Sunnynook Solar and Storage Project

Noise Impact Assessment

Client: Sunnynook Solar Inc.
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Executive Summary

Sunnynook Solar Inc. propose to install a 270 megawatts (MW_{AC}) photovoltaic (PV) electricity generating power plant with 100MW/200 megawatt-hour (MWh) Battery Energy Storage System (BESS) located within the Rural municipality of Special Area No.2, Alberta, approximately seven kilometres northeast of the Hamlet of Sunnynook, called Sunnynook Solar and Storage Project (the Project). The Project will consist of ground mounted PV panels, 75 inverter/transformer stations (for the PV electricity generating facility), 62 energy storage battery units (megapacks), 16 BESS transformers and a Project substation. The inverter/transformer stations, megapacks, BESS transformers and the Project substation are assumed to be the only significant noise producing Project elements. As such, no other Project elements are considered in this assessment. For the purposes of the noise assessment, the noise producing Project elements are assumed to operate at full load.

GCR reviewed aerial imagery of the site, identifying two receptors as having the potential to be affected by noise from the proposed Project. The area was also checked for other 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 Alberta Utilities Commission (AUC) Rule 012: Noise Control requirements. Cumulative sound levels were 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.

Where applicable, cumulative sound levels incorporated sound from: approved and existing regulated third-party energy-related facilities; third party projects; the proposed Project; and ambient sources. The assessment concluded that cumulative sound levels were compliant with permissible sound levels at all receptors assessed. R1 was identified as the most impacted receptor. A Low Frequency Noise (LFN) assessment determined that sound from the proposed Project was not assessed to contain any significant LFN effects.

The proposed Sunnynook Solar and Storage Project is therefore assessed to meet the requirements of AUC Rule 012.

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1 Introduction

Sunnynook Solar Inc. (Sunnynook Solar) retained Green Cat Renewables Canada Corporation (GCR) to conduct a noise impact assessment (NIA) for the proposed Sunnynook Solar and Storage Project (the Project). The Project will include a 270 megawatts (MW_{AC}) solar photovoltaic (PV) electricity generating facility and 100MW/200 megawatt-hour (MWh) Battery Energy Storage System (BESS), which will be located within the Rural municipality of Special Area No.2, Alberta, approximately seven kilometres northeast of the Hamlet of Sunnynook. The Project location is shown in **Figure 1-1** below. The assessment considered the cumulative impact of existing and proposed noise sources on nearby receptors.

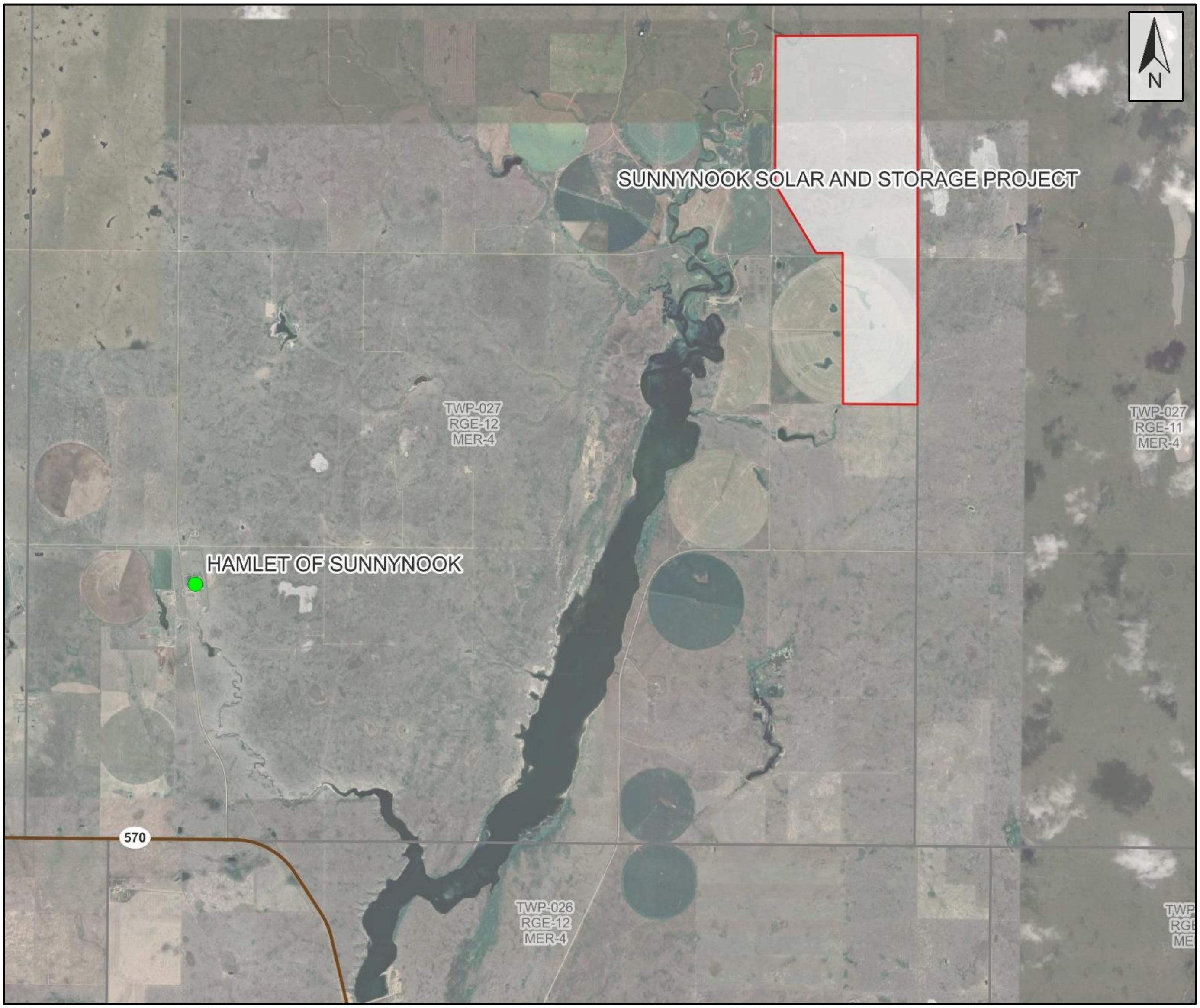


Figure 1-1 – Sunnynook Solar and Storage Project Location

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 Regulated (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)
- Predict sound level from existing and approved third party regulated energy-related facilities
- Combine facility and Ambient Sound Levels to give baseline sound levels
- Predict sound level from the proposed project
- Assess for Low Frequency Noise (LFN) content due to project
- Calculate Permissible Sound Levels (PSLs)
- Calculate Cumulative Sound Levels
- Assess compliance with AUC Rule 012 requirements.

3 Noise Model

All noise propagation calculations were performed using iNoise from DGMR Software (version Enterprise 2022.11). 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 17534-3[1]: '*The ISO 9613 standard from 1996 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-6913
Ground Attenuation	0.5
Number of Sound Reflections	1
Receptor Height	4.5m
Operation Condition	Full load
Source Height	1.85m for Inverters 1.39m for Project Transformers 2.8m for BESS Energy Storage Container 1.45m for BESS Transformers 4.0m for Substation Transformers

[1] https://dgmrsoftware.com/products/inoise/
[2] Data obtained from AltaLIS.

4 Baseline

4.1 Study Area

The development site spans eight quarter sections of land approximately seven kilometres northeast of the Hamlet of Sunnynook, Alberta. The study area includes rural/agricultural land, waterbodies, and wetlands.

Two dwellings located within the 1.5 km boundary criterion have been assessed for cumulative noise impacts from the Project and other nearby facilities, as required by Rule 012.

4.2 Project Description

The Project will encompass a large portion of eight quarter sections of land, consisting of approximately 512,000 PV modules, with a total generating capacity of 270 MW_{AC}. The modules will use a fixed tilt racking system secured to the ground with piles, and they will feed 75 inverter/transformer stations. The BESS will consist of 62 megapacks and 16 Medium Voltage (MV) transformers (15 X 8 MVA transformers and 1 X 4 MVA transformer). The inverter/transformer stations, megapacks, BESS transformers, along with the Project substation are assumed 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 between 07:00-22:00, while night-time periods fall between 22:00-07:00. While the BESS could operate at anytime, the solar PV electricity generating facility is anticipated to normally 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

Residential dwellings regarded as having the potential to be the most impacted were identified during a site visit conducted by GCR in September 2022. The heights of identified dwellings were also confirmed during the site visit. To provide a conservative assessment, any dwellings with the potential to be considered as higher than a one-storey dwelling were modelled at a two-storey elevation of 4.5m. Model receptors were placed at each of the dwellings within 1.5km of the Project boundary. **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 12N)		Dwelling type	Receptor height (m)	Relative location from site boundary
	Easting	Northing			
R1	459578	5688041	Two-Storey	4.5	350m W
R2	459268	5686110	Two-Storey	4.5	1150m SW

4.4 Existing and Approved Third Party Regulated Energy-Related Facilities

A search for existing and approved regulated energy-related facilities (both AER and AUC) and pumping wells was conducted within 3km of the Project boundary in September 2022. The AER's Facilities list (ST102) and Wells list (ST037) were consulted for the AER regulated facilities and wells, and AUC eFiling portal was used to identify existing and approved AUC regulated facilities. GCR initially identified 10 AER regulated facilities and four pumping wells within 3km of the Project boundary, but no AUC regulated facility was identified.

GCR personnel also conducted a site visit in September 2022 to confirm the location and operational status of the facilities and pumping wells identified. During the site visit and in consultation with facility operators, GCR personnel identified inconsistencies between the AER lists and what was currently in operation. GCR personnel recorded site details, including taking noise measurements at all active noise producing facilities and wells, and this information has been used in the Project modelling.

Table 4-2 lists the active facilities and pumping wells identified within 3km of the Project through the AER databases and during the site visit.

Table 4-2 – Third Party Sound Sources

Map Label	Type	Operator Name	UTM Coordinates (NAD 83, Zone 12N)	
			Easting	Northing
AER1	Crude Oil Multiwell Group Battery	West Lake Energy Corp.	458881	5691619
AER2	Compressor Station	Canadian Natural Resources Limited	461681	5686555
AER3	Crude Oil Single-Well Battery	Canadian Natural Resources Limited	457538	5687317
AER4	Gas Single-Well Battery	AlphaBow Energy Ltd.	461017	5686481
AER5	Crude Oil Single-Well Battery	Canadian Natural Resources Limited	458695	5687501
AER6	Crude Oil Single-Well Battery	Canadian Natural Resources Limited	457515	5686738
AER7	Crude Oil Single-Well Battery	Fairwest Energy Corporation	458780	5691350
AER8	Crude Oil Single-Well Battery	Fairwest Energy Corporation	458740	5690229
AER9	Crude Oil Single-Well Battery	Fairwest Energy Corporation	457976	5691100
AER10	Gas Multiwell Group Battery	Canadian Natural Resources Limited	461597	5686585
AER11	Pumping Well (Oil)	West Lake Energy Corp.(A7H7)	458877	5691633
AER12	Pumping Well (Oil)	Canadian Natural Resources Limited	458682	5687503
AER13	Pumping Well (Oil)	Canadian Natural Resources Limited	457497	5686747
AER14	Pumping Well (Oil)	Canadian Natural Resources Limited	457532	5687308

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

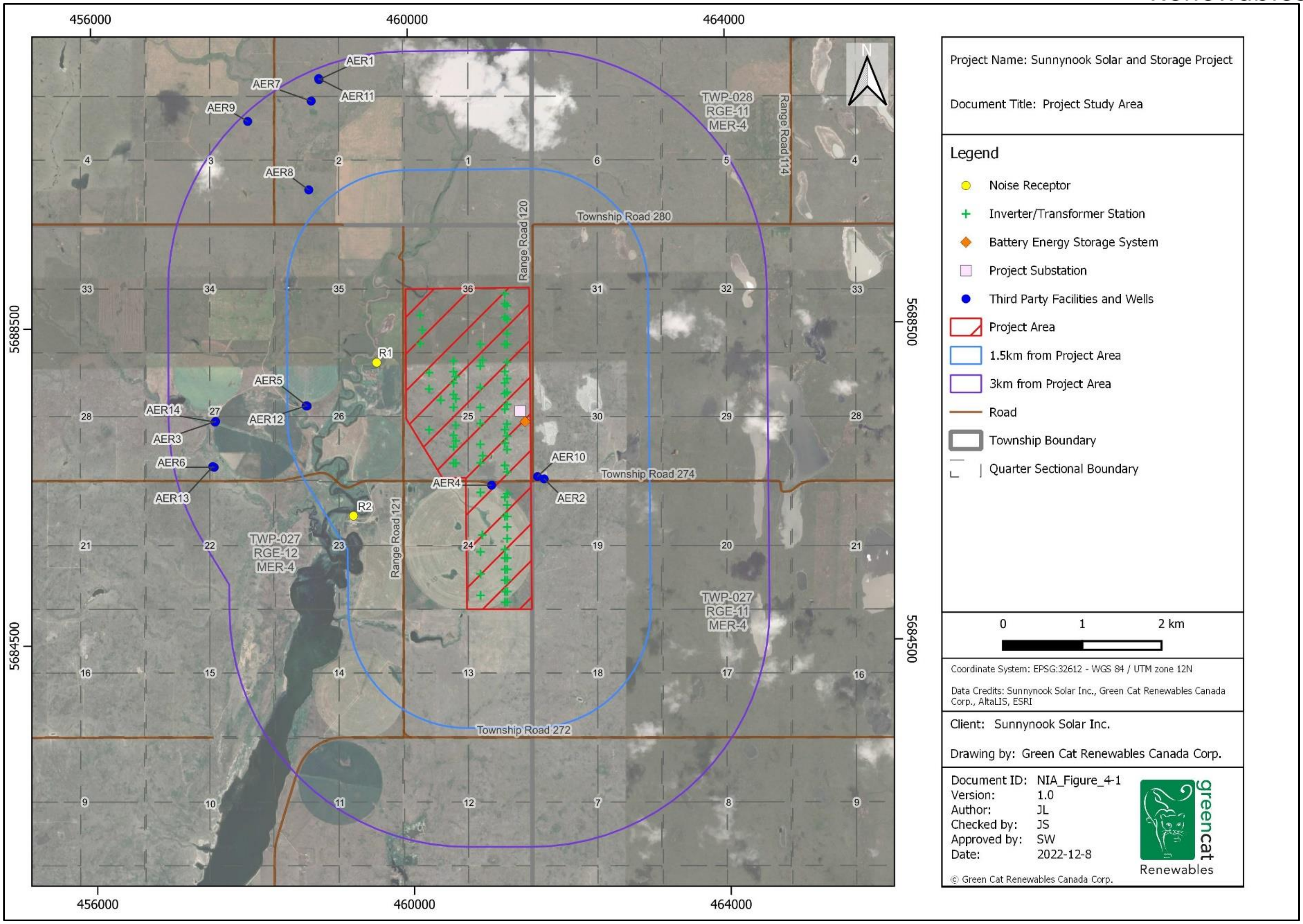


Figure 4-1 – Project Study Area

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)

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) >160 dwellings; 22:00 - 07:00 (night-time) (dBA Leq)
Category 1[3]	40	43	46
Category 2[4]	45	48	51
Category 3[5]	50	53	56

All assessed receptors in the study area have been evaluated as category one for both dwelling density and proximity to transportation. **Table 4-4** identifies the categories for each receptor.

4.5.2 Determination of Ambient Sound Level (ASL)

The area immediately surrounding the Project site consists of a typical rural farmland environment (including agricultural and Oil & Gas industries). Rule 012 states that 'In the absence of measurement, the nighttime 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[6]. This results in a night-time ASL of 35dB(A) and a daytime ASL of 45dB(A) for all receptors. BSLs and ASLs for night-times and daytimes for each location 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

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

[3] 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.

[4] 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.

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

[6] 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.

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
R1	1	1	40	35	45	40	50
R2	1	1	40	35	45	40	50

4.5.4 Third Party Sound Power Levels

Sound power levels for AER2 and AER11-AER14 were calculated based on field measurements conducted during the site visit in September 2022. While on site, GCR did not identify any noise emitting sources for AER1, AER3, AER5, AER6, and AER10. AER9 appeared to be abandoned and was inaudible at the facility location. Furthermore, GCR personnel also noted that no infrastructure was observed at AER4, AER7, and AER8. As such, only AER2 and AER11-AER14 are included in the assessment. Table 4-5 lists octave band sound power levels for third party regulated energy-related facilities within 3km of the Project.

Table 4-5 Octave Band Sound Power Levels for Noise Producing Third Party Regulated Energy-Related Facilities

Map Label	Octave Band Centre Frequency, Hz									Total	
	31.5	63	125	250	500	1000	2000	4000	8000	dB(A)	dB
AER1	-	-	-	-	-	-	-	-	-	-	-
AER2	92.2	98.1	99.4	102.3	94.2	94.8	91.3	87.3	83.0	99.8	106.2
AER3	-	-	-	-	-	-	-	-	-	-	-
AER4	-	-	-	-	-	-	-	-	-	-	-
AER5	-	-	-	-	-	-	-	-	-	-	-
AER6	-	-	-	-	-	-	-	-	-	-	-
AER7	-	-	-	-	-	-	-	-	-	-	-
AER8	-	-	-	-	-	-	-	-	-	-	-
AER9	-	-	-	-	-	-	-	-	-	-	-
AER10	-	-	-	-	-	-	-	-	-	-	-
AER11	91.6	89.7	87.7	85.5	87.9	84.6	85.3	80.7	76.3	91.0	96.8
AER12	94.5	87.9	82.9	72.3	76.0	77.3	80.9	83.4	78.9	87.6	96.2
AER13	104.7	100.3	96.3	84.7	83.6	83.1	87.9	88.9	89.6	94.8	106.7
AER14	100.9	98.0	88.6	78.0	81.6	78.7	75.9	78.3	74.6	85.4	102.9

4.6 Modelling Results

Table 4-6 shows the predicted sound levels at each receptor from existing third party regulated energy-related facilities. For the purpose of this assessment, all noise producing facilities were deemed to operate at full load and produce noise continuously.

Table 4-6 Predicted Sound Levels from AER and AUC Regulated Energy-Related Facilities (Existing and Approved)

Dwelling ID	Total Existing Third Party Regulated Energy-Related Facilities Sound levels dB(A)
R1	13.2
R2	14.2

4.7 Total Baseline Sound Levels

Baseline sound levels include the noise contributions from existing and approved adjacent sound sources and the ambient sound level considered typical of the local environment.

Table 4-7 shows cumulative baseline sound level for night-time (NT) and daytime (DT) periods.

Table 4-7 Cumulative Baseline Sound Levels for Night-Time and Daytime Periods

Receptor	Total Regulated Facilities		ASL		Baseline	
Dwelling ID	NT	DT	DT	DT	NT	DT
R1	13.2	13.2	35	45	35.0	45.0
R2	14.2	14.2	35	45	35.0	45.0

5 Project Sound Levels

The Project will consist of solar PV arrays using a fixed tilt racking system secured to the ground with piles. The arrays will be connected to 75 inverter/transformer stations with a total capacity of 270 MW_{AC}. Additionally, a substation has been proposed to be added within the Project boundary and will consist of two 135 MVA high voltage (HV) transformers. A BESS will be constructed adjacent to the substation area, consisting of 62 megapacks and 16 MV transformers, for a total capacity of 100MW/200MWh. The inverter/transformer stations, megapacks, BESS transformers and the Project substation are assumed to be the only significant noise producing Project elements. As such, no other Project elements are considered in this assessment. For the purposes of the noise assessment, the noise producing Project elements are assumed to operate at full load.

The sound power levels data for the noise producing Project elements were used to model sound emissions for both daytime and night-time periods.

5.1 Inverter/Transformer Stations

5.1.1 Inverters

The inverter proposed for the Project are the SMA SC 4000 UP-US units. The sound data measurements for these inverters provided by the equipment manufacturer are shown in **Appendix B**.

Table 5-1 shows the linear 'A', and 'C' frequency weighted one third octave band sound power spectra for the SMA SC 4000 UP-US inverter.

Table 5-1 One Third Octave Band Sound Power Levels for SMA SC 4000 UP-US Inverters

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
25	84.4	39.7	80.0
31.5	87.7	48.3	84.7
40	83.8	49.2	81.8
50	85.6	55.4	84.3
63	87.0	60.8	86.2
80	86.5	64.0	86.0
100	83.9	64.8	83.6
125	90.0	73.9	89.8
160	83.2	69.8	83.1
200	85.6	74.7	85.6
250	87.0	78.4	87.0
315	88.4	81.8	88.4
400	84.5	79.7	84.5
500	81.2	78.0	81.2

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
630	79.7	77.8	79.7
800	82.0	81.2	82.0
1000	78.6	78.6	78.6
1250	78.0	78.6	78.0
1600	78.1	79.1	78.0
2000	75.8	77.0	75.6
2500	79.9	81.2	79.6
3150	87.8	89.0	87.3
4000	70.7	71.7	69.9
5000	71.1	71.6	69.8
6300	80.9	80.8	78.9
8000	70.8	69.7	67.8
10000	69.3	66.8	64.9
Sum	98.6	93.0	97.9

5.1.2 Transformers

The proposed MV transformers for the PV electricity generating facility are 4 MVA in size and the manufacturer is yet to specify transformer sound level. Transformer sound levels are expected to be more than one order of magnitude lower than the equivalent inverters, thereby contributing a negligible amount to cumulative sound levels. As such, a typical transformer of a suitable type was modelled.

The linear ‘A’, and ‘C’ frequency weighted octave band sound power spectra for the MV transformers used in this project are shown in Table 5-2.

Table 5-2 Sound Power Levels for 4MVA Transformer[7]

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	86.4	47.0	83.4
63	81.4	55.2	80.6
125	83.4	67.3	83.2
250	79.4	70.8	79.4
500	78.4	75.2	78.4

[7] Based on theoretical prediction method (Croker,2007).

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
1000	67.4	67.4	67.4
2000	60.4	61.6	60.2
4000	55.4	56.4	54.6
8000	49.4	48.3	46.4
Sum	89.8	77.7	88.5

5.2 BESS

5.2.1 Energy Storage Battery Racks (Megapacks)

The proposed battery energy storage units are the Tesla Megapack 2 XL and are designed as an all-in-one system, which includes the required inverters. The product data sheet states that sound power measurements were conducted 10m from the source at all sides of the unit. The primary source of noise arising from the unit will be from the cooling fans, for the purposes of this assessment it has been assumed that these fans will run at full capacity at all times of day.

Table 5-3Error! Reference source not found. shows the linear, 'A', and 'C' frequency weighted octave band sound power for the megapacks.

Table 5-3 One Third Octave Band Sound Power Levels for the Megapacks

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
100	87.3	68.20	87.0
125	82.1	66.00	81.9
160	83.5	70.10	83.4
200	83.0	72.10	83.0
250	86.3	77.70	86.3
315	90.5	83.90	90.5
400	99.9	95.10	99.9
500	85.2	82.00	85.2
630	88.7	86.80	88.7
800	92.1	91.30	92.1
1000	90.8	90.80	90.8
1250	92.1	92.70	92.1
1600	90.6	91.60	90.5
2000	90.2	91.40	90.0
2500	90.3	91.60	90.0

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
3150	86.6	87.80	86.1
4000	87.0	88.00	86.2
5000	87.4	87.90	86.1
6300	84.6	84.50	82.6
8000	80.6	79.50	77.6
10000	75.7	73.20	71.3
Sum	103.7	101.8	103.5

5.2.2 BESS Transformers

The proposed MV transformers for the BESS are 4 MVA and 8 MVA in size. Specific sound levels have not been specified by the manufacturer. However, the sound levels arising from the MV transformers are expected to be significantly lower in comparison to the megapacks, contributing a negligible amount to cumulative levels. As such, a typical transformer of a suitable type has been modelled.

Table 5-4 and **Table 5-5** show the linear, 'A', and 'C' frequency weighted octave band sound power for the 4MVA and 8MVA BESS transformers, respectively.

Table 5-4 Octave Band Sound Power Levels for 4MVA BESS Transformer[8]

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	72.5	33.1	69.5
63	76.5	50.3	75.7
125	79.5	63.4	79.3
250	77.5	68.9	77.5
500	77.5	74.3	77.5
1000	71.5	71.5	71.5
2000	66.5	67.7	66.3
4000	61.5	62.5	60.7
8000	53.5	52.4	50.5
Sum	84.6	77.7	84.2

Table 5-5 Octave Band Sound Power Levels for 8MVA BESS Transformer[9]

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	76.9	37.5	73.9
63	80.9	54.7	80.1
125	83.9	67.8	83.7
250	81.9	73.3	81.9
500	81.9	78.7	81.9
1000	75.9	75.9	75.9
2000	70.9	72.1	70.7
4000	65.9	66.9	65.1
8000	57.9	56.8	54.9
Sum	88.9	82.1	88.6

5.3 Substation

The substation will be comprised of two 135 MVA HV transformers that will be used to transform the electricity generated from the PV system to grid voltage. The transformers have been modelled in Oil Natural Air Forced (ONAF)

[8] Based on theoretical prediction method (Croker,2007).
[9] Based on theoretical prediction method (Croker,2007).

conditions for a conservative prediction. ONAF is an operation that uses second stage cooling for the transformers when there are higher ambient temperatures. Typically, in ONAF mode, the cooling fan is the source of the loudest noise emissions from the transformer. Octave band levels were derived using published ONAF spectral data, shown in Table 5-6.

Table 5-6 Octave Band Sound Power Levels for the Project Substation[10]

Octave band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	94.7	55.3	91.7
63	98.7	72.5	97.9
125	101.7	85.6	101.5
250	99.7	91.1	99.7
500	99.7	96.5	99.7
1000	93.7	93.7	93.7
2000	88.7	89.9	88.5
4000	83.7	84.7	82.9
8000	75.7	74.6	72.7
Sum	**106.7**	**99.9**	**106.4**

5.4 Modelling Results

Predicted sound levels for the Project are shown in Table 5-7. The results assume full operation 24 hours a day, and they are applicable to night-time and daytime periods.

Table 5-7 Predicted Project Case Sound Levels

Dwelling ID	Project Sound Level (dBA)
R1	36.1
R2	32.1

Receptor R1 is expected to be the receptor most impacted by noise from the Project. The maximum sound pressure level at R1 is predicted to be 36.1 dB(A). Project sound level contours are shown in Appendix C.

[10] Based on theoretical prediction method (Croker,2007).

5.5 Low Frequency Assessment

Table 5-8 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 5-8 Low Frequency Noise Assessment

Dwelling ID	Predicted Sound Level (dBA)	Predicted Sound Level (dBC)	Difference dBC – dBA
R1	36.1	45.0	8.9
R2	32.1	40.7	8.6

6 Cumulative Impact Assessment

The cumulative impact assessment incorporates sound level contributions from the baseline and Project case 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-Times (NT) and Daytimes (DT)

Receptor	Baseline Sound Level (dBA)		Project Sound Level (dBA)		Cumulative Sound Level (dBA)		PSL (dBA)		PSL Compliance Margin (dB)	
Dwelling ID	NT	DT	NT	DT	NT	DT	NT	DT	NT	DT
R1	35.0	45.0	36.1	36.1	38.6	45.5	40	50	1	4
R2	35.0	45.0	32.1	32.1	36.8	45.2	40	50	3	5

The cumulative sound levels at all assessed receptors are shown to meet PSLs with the Project operating at full capacity. Receptor R1 is the most affected by the Project sound levels. Worst case Project sound levels are therefore determined to be compliant with the requirements of AUC Rule 012.

7 Conclusions

Two receptors 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 day and night periods.

While the BESS could operate at anytime, the solar PV electricity generating facility 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 solar PV electricity generating facility may operate during the defined night-time period. Therefore, the assessment considered worst-case (full 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.

Cumulative sound levels were assessed to be at or below PSLs at all receptors. R1 was identified as the most impacted receptor. A Low Frequency Noise (LFN) assessment determined that sound from the proposed Project was not assessed to contain any significant LFN effects.

It is therefore concluded that the proposed Sunnynook Solar and Storage Project would operate in compliance with AUC Rule 012 requirements at all assessed receptors.

8 Acoustic Practitioners' Information

Table 8-1 summarizes the information of the authors and technical reviewer.

Table 8-1 – Summary of Practitioners' Information

Name	Justin Lee	Merlin Garnett	Cameron Sutherland
Title	Renewable Energy (E.I.T)	Principal Noise Consultant	Technical Director
Role	• Acoustic noise modelling • Noise Impact Assessment (NIA) co-author	• Discipline lead • Acoustic noise modelling • Fieldwork lead • Noise Impact Assessment (NIA) co-author	• Technical Assessment Lead • Noise Impact Assessment (NIA) Reviewer
Experience	• Experience with acoustic modelling in iNoise. • Analyst on multiple noise assessments for renewable energy projects in Alberta. • Current INCE associate	• Over 10 years of acoustic and environmental consultancy. • Completed the UK Institute of Acoustics (IOA) diploma in 2015. • Full member of the IOA. • Author on multiple NIAs for renewable energy projects in Alberta.	• 16 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 development in Canada (2019/20).

Appendix A: Rule 012 Glossary

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 1[11]. 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.

[11] 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 two 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 logarithmic addition of sound pressure levels when predicting noise where the sum does not exceed the permissible sound level by 0.4 dBA.

Noise

The unwanted portion of sound.

Permissible sound level (PSL)

The maximum daytime or nighttime 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.

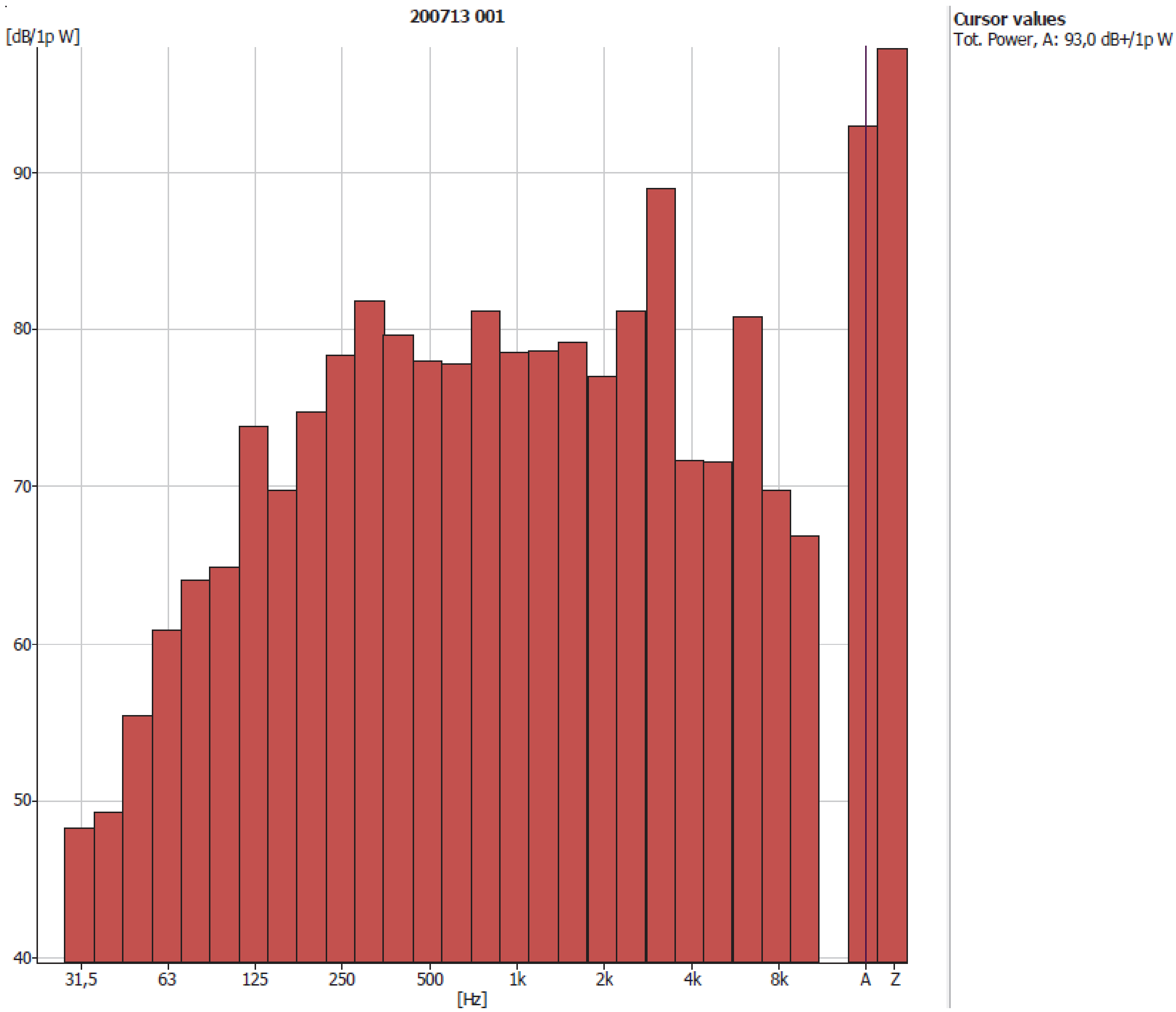
The second part is that the tonal component must be a pronounced peak clearly obvious within the spectrum.

Wind speed

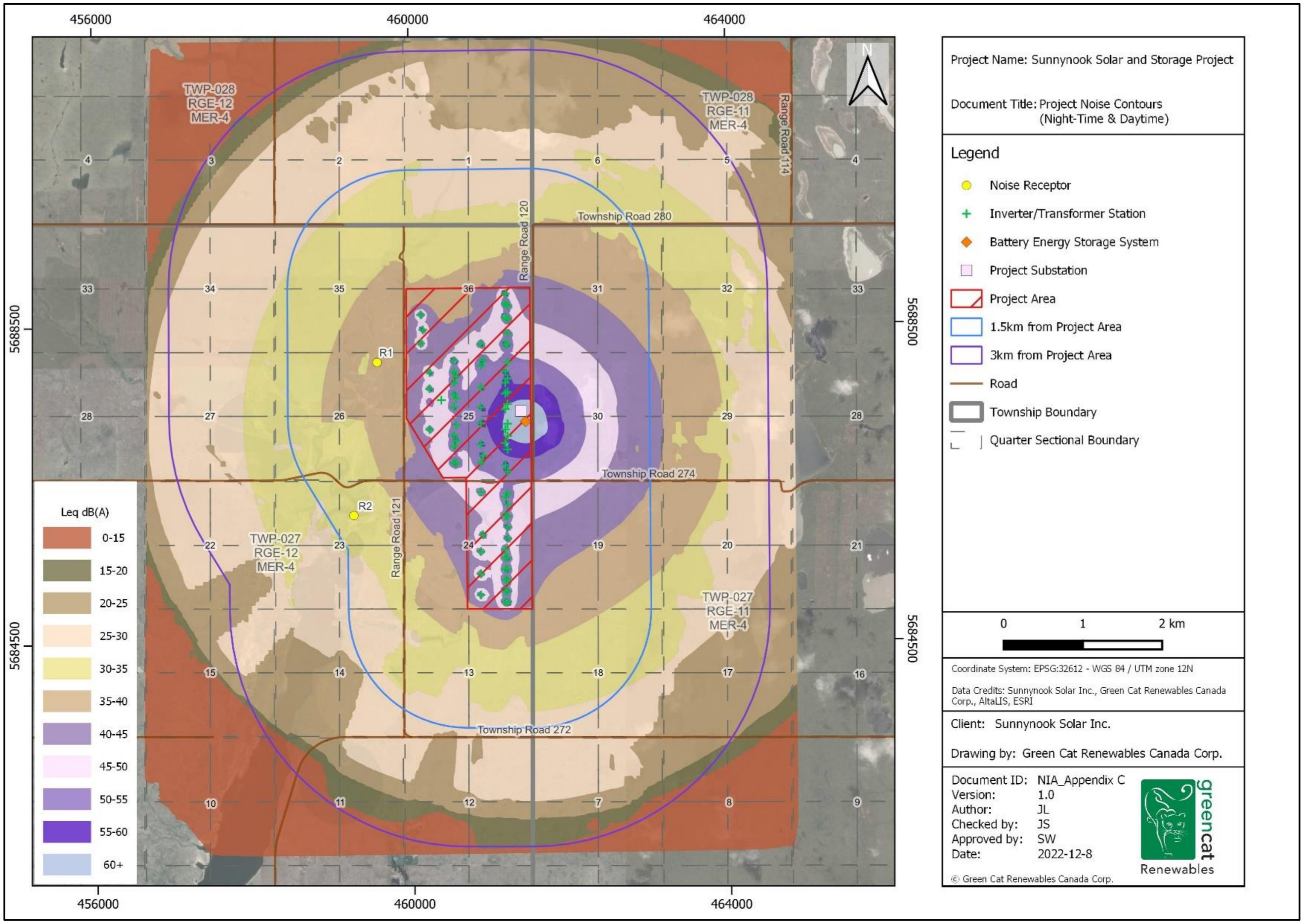
The speed of the wind, expressed in metres per second (m/s), measured in and averaged over 10-minute intervals at the same height as the microphone, but not more than 10 metres above ground level.

Appendix B: Vendor's Sound Power Data

Sound Power Levels of the Third Octave Band Frequencies according to EN ISO 9614-2



Appendix C: Project Sound Level Contours



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