levels at all receptors assessed. A Low Frequency Noise (LFN) assessment determined that sound from the proposed Project was not assessed to contain any significant LFN effects.

The proposed Bright Meadows Solar Project was therefore assessed to meet the requirements of AUC Rule 012.

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1 Introduction

Revolve Meadows Solar GP Inc. (Revolve) retained Green Cat Renewables Canada Corporation (GCR) to conduct a noise impact assessment (NIA) for the proposed Bright Meadows Solar Project (the Project). The Project will include a solar photovoltaic (PV) electricity generating facility of up to 15.7-megawatts (MW_{AC}) and will be located approximately 4km north of the Hamlet of Falun, Alberta. The Project location is shown in **Figure 1** below. The assessment considered the cumulative impact of active and proposed noise sources on receptors within 1.5km of the Project facility property boundary.



Figure 1-1: Bright Meadows Solar Project Location

2 Rule 012 Assessment Process

The assessment process follows Alberta Utilities Commission (AUC) Rule 012 guidelines. The International Standard 'ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors', was followed in the prediction of noise levels at nearby receptors. A glossary of relevant AUC Rule 012 terms is reproduced in **Appendix A**.

The following steps give an overview of the process followed in identifying potential noise impacts on the most affected receptors.

- Define study area (distance contour at site boundary + 3km).
- Identify active and approved third-party regulated energy-related facilities (AUC or Alberta Energy Regulator (AER)) within the study area.
- Identify noise receptor(s) within 1.5km of the site boundary, or along the 1.5km boundary criteria (where no noise receptors exist).

For each noise receptor:

- Determine Basic Sound Level (BSL) and Ambient Sound Level (ASL)
- Calculate Permissible Sound Levels (PSLs)
- Predict the sound level from existing and approved third-party regulated energy-related facilities
- Combine facility and Ambient Sound Levels to give baseline sound levels
 - If baseline sound levels exceed PSLs or if facility sound level data is not available, then the baseline sound level may be set such that it is equivalent to (and therefore compliant with) the PSLs.
- Predict sound level from the proposed Project
- Assess for Low Frequency Noise (LFN) content due to the proposed Project
- Calculate Cumulative Sound Levels
- Assess compliance with AUC Rule 012 requirements.
 - In the case where baseline sound levels have been set to PSLs, cumulative sound levels are assessed against a 'no net increase' criterion.

3 Noise Model

All noise propagation calculations were performed using iNoise from DGMR Software (version Enterprise 2024.1). This is quality assured software with full support of ISO/TR 17534-3, which provides recommendations to ensure uniformity in the interpretation of the ISO 9613 method.

DGMR provide the following information on the function of ISO/TR 17534-3¹: *'The ISO 9613 standard is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software...'*

3.1 Model Parameters

Summer-time climatic conditions were assumed as required by Rule 012. **Table 3-1** shows the modelling parameters that were adopted for all calculations.

Table 3-1: Model Parameters

Modelling Parameter	Setting
Terrain of Site Area	Height contours interpolated at 3m ²
Barrier Effects Included	None
Temperature	10°C
Relative Humidity	70%
Wind	1 – 5ms ⁻¹ from facility to receptor as per ISO-9613
Ground Attenuation	0.5 (default throughout the study area) 0 (for waterbodies)
Number of Sound Reflections	1
Receptor Height	4.5m (two-storey) ³
Operation Condition	Full load
Source Height	2.3m for Inverter Stations 1.7m for Transformer Stations

¹ <https://dgmsoftware.com/products/innoise/>

² Data obtained from AltaLIS.

³ A height of two-storeys (4.5m) for the receptors is considered a conservative 'worst-case' model assumption since site validation of the receptors was not conducted.

4 Baseline

4.1 Study Area

The development site has a total fenced area of approximately 103 acres. The study area consists of all areas within 3km of the Project boundary. The study area for the Project includes several detached dwellings, rural/agricultural land, waterbodies, regulated third-party energy-related facilities, and portions of Highway 780.

Ten (10) dwellings within 1.5km from the Project boundary were identified and have been assessed for cumulative noise impacts from the Project and other nearby facilities, as required by AUC Rule 012.

4.2 Project Description

The Project encompasses an area of 103 acres of land consisting of approximately 30,716 PV modules, with a total generating capacity of 15.7 MW_{AC}. The solar arrays will utilize ground mounted, single-axis tracker modules which will feed six (6) inverter/transformer stations. The Project will also consist of the Project substation containing one (1) 1 MVA grounding system transformer. The inverter/transformer stations are assessed to be the only significant sources of noise from the Project. As such, no other Project elements are considered in this assessment.

Daytime periods are defined as occurring between 07:00-22:00, while night-time periods fall between 22:00-07:00. The Project will largely operate during the defined daytime hours; however, sunrise on the longest days of the year (during summer months) will occur at approximately 05:00, which falls within the night-time period. Therefore, the assessment considers both daytime and night-time operational impacts (i.e., operating 24/7).

4.3 Sensitive Receptors

GCR conducted a desktop assessment and identified ten (10) residential dwellings located within 1.5km from the Project boundary as potentially being impacted by the Project. To provide a conservative assessment, all receptors were modelled at a two-storey elevation of 4.5m. **Table 4-1** shows the location details and the height of each receptor.

Table 4-1 – Receptor Details

Receptor ID	UTM Coordinates (NAD 83, Zone 11N)		Receptor Type	Receptor height (m) ⁴	Relative location from site boundary
	Easting	Northing			
R01	307230	5875360	Two-Storey	4.5	115m E
R02	307609	5874843	Two-Storey	4.5	580m E
R03	307447	5876389	Two-Storey	4.5	750m NE
R04	307046	5874131	Two-Storey	4.5	790m S
R05	305552	5874437	Two-Storey	4.5	925m SW
R06	305665	5876894	Two-Storey	4.5	1350m NW
R07	305507	5876779	Two-Storey	4.5	1345m NW
R08	308333	5876340	Two-Storey	4.5	1360m NE

⁴ A height of two-storeys (4.5m) for the receptors is considered a conservative 'worst-case' model assumption since site validation of the receptors was not conducted.

Receptor ID	UTM Coordinates (NAD 83, Zone 11N)		Receptor Type	Receptor height (m) ⁴	Relative location from site boundary
	Easting	Northing			
R09	308621	5875671	Two-Storey	4.5	1490m E
R10	307137	5873505	Two-Storey	4.5	1425m S

4.4 Existing Third-Party Regulated Energy-Related Facilities

A search for active and approved regulated energy-related facilities (both AER and AUC) and pumping wells within 3km of the Project boundary was conducted by GCR in November 2024. The AER's Facilities list (ST102) and wells list (ST037) were consulted for the AER regulated facilities and wells. The AUC e-filing portal was used to identify any existing and approved AUC regulated facilities.

GCR identified one (1) AER regulated facility, and one (1) pumping well located within the study area that have the potential to influence cumulative sound levels. Additionally, one (1) AUC regulated facility was identified and included in this assessment.

Table 4-2 lists the third-party energy-related facilities and pumping well identified within 3km of the Project that have the potential to influence cumulative sound levels. Information was gathered using the AER databases and the AUC e-filing portal.

Table 4-2 – Third Party Sound Sources

Map Label	Name	Type	Operator Name	UTM Coordinates (NAD 83, Zone 12N)	
				Easting	Northing
AER1	WESTROSE 11-30-046-27W4	Gas Multi-well Group Battery	Tourmaline Oil Corporation	304531	5875999
AER2	BEC BLEN 15-24-46-28	Pumping Well (Gas)	Tourmaline Oil Corporation	303339	5874982
AUC1	Pigeon Lake 964S Substation	Electrical Substation	AltaLink Management Ltd.	305254	5874887

All third-party noise sources as well as the 1.5km and 3km study area boundaries are noted in **Figure 4-1**.

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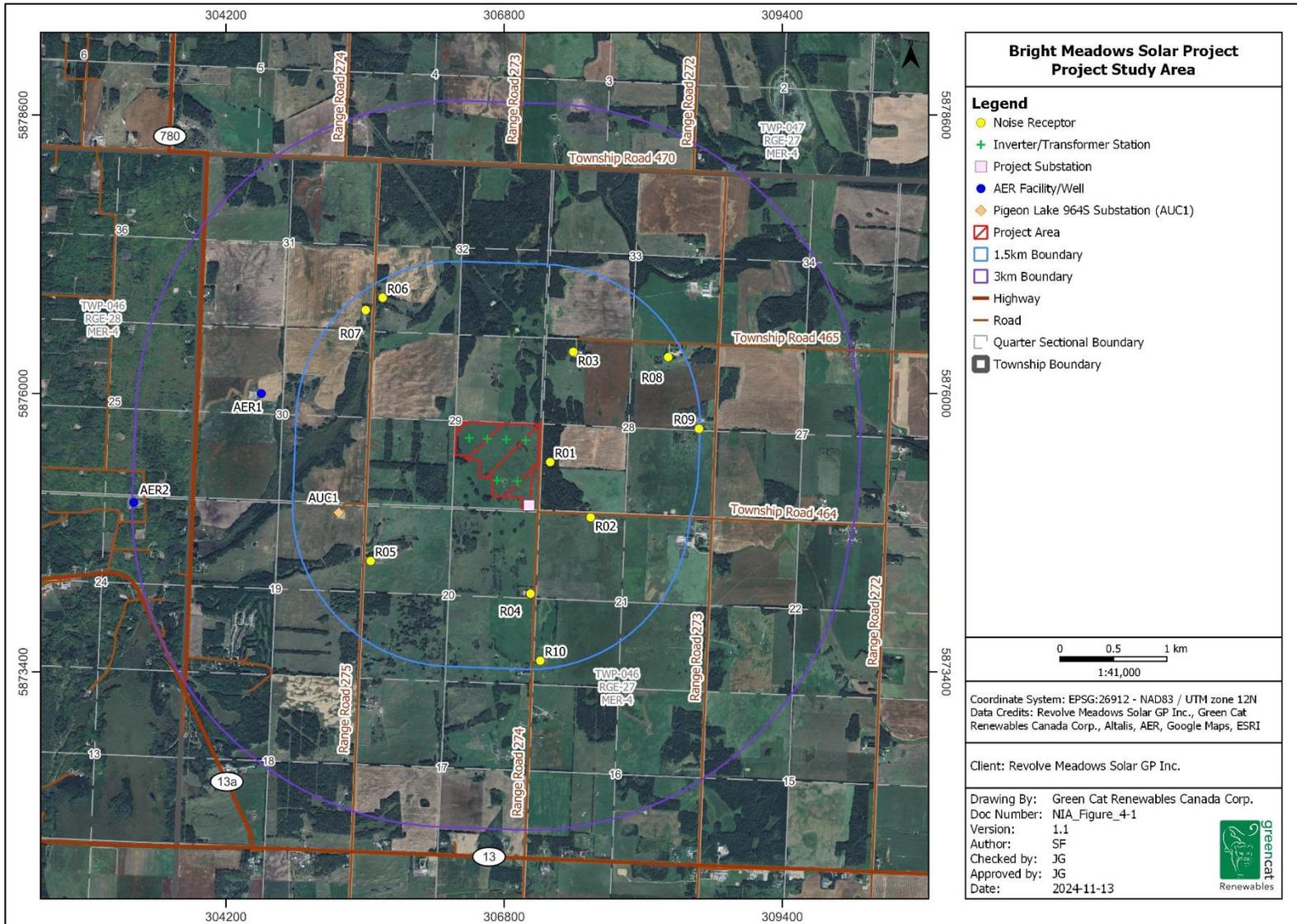


Figure 4-1: Bright Meadows Solar Project Study Area

4.5 Baseline Sound Levels

Baseline sound levels for each receptor should incorporate a contribution from all existing and approved AER and AUC facilities with the addition of the Ambient Sound Level (ASL). ASL is determined from the Basic Sound Level (BSL).

4.5.1 Determination of Basic Sound Level (BSL)

Rule 012 criteria for the determination of BSL include: dwelling density; road and rail traffic noise; and aircraft flyovers. In this case, dwelling density and road & traffic noise are the determining factors. Criteria are given in **Table 4-3**.

Table 4-3 – Rule 012 Criteria for determination of Basic Sound Levels (BSL)⁵

Proximity to transportation	Dwelling density per quarter section of land				
	(1) 1 to 8 dwellings; 22:00 - 07:00 (night-time) (dBA Leq)	(2) 9 to 160 dwellings; 22:00 - 07:00 (night-time) (dBA Leq)	(3) 161 to 400 dwellings; 22:00 - 07:00 (night-time) (dBA Leq)	(4) 401 to 1,000 dwellings (Suburban); 22:00 - 07:00 (night-time) (dBA Leq)	(5) >1,000 dwellings (Urban); 22:00 - 07:00 (night-time) (dBA Leq)
Category 1 ⁶	40	43	46	48	53
Category 2 ⁷	45	48	51	51	53
Category 3 ⁸	50	53	56	56	56

All dwellings have been evaluated as category one for dwelling density and proximity to transportation. **Table 4-4** identifies the categories for the assessed receptors.

4.5.2 Determination of Ambient Sound Level (ASL)

The Project is located in an area typical of rural Alberta (including agricultural and oil & gas industries). AUC Rule 012 states that 'In the absence of measurement, the night-time ambient sound level is assumed to be five dB less than the basic sound level and the daytime ambient sound level is assumed to be five dB less than the basic sound level plus the daytime adjustment'.^{9,10} This results in a night-time ASL of 35dB(A) and a daytime ASL of 45dB(A) for the assessed receptors. BSL and ASL for night-times and daytimes for each receptor are given in **Table 4-4**.

4.5.3 Determination of Permissible Sound Level (PSL)

For each receptor, the PSL is determined using Basic Sound Level (BSL) plus any allowed adjustments. In this case, as no special conditions exist, the PSL is determined as:

Night-Time (NT) Permissible Sound Level = Basic Sound Level

⁵ Alberta Utilities Commission Rule 012: Noise Control, effective September 30, 2024 (PDF Page 5, Table 1)

⁶ Category 1—dwelling(s) distance is more than or equal to 500 metres (m) from heavily travelled roads or rail lines and not subject to frequent aircraft flyovers.

⁷ Category 2—dwelling(s) distance is more than or equal to 30 m, but less than 500 m from heavily travelled roads or rail lines and not subject to frequent aircraft flyovers.

⁸ Category 3—dwelling(s) distance is less than 30 m from heavily travelled roads, or rail lines or subject to frequent aircraft flyovers.

⁹ Alberta Utilities Commission Rule 012: Noise Control, effective September 30, 2024 (PDF Page 14, Bullet 7)

¹⁰ The daytime ASL accounts for the addition of the standard 10db(A) daytime adjustment to the night-time ASL for the hours between 7 a.m. and 10 p.m., without any further adjustments, i.e., Class A, B, and C adjustments were not applied.

Daytime (DT) Permissible Sound Level = Basic Sound Level + Daytime Adjustment (10dB)

BSLs, ASL, and PSLs for night-times and daytimes and for each location are given in **Table 4-4**.

Table 4-4 – Daytime and Night-time BSL, ASL, and PSL

Dwelling ID	Transportation Category	Dwelling Category	BSL	ASL		PSL	
			NT/DT	NT	DT	NT	DT
R01	1	1	40	35	45	40	50
R02	1	1	40	35	45	40	50
R03	1	1	40	35	45	40	50
R04	1	1	40	35	45	40	50
R05	1	1	40	35	45	40	50
R06	1	1	40	35	45	40	50
R07	1	1	40	35	45	40	50
R08	1	1	40	35	45	40	50
R09	1	1	40	35	45	40	50
R10	1	1	40	35	45	40	50

4.5.4 AER Facility Sound Power Levels

Sound power levels for AER1 and AER2 were compiled from an internal noise measurement database and third-party NIAs that included measurements of similar facilities. The quoted sound power level is the average of at least two similar facilities and is deemed typical and representative for the facility type.

Table 4-5 shows the octave band sound power levels for the included AER regulated energy-related facilities within 3km of the Project.

Table 4-5 – Octave Band Sound Power Levels for AER Regulated Facilities

Map Label	Sub Type	Octave Band Centre Frequency, Hz									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
AER1	Gas Multi-well Group Battery	112.3	108.4	102.8	98.8	96.7	95.4	94.0	88.6	82.9	114.4	100.7
AER2	Gas Lift Pumping Well	66.9	65.0	53.1	55.0	65.7	67.6	63.8	58.4	54.0	73.3	70.7

4.5.5 AUC Facility Sound Power Levels

The Pigeon Lake 964S Substation is an existing AUC facility that was identified within 3km of the Project.

One (1) 25MVA High-Voltage (HV) transformer was listed in the permit and license for the Pigeon Lake 964S Substation¹¹. The 25MVA transformer is understood to be the only significant noise producing element operating at this facility, however the sound information for this transformer was not included in the AUC document. In the absence of the noise information, this transformer was conservatively modelled in Oil Natural Air Forced (ONAF) conditions using a theoretical prediction method^{12,13}. ONAF is an operation that uses second stage cooling for the transformer when there are higher ambient temperatures. Typically, in ONAF mode, the cooling fan is the source of the loudest noise emissions from the transformer. The estimated octave band sound power levels and the location of this transformer is shown in **Table 4-6**.

Table 4-6 – Octave Band Sound Power Levels for The Pigeon Lake 964S Substation

Map Label	Facility	Location		Octave Band Centre Frequency, Hz										Total	
		E	N	31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
AUC1	Pigeon Lake 964S Substation														
AUC1	Transformer 138/25kV, 15/20/25 MVA	305254	5874887	84.1	88.1	91.1	89.1	89.1	83.1	78.1	73.1	65.1	96.1	89.3	

4.6 Modelling Results

Table 4-7 shows the predicted sound levels at each receptor from the existing and approved regulated facilities included in this assessment. For the purpose of this assessment, all third-party regulated energy-related facilities within the study area were deemed to operate at full load and produce noise continuously.

Table 4-7 – Predicted Sound Levels from Existing Third-Party Regulated Facilities

Receptor ID	AER Facilities (dBA)		Pigeon Lake 964S Substation (dBA)		Total Regulated Facilities (dBA)	
	NT	DT	NT	DT	NT	DT
R01	10.4	10.4	9.7	9.7	13.1	13.1
R02	8.2	8.2	7.8	7.8	11.0	11.0
R03	9.7	9.7	6.2	6.2	11.3	11.3
R04	8.8	8.8	10.2	10.2	12.6	12.6
R05	15.5	15.5	24.0	24.0	24.6	24.6
R06	18.6	18.6	9.6	9.6	19.1	19.1
R07	20.3	20.3	10.5	10.5	20.8	20.8

¹¹ Permit and Licence - Pigeon Lake 964S Substation Alteration, September 26, 2024 (Exhibit 29339-D01-2024)

¹² Handbook of Noise and Vibration Control (Crocker, M., 2007).

¹³ Toward a Realistic Estimate of Octave Band Sound Levels for Electric Transformer (Stevens, R. and Hung, C., 2010)

Receptor ID	AER Facilities (dBA)		Pigeon Lake 964S Substation (dBA)		Total Regulated Facilities (dBA)	
	NT	DT	NT	DT	NT	DT
R08	6.2	6.2	2.8	2.8	7.8	7.8
R09	5.2	5.2	2.6	2.6	7.1	7.1
R10	6.9	6.9	7.9	7.9	10.5	10.5

4.7 Total Baseline Sound Levels

Baseline sound levels include the noise contributions from the existing adjacent sound sources, planned adjacent sources, and the ambient sound level assessed for the local environment. **Table 4-8** shows the cumulative baseline sound levels for night-time (NT) and daytime (DT) periods.

Table 4-8 – Cumulative Baseline Sound Levels for Night-Time and Daytime Periods

Receptor ID	Total Regulated Facilities		ASL		Baseline	
	NT	DT	NT	DT	NT	DT
R1	13.1	13.1	35	45	35.0	45.0
R2	11.0	11.0	35	45	35.0	45.0
R3	11.3	11.3	35	45	35.0	45.0
R4	12.6	12.6	35	45	35.0	45.0
R5	24.6	24.6	35	45	35.4	45.0
R6	19.1	19.1	35	45	35.1	45.0
R7	20.8	20.8	35	45	35.2	45.0
R08	7.8	7.8	2.8	2.8	35.0	45.0
R09	7.1	7.1	2.6	2.6	35.0	45.0
R10	10.5	10.5	7.9	7.9	35.0	45.0

Supplemental noise source information for each receptor is provided in **Appendix B**.

5 Project Sound Levels

The Project will consist of solar PV arrays using ground-mounted single-axis trackers. The solar arrays will be connected to six (6) inverter/transformer stations, with a total capacity of up to 15.7 MW_{AC}. The Project will also include a substation containing one (1) 1 MVA grounding system transformer.

The proposed single-axis trackers from NEXTracker Inc¹⁴ use a mass balanced system requiring only low wattage motors, expected to be four orders of magnitude quieter than the inverter/transformer stations. Additionally, the single-axis trackers will operate asynchronously across the site for a few seconds every few minutes to adjust the tilt angle of the modules (adjustment frequency is dependant on time of year). Considering this, it was assessed that the trackers would have limited potential to contribute to overall project sound levels and would not be considered significant noise producing Project elements.

Similarly, it was assessed that the single 1 MVA grounding system transformer has a sound power output of around 3 orders of magnitude lower than any of the project inverters, and would therefore have limited potential to contribute to overall project sound levels, and would not be considered a significant noise producing Project element.

As such, for the purposes of the noise assessment, it has been assessed that the only significant noise producing Project elements are the inverter/transformer stations.

The sound power level data for the significant noise producing Project elements was used to model sound emissions for both daytime and night-time periods. The Project elements were assumed to operate at full load, which is an inherently conservative modelling approach for night-time periods at a solar farm.

5.1 PV Electricity Generating Facility

5.1.1 Inverters

The inverter stations proposed for the PV electricity generating facility are the SG3150 UD-MV (SG3150) units. However, the sound data for this specific unit is currently unavailable. In the absence of the manufacturer-provided sound data for the SG3150, the manufacturer has recommended using the sound information for the SG4400UD-MV (SG4400) units. The SG4400 is understood to have similar sound characteristic as SG3150, with one extra inverter compartment. Since SG4400 includes one extra inverter compared to SG3150, it is GCR's understanding that using the sound data for SG4400 as a proxy for the SG3150 represents a conservative approach, since the SG4400 has higher electrical power output and contains an extra inverter cabinet, leading to a higher sound output, than the SG3150. The sound data for the SG4400 inverters provided by the equipment manufacturer are shown in **Appendix C**.

Table 5-1 shows the linear, 'A', and 'C' frequency weighted octave band sound power spectra for the Sungrow SG4400 inverters

Table 5-1 – Octave Band Sound Power Levels for the SG4400 Inverters

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	94.7	55.3	91.7
63	90.4	64.2	89.6

¹⁴ <https://www.nextracker.com/nx-horizon-solar-tracker>

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
125	90.1	74.0	89.9
250	90.7	82.1	90.7
500	92.1	88.9	92.1
1000	88.7	88.7	88.7
2000	89.2	90.4	89.0
4000	93.0	94.0	92.2
8000	81.4	80.3	78.4
Sum	100.6	97.4	99.7

5.1.2 Transformers

The proposed MV transformers for the PV electricity generating facility are rated at 3.15 MVA each. Although the manufacturer has not yet specified the transformer sound levels, these transformers have been modelled in (non-mineral) Oil Natural Air Natural (KNAN) conditions as specified by Revolve. Transformer sound levels are approximately two orders of magnitude lower than the equivalent inverters, thereby contributing a negligible amount to cumulative sound levels. Nevertheless, a typical transformer of a suitable type was modelled. Octave band levels were derived using published spectral data.

The linear 'A' and 'C' frequency weighted octave band sound power spectra for the 4 MVA transformers used in the Project area is shown in **Table 5-2**.

Table 5-2 – Octave Band Sound Power Levels for the 3.15 MVA transformers Based on Theoretical Prediction Methods^{15,16}

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	84.9	45.5	81.9
63	79.9	53.7	79.1
125	81.9	65.8	81.7
250	77.9	69.3	77.9
500	76.9	73.7	76.9
1000	65.9	65.9	65.9
2000	58.9	60.1	58.7
4000	53.9	54.9	53.1
8000	47.9	46.8	44.9
Sum	88.3	76.2	87.0

5.2 Modelling Results

Predicted sound levels for the Project is shown in **Table 5-3**. The results assume full operation 24 hours a day, and they are applicable to night-time and daytime periods.

Table 5-3 - Predicted Project Sound Levels

Receptor ID	Project Sound Level (dBA)
R01	38.6
R02	29.5
R03	27.8
R04	26.2
R05	23.8
R06	22.1
R07	22.0
R08	17.4
R09	17.0
R10	21.1

¹⁵ Handbook of Noise and Vibration Control (Crocker, M., 2007).

¹⁶ Toward a Realistic Estimate of Octave Band Sound Levels for Electric Transformer (Stevens, R. and Hung, C., 2010).

Receptor R01 is expected to be the receptor most impacted by noise from the Project, having a maximum sound pressure level of 38.6 dB(A) for both daytime and night-time periods. Project sound level contours are shown in Appendix D.

5.3 Low Frequency Assessment

Table 5-4 shows the difference between A and C weighted predicted sound levels at each of the receptors modelled. The results show that the C-weighted and A-weighted receptor levels have differences well below the Rule 012 criterion of 20dB. This indicates that low frequency noise is not expected to be an issue.

Table 5-4 - Low Frequency Noise Assessment

Receptor ID	Project Sound Level (dBA)	Project Sound Level (dBC)	Difference (dBC – dBA)
R01	38.6	44.9	6.3
R02	29.5	37.9	8.4
R03	27.8	36.7	8.9
R04	26.2	35.6	9.4
R05	23.8	33.9	10.1
R06	22.1	32.7	10.6
R07	22.0	32.6	10.6
R08	17.4	28.0	10.6
R09	17.0	27.7	10.7
R10	21.1	31.9	10.8

6 Cumulative Impact Assessment

The cumulative impact assessment incorporates sound level contributions from the baseline and Project assessments. Compliance with AUC Rule 012 is determined through comparison of cumulative sound levels with PSLs. **Table 6-1** shows the results of the cumulative impact and compliance assessment.

Table 6-1 – Cumulative Sound Level Assessment for Night-Time (NT) and Daytime (DT) Periods

Receptor	Baseline Sound Level (dBA)		Project Sound Level (dBA)		Cumulative Sound Level (dBA)		PSL (dBA)		PSL Compliance Margin (dB)	
	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R01	35.0	45.0	38.6	38.6	40.2	45.9	40	50	0	4
R02	35.0	45.0	29.5	29.5	36.1	45.1	40	50	4	5
R03	35.0	45.0	27.8	27.8	35.8	45.1	40	50	4	5
R04	35.0	45.0	26.2	26.2	35.6	45.1	40	50	4	5
R05	35.4	45.0	23.8	23.8	35.7	45.1	40	50	4	5
R06	35.1	45.0	22.1	22.1	35.3	45.0	40	50	5	5
R07	35.2	45.0	22.0	22.0	35.4	45.0	40	50	5	5
R08	35.0	45.0	17.4	17.4	35.1	45.0	40	50	5	5
R09	35.0	45.0	17.0	17.0	35.1	45.0	40	50	5	5
R10	35.0	45.0	21.1	21.1	35.2	45.0	40	50	5	5

The cumulative sound levels at all assessed receptors are determined to be compliant with the requirements of AUC Rule 012, though the PSL compliance margin at the most impacted receptor is 0 dB. However, the cumulative sound levels calculated at all receptors are considered to be conservative, as they assume the proposed solar PV facility will operate at full load throughout both daytime and night-time hours. In practice, this solar PV facility will never operate at full sound output during the night-time hours due to lower electricity generation, as well as lower than average ambient temperature.

7 Conclusions

Ten (10) receptors, within 1.5km of the Project boundary, were identified as having the potential to be impacted by sound emitted from the proposed Project and/or cumulative sound levels. Worst-case sound power levels were used to model sound emissions from the Project during night-time and daytime periods.

The Project will generally operate when the sun is out during daytime hours; however, AUC Rule 012 defines night-time hours to be from 22:00 to 07:00 all year long. Due to the sun rising prior to 07:00 during summer months, the Project may operate during the defined night-time period. Therefore, the assessment also considered worst-case (full load operation) noise emission levels 24 hours a day. In practice there will be periods when the Project operates in standby mode where sound emissions are much lower than the peak sound output levels assumed throughout this assessment.

Additionally, the model incorporated two additional conservatisms. Firstly, the height of all receptors was modelled as two-storeys. Modelling all receptors at two-storeys (4.5m) provides a worst-case assumption, since site validation was not conducted. Secondly, sound power data for the SG3150 inverter was not available, so manufacturer's data from the larger SG4400 was used instead. Using the sound power data for the larger power output unit, with an additional inverter cabinet, causes Project sound levels to be conservative. As such, the assessment is considered significantly conservative in nature, with results representing a worst-case model.

The cumulative sound levels for all receptors during both daytime and night-time hours were found to be compliant with the PSL. R01 was assessed to be the receptor most impacted by the Project sound levels. A LFN assessment determined that the sound from the proposed Project is not expected to produce any significant LFN effects.

It is therefore concluded that the proposed Bright Meadows Solar Project will operate in compliance with AUC Rule 012 requirements at all assessed receptors.

8 Acoustic Practitioners' Information

Table 8-1 summarizes the information of the author(s) and technical reviewer(s).

Table 8-1 – Summary of Acoustic Practitioners' Information

Name	Sarah Forman	Justin Lee	Cameron Sutherland
Title	Renewable Energy E.I.T.	Principal Noise Consultant	Technical Director
Role	<ul style="list-style-type: none"> Acoustic noise modelling Noise Impact Assessment (NIA) author 	<ul style="list-style-type: none"> Technical Reviewer Acoustic noise modelling 	<ul style="list-style-type: none"> Technical Assessment Lead Noise Impact Assessment (NIA) Technical Approver
Experience	<ul style="list-style-type: none"> Experience with acoustic modelling (iNoise) of renewable energy projects in Alberta. Analyst on multiple noise assessments for renewable energy projects in Alberta (2024). MEng Mechanical Engineering with Specialization in Energy & Environment. 	<ul style="list-style-type: none"> Experience with acoustic modelling (iNoise) of renewable energy projects in Alberta. Analyst on multiple noise assessments for renewable energy projects in Alberta (2021-Present). Current INCE associate. 	<ul style="list-style-type: none"> 19 years of acoustic and environmental consultancy. Acoustics (IOA) diploma (2012). Expert witness experience in wind turbine noise in the UK (2017/18). Expert witness experience in technical solar and wind development in Canada (2019-23).

Appendix A: Glossary of Rule 012 Terminology

Ambient sound level (ASL)

The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The ambient sound level does not include noise from any energy-related facilities or from wind and must be determined without it. The average night-time ambient sound level in rural Alberta is 35 dBA. The ambient sound level can be measured when the sound level in an area is not believed to be represented by the basic sound levels in Table 1¹⁷. The ambient sound level must be determined under representative conditions and does not constitute absolute worst-case conditions (e.g., an unusually quiet day) but conditions that portray typical conditions for the area.

In the absence of measurement, the night-time ambient sound level is assumed to be 5 dBA less than the basic sound level and the daytime ambient sound level is assumed to be 5 dBA less than the basic sound level plus the daytime adjustment.

A-weighted sound level

The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear at levels typical of rural backgrounds in mid frequencies. Sound levels are denoted: dB(A).

Basic sound level (BSL)

The night-time A-weighted Leq sound level commonly observed to occur in the designated land-use categories with industrial presence and is assumed to be five dB(A) above the ambient sound level, as set out in Table 1 of Rule 012.

Comprehensive sound level

The comprehensive sound level includes ambient sound level, noise from existing facilities and energy-related facilities.

Cumulative sound level

The cumulative sound level includes the comprehensive sound level, noise from proposed facilities, energy-related facilities approved but not yet constructed, and the predicted noise from the applicant's proposed facility.

C-weighted sound level

The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dBA). The C-weighted sound level (e.g., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments.

Daytime

Defined as the hours from 7 a.m. to 10 p.m.

Daytime adjustment

An adjustment that allows a 10 dBA increase because daytime ambient sound levels are generally about 10 dBA higher than night-time values.

¹⁷ Table 1. Basic sound levels (BSL) for night-time (AUC Rule 12, Page 5, <http://www.auc.ab.ca/Shared%20Documents/Rules/Rule012.pdf>)

Density per quarter section

Refers to a quarter section with the affected dwelling at the centre (a 451-metre radius). For quarter sections with various land uses or with mixed densities, the density chosen must be factored for the area under consideration.

Down wind

The wind direction from the noise source towards the receiver (± 45 degrees), measured at either dwelling height or source height. The 45 degrees requirement is consistent with the definition for downwind conditions, as included in ISO 9613-1996, Attenuation of Sound During Propagation Outdoors – Part 2: general method of calculation.

Dwelling

Any permanently or seasonally occupied structure used for habitation for the purpose of human rest; including a nursing home or hospital with the exception of an employee or worker residence, dormitory, or construction camp located within an energy-related industrial plant boundary. Trailer parks and campgrounds may qualify as a dwelling if it can be demonstrated that they are in regular and consistent use.

A permanent dwelling is a fixed residence occupied on a full-time basis.

The most impacted dwelling(s) are those subject to the highest average weighted sound level relative to the permissible sound level.

Energy equivalent sound level (Leq)

The Leq is the average weighted sound level over a specified period of time. It is a single-number representation of the cumulative acoustical energy measured over a time interval. The time interval used should be specified in brackets following the Leq—e.g., Leq (9 hours) is a nine-hour Leq.

Energy-related facility

A facility under the jurisdiction of the Commission or other regulatory agency, used for energy generation, transport (except by road or rail line) and resource extraction. These include mining, extraction, processing, and transportation (except by road or rail line) as well as federally regulated electrical transmission lines and pipelines.

Far field

The far field is that area far enough away from the noise source that the noise emissions can be treated as if they come from a single point or line source and the individual components of the noise source are not apparent as separate sources. This is typically at a distance of at least three to five times the major dimensions of the noise source, such as length, width, height, or diameter.

Heavily travelled road

Includes highways and any other road where 90 or more vehicles travel during the nine-hour night-time period consistently for any one-month period in a year. The following methods to validate the travel volume are acceptable:

Alberta Transportation's Average Annual Summer Daily Traffic (ASDT) value. If the ASDT is not available, the Alberta Transportation's Average Annual Daily Traffic (AADT) value can be used. In the case of using the ASDT or AADT, 10 per cent of the daily traffic volume can be assumed to be the night-time period traffic.

Linear weighting (or Z-weighting)

The sound level measured without any adjustment for the sensitivity of human hearing. It is a direct measure in decibels of the variation in air pressure and is often referred to as the "sound pressure level". This level is sometimes

called the “linear weighted level” or “the unweighted level,” as it includes no frequency weighting beyond the tolerances and limits of the sound level meter being used for the measurements.

Low frequency noise

Where a clear tone is present below and including 250 Hz and the difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB.

Night-time

Defined as the hours from 10 p.m. to 7 a.m.

No net increase

The concept of no net increase in relation to noise impact assessments may arise when the sound added by an incremental project to the baseline sound level results in a negligible sound level increase.

In cases where an applicant is proposing development of a facility where it is not practical or efficient to characterize baseline sound levels, the applicant may assume baseline compliance with the permissible sound level and use no net increase to justify that the proposed facility will have a negligible impact on cumulative sound levels. However, the predicted cumulative sound level must not exceed the permissible sound level by more than 0.4 dB.

When baseline sound levels are predicted to exceed the permissible sound level by 0.4 dB or less, the applicant is required to assess compliance for its proposed facility by adding noise contribution from its proposed facility to baseline sound levels.

Noise

The unwanted portion of sound.

Permissible sound level (PSL)

The maximum daytime or night-time sound level as determined in Table 1 at a point 15 m from the dwelling(s) in the direction of the facility. The permissible sound level is the sum of the basic sound level, daytime adjustment, Class A adjustments and Class B adjustment, or Class C adjustments.

Proposed facility

A proposed facility is a facility for which an application has been deemed complete by the Commission but is not yet approved or for which an approval has been issued, but is not yet constructed.

Sound power level

The decibel equivalent of the rate of energy (or power) emitted in the form of noise. The sound power level is an inherent property of a noise source.

Sound pressure level

The decibel equivalent of the pressure of sound waves at a specific location, which is measured with a microphone. Since human reaction and material behaviours vary with frequency, the sound pressure level may be measured using frequency bands or with an overall weighting scale such as the A-weighting system. The sound pressure level depends on the noise sources, as well as the location and environment of the measurement path.

Summertime conditions

Ground cover and temperatures that do not meet the definition for wintertime conditions. These can occur at any time of the year.

Tonal components

The test for the presence of tonal components consists of two parts. The first must demonstrate that the sound pressure level of any one of the slow-response, linear, one-third octave bands between 20 and 250 Hz is 10 dBA or more than the sound pressure level of at least one of the adjacent bands within two one-third octave bandwidths. In addition, there must be a minimum of a 5 dBA drop from the band containing the tone within two bandwidths on the opposite side.

The second part is that the tonal component must be a pronounced peak clearly obvious within the spectrum.

Wind speed

The speed of the wind, expressed in metres per second (m/s), measured in and averaged over 10-minute intervals at the same height as the microphone, but not more than 10 metres above ground level.

Appendix B: Supplemental Noise Source Information

Dwelling ID	Project		Third-Party	
	Nearest Significant Project Noise Source	Distance to Nearest Significant Project Noise Source	Nearest Third-Party Facility Noise Source	Distance to Nearest Third-Party Facility Noise Source
R01	Inverter/Transformer Station	305m NW	AUC1	2030m SW
R02	Inverter/Transformer Station	765m NW	AUC1	2355m W
R03	Inverter/Transformer Station	935m SW	AUC1	2655m SW
R04	Inverter/Transformer Station	1055m N	AUC1	1945m NW
R05	Inverter/Transformer Station	1400m NE	AUC1	540m NW
R06	Inverter/Transformer Station	1540m SE	AER1	1445m SW
R07	Inverter/Transformer Station	1540m SE	AER1	1250m SW
R08	Inverter/Transformer Station	1540m SW	AUC1	3405m SW
R09	Inverter/Transformer Station	1625m W	AUC1	3455m SW
R10	Inverter/Transformer Station	1690m N	AUC1	2335m NW

Appendix C: Sungrow SG4400UD-MV Manufacturer's Sound Data

SUNGROW		Public		Clean power for all	
<p>SUNGROW POWER SUPPLY CO., LTD No. 1699 Xiyou Rd., New & High Technology Industrial Development Zone, 230088, Hefei, P. R. China. Tel: +86-551-85327878 E-mail: _____ www.sungrowpower.com</p>					
Noise Test Report					
TYPE TEST SHEET					
This Type Test sheet shall be used to record the results of the type testing of Generating Unit					
Report reference number		RZ2023040702			
Report version		V1.0			
Date of issue		2023-04-07			
Standard reference		IEC 62109-1_2010			
Generating Unit technology		Grid-connected PV Inverter			
Inverter Type		SG4400UD-MV			
Rated power (KW)		4400			
Rated AC voltage (V)		630			
System supplier name		Sungrow Power Supply Co., Ltd.			
Address		No. 1699 Xiyou Rd., New & High Technology Industrial Development Zone, Hefei, P.R. China			
Compiled by	张之明	Approved by			
<p>Note that testing can be done by the manufacturer of an individual component, by an external test house, or by the supplier of the complete system, or any combination of them as appropriate.</p> <p>Where parts of the testing are carried out by persons or organisations other than the supplier then the supplier shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.</p>					
Report Version		Description			
V1.0		Initial			

The aim of this test is to determine the noise level when the PV Grid inverter in rated working condition.

Standard requirements: If equipment produces noise at a level that could cause a hazard, the noise shall be measured to determine the maximum sound pressure level that the equipment can produce (except that sound from alarms and from parts located remotely is not included). If the measured sound pressure exceeds 80dBA above a reference sound pressure of 20 μ P, at a measurement distance of 1 m, the instructions shall include information regarding the sound pressure level and how to reduce the risk of hearing damage to safe levels, and the product shall be marked with symbol 22 of Annex C.

• **Used settings of the measurement device for Noise measurement:**

Measurement device	Calibration Date	Expire Date
AWA6228+	2023-01-02	2024-01-01

• **The conditions during testing are specified below:**

PV inverter operation mode	Actual operation condition (4839KW)
Voltage range	895-1300V
Grid frequency range	50Hz
Distance	1m, 5m, 10 m
Testing duration	10min
Date	2023-04-07

• **The system noise level please check the table below:**

1) Actual operation condition (1m@4839KW)

Orientation	Noise (dB) 1m
Front	85.0
Behind	85.0
Left	85.0
Right	84.0
Maximum Noise	85.0

2) Actual operation condition (5m@4839KW)

Orientation	Noise (dB) 5m
Front	73.0
Behind	76.0
Left	73.0
Right	69.0
Maximum Noise	76.0

3) Actual operation condition (10m@4839KW)

Orientation	Noise (dB) 10m
Front	64.0
Behind	72.0
Left	66.0
Right	63.0
Maximum Noise	72.0

SUNGROW
Public
Clean power for all

Site photos:
Actual operation condition



Actual operation condition

10:53

功率流向

4839.318kW

数据指标

12145.3 kWh
日发电量
1177233 kWh
累计发电量

4839.318 kW
实时有功功率
-26.424 kVar
实时无功功率

0 个

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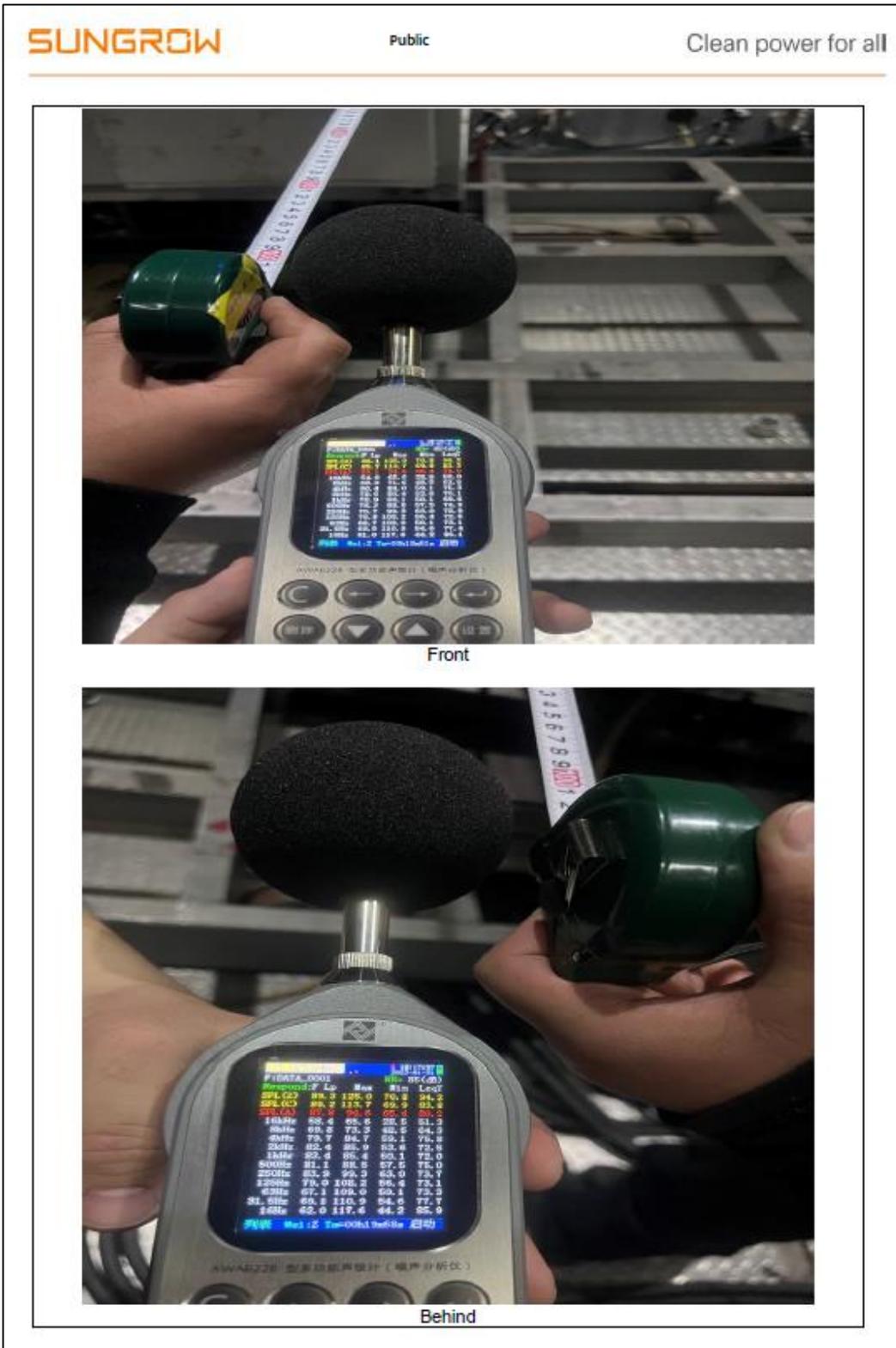
大小 不安全 — sungrow.net

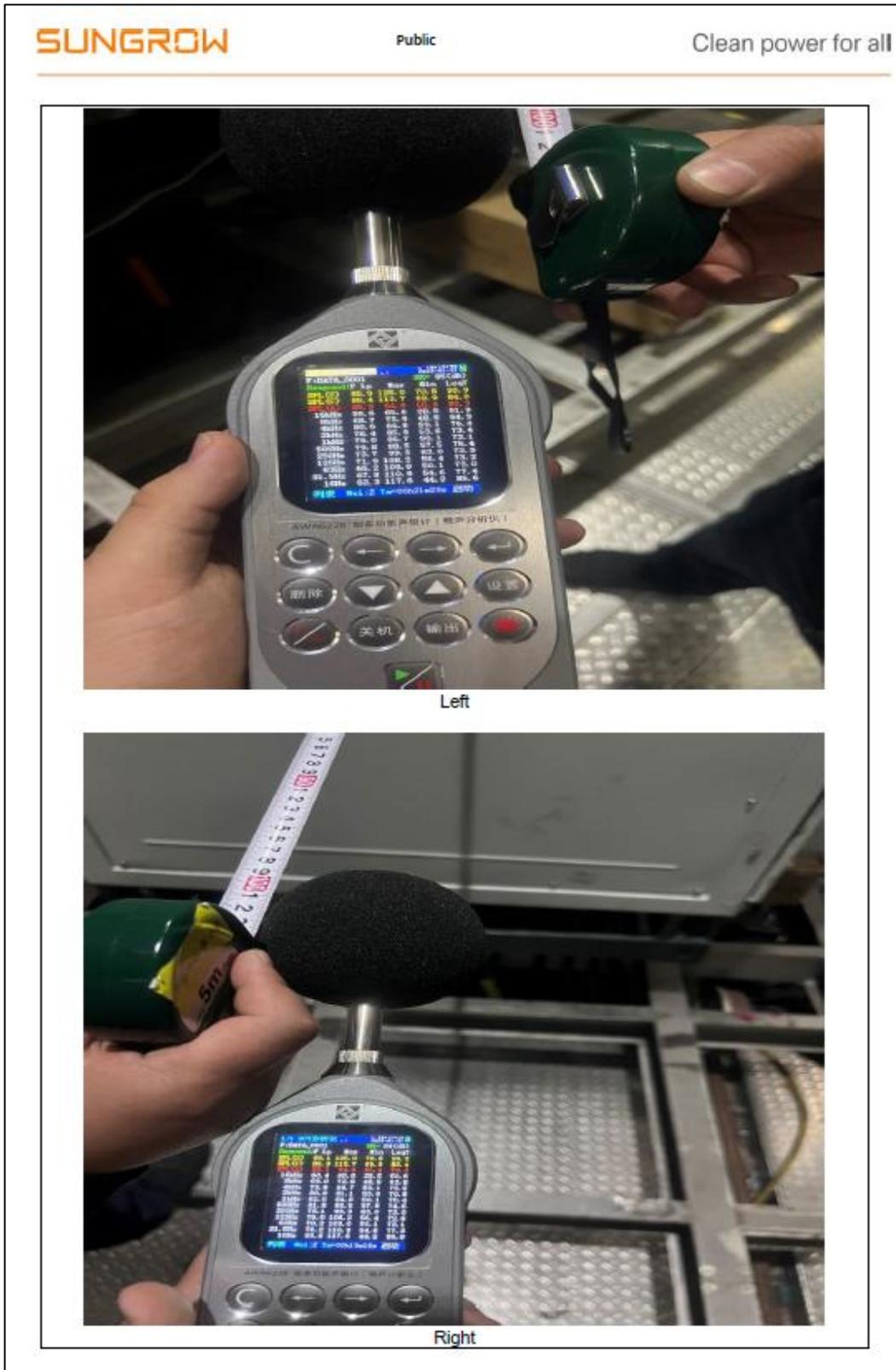
Background noise



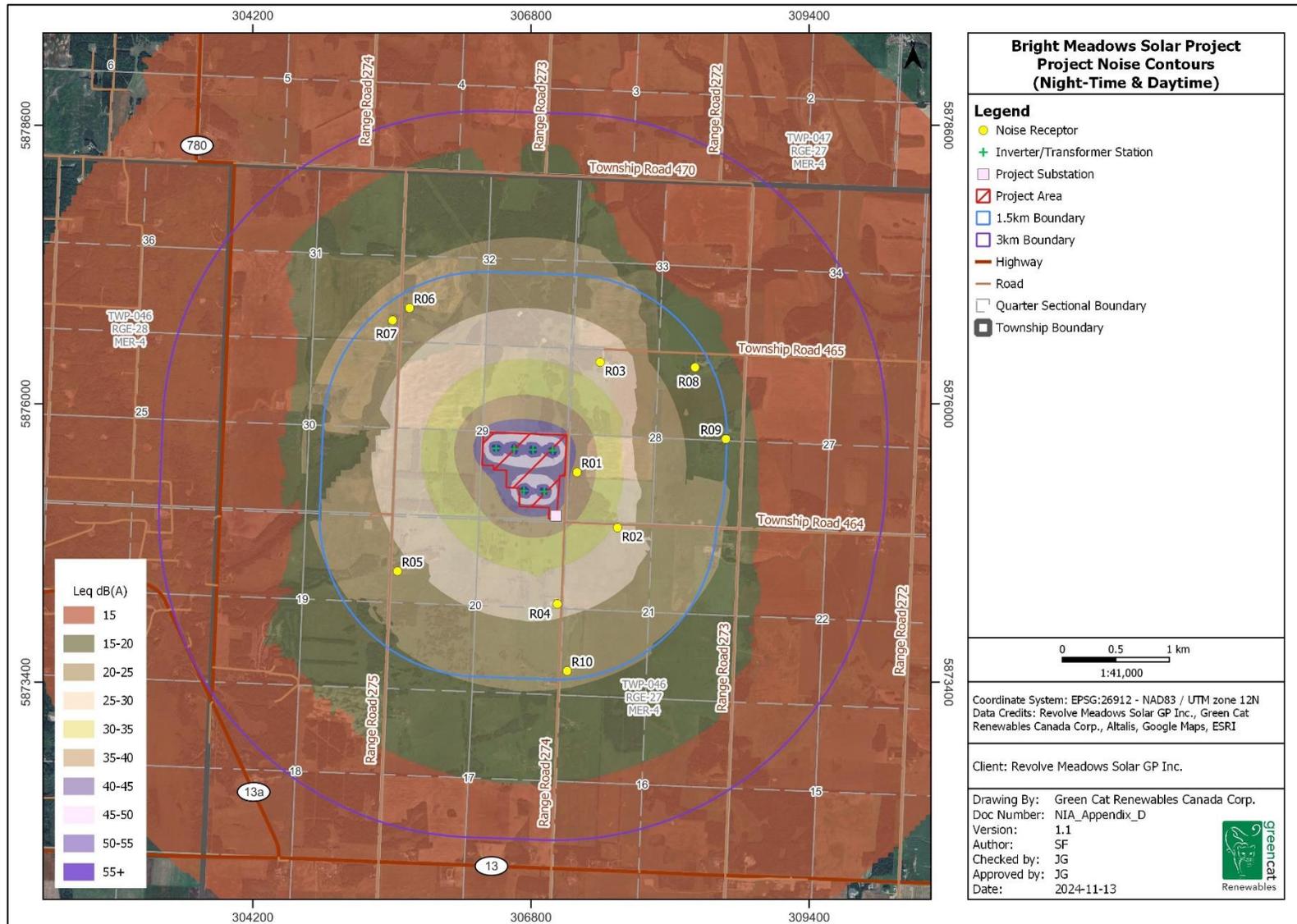
AWA6228 型多功能声级计 (噪声分析仪)

1) 1m noise photo





Appendix D: Project Sound Level Contour





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