Kneehill Solar Facility & BESS Project

Noise Impact Assessment

Client: Kneehill Solar LP (Capstone Infrastructure Corporation)
Reference: 23-042
Version 1.0

June 2024

Report Prepared for:
Kneehill Solar LP

Author:
Green Cat Renewables Canada Corporation

Issue History	Date	Details
V1.0	June 20th, 2024	Final for Issue

Version History	Author	Reviewed By	Approved By	Issue Date
V1.0	Joshua Kim Justin Lee	Merlin Garnett (June 4th, 2024)	Cameron Sutherland (June 5th, 2024)	June 20th, 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.

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GREEN CAT RENEWABLES CANADA CORPORATION
RM SIGNATURE:
RM APEGA ID#: 125095
DATE: 2024-JUN-20
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.

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Executive Summary

Kneehill Solar LP (Kneehill Solar), a subsidiary of Capstone Infrastructure Corporation, is the owner and operator of the Kneehill Solar Facility (the Solar Facility). The Kneehill Solar Facility is an operational 25-megawatt (MW_{AC}) solar photovoltaic (PV) electricity generating facility located within quarter section SW-13-32-24-W4M in Kneehill County, Alberta, approximately 2.5km north of the Town of Three Hills.

Kneehill Solar is proposing to install a Battery Energy Storage System (the BESS Project) within the fence line of the existing Solar Facility. The BESS Project would be installed adjacent to the existing switching station at the Solar Facility. The BESS Project would have a total capacity of 10 MW, with a total energy storage capacity of 20 MWh.

Kneehill Solar retained Green Cat Renewables Canada Corporation (GCR) to conduct an updated noise impact assessment (NIA) to include the BESS Project, and to compare the results with the NIA previously conducted by GCR for the Solar Facility, which was submitted to the Alberta Utilities Commission (AUC) in November 2022. The Solar Facility was approved by the AUC under Approval 27824-D02-2022, constructed, and has been operational since March 2023. The BESS Project is a proposed addition to the Solar Facility (collectively, the combined Solar Facility and BESS Project). This assessment has considered all noise producing sources within the combined Solar Facility and BESS Project, and has evaluated the incremental noise at receptors from the BESS Project

The BESS Project would consist of eight (8) BESS units, eight (8) BESS inverters, and four (4) BESS transformers. The Solar Facility inverter/transformer stations, BESS units, BESS inverters/transformers, and the backup generator for the Solar Facility are understood to be the only significant noise producing elements of the combined Solar Facility and BESS Project. As such, no other noise emitting elements were considered in this assessment.

GCR reviewed aerial imagery and identified seventeen (17) receptors within and bordering the combined Solar Facility and BESS Project study area (1,500m of the combined Solar Facility and BESS Project boundary). The receptors are considered representative of the receptors expected to be the most impacted by any incremental noise related to the proposed BESS Project. The area was also reviewed for regulated third-party energy-related facilities that may produce noise within the vicinity of the combined Solar Facility and BESS Project.

GCR conducted a site visit in May 2024 to verify details of the third-party facilities, as well as to conduct field measurements of the operational Solar Facility inverter/transformer stations under full load. It was found that GCR's field measurements aligned well with the manufacturer's noise test report, and thereby validated the use of the manufacturer's noise test report for this NIA update.

A software model was used to predict sound levels from the combined Solar Facility and BESS Project to determine compliance of the BESS Project with the permissible sound levels established in AUC Rule 012: *Noise Control*. The cumulative sound levels of the combined Solar Facility and BESS Project were found to be below the night-time permissible sound levels (PSL) for all receptors; however, the compliance margin was found to be less than 3dB. Therefore, 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: existing regulated third-party energy-related facilities; third-party projects; the combined Solar Facility and BESS Project; and ambient sources.

Receptor R04 was assessed to be the most impacted receptor by the combined Solar Facility and BESS Project, with night-time cumulative sound levels of 38.7 dB(A), falling below its respective PSL. Receptor R04 was assessed to also be the most impacted receptor by the BESS Project with an incremental cumulative sound level of 0.8dB from the previous NIA. Cumulative sound levels at all other receptors considered in this NIA were assessed to be below PSLs by a minimum margin of 2dB. In comparison to the previous assessment for the Solar Facility (submitted to the AUC and dated November 2022), the maximum increase in cumulative sound levels for the assessed receptors is 0.9dB.

A Low Frequency Noise (LFN) assessment determined that sound from the combined Solar Facility and BESS Project was not likely to produce any significant LFN effects.

Therefore, the combined Solar Facility and BESS Project is therefore assessed to meet the requirements of AUC Rule 012.

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1 Introduction

Kneehill Solar LP (Kneehill Solar) has constructed and is operating the 25-MW_{AC} Kneehill Solar Facility (the Solar Facility). Green Cat Renewables Canada Corporation (GCR) prepared a Noise Impact Assessment (NIA) for the Solar Facility, which was submitted to the AUC as Exhibit 27824-X0005[1] in November 2022. The Solar Facility is located within Kneehill County, Alberta, within SW-13-32-24-W4M, approximately 2.5km north of the Town of Three Hills.

Kneehill Solar have retained GCR to conduct a NIA for the proposed addition of Battery Energy Storage to the operational Solar Facility (the BESS Project), within the constructed fence line of the Solar Facility. This assessment has considered the cumulative impact of the existing Solar Facility and the BESS Project (collectively, the combined Solar Facility and BESS Project), as well as third-party energy related facilities on nearby receptors.

The combined Solar Facility and BESS Project location is shown in **Figure 1-1** below.

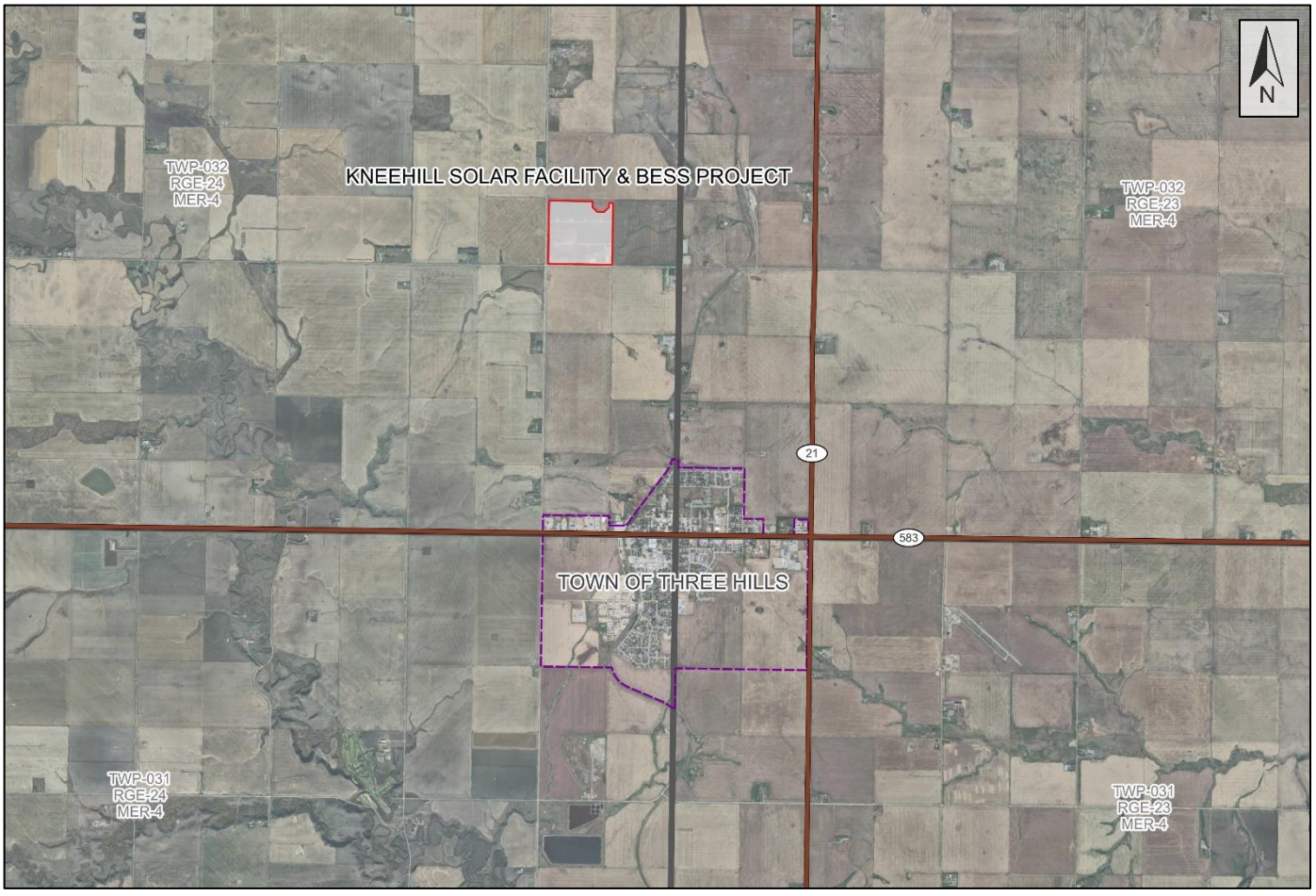


Figure 1-1 – Kneehill Solar Facility and BESS Project Location

[1] AUC Exhibit 27824-X0005: Kneehill Solar Project - NIA v1.0 Final (2021-08-04)

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 17534-3[2]: '*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[3]
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) 0.0 (for waterbodies)
Number of Sound Reflections	1
Receptor Height	4.5m (for two-storey)
Operation Condition	Full load
Source Height	2.3m for Inverter/Transformer Stations 2.3m for BESS Units 1.1m for BESS Transformers 2.0m for BESS Inverters 1.0m for Diesel Generator

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

4 Baseline

4.1 Study Area

The combined Solar Facility and BESS Project site has a total fenced area of approximately 141 acres. The BESS Project is located on less than 1 acre of this total site area. Therefore, the study area for the Solar Facility, consists of all areas within 3km of the combined Solar Facility and BESS Project boundary. The study area for the combined Solar Facility and BESS Project includes several detached dwellings in the surrounding area, rural/agricultural land, waterbodies, and portions of Highway 21.

Within the guidelines of AUC Rule 012, seventeen (17) dwellings within and bordering 1.5km from the combined Solar Facility and BESS Project boundary were identified from satellite imagery. All receptors were modelled at a height of 4.5m to represent two-storey dwellings as a conservative assumption, and to align with the previous NIA. These receptors are considered representative of the dwellings expected to be the most impacted by noise from the proposed BESS Project. These dwellings have been assessed for cumulative noise impacts from the combined Solar Facility and BESS Project, and other nearby facilities, as required by AUC Rule 012.

4.2 Project Description

The Solar Facility encompasses an area of approximately 141 acres of land consisting of approximately 63,700 PV modules, with a total generating capacity of 25.0 MW_{AC}. The solar arrays utilize ground mounted, single-axis tracker modules which feed eight (8) inverter/transformer stations. A 30kW diesel back-up generator is also installed on-site, which was confirmed by Kneehill Solar to only be operational during daytime periods under standard conditions.

The BESS Project will consist of eight (8) BESS units accompanied by eight (8) BESS inverters and four (4) BESS transformers, with a total BESS capacity of 10MW/20MWh. The combined Solar Facility and BESS Project also consists of several auxiliary switching station transformers, but these were not included in this assessment given their small size (<250 kVA) and their consequently negligible noise impact.

The aforementioned equipment are assessed to be the only significant sources of noise from the combined Solar Facility and BESS Project. As such, no other elements are considered in this assessment.

A list of all noise producing sources, along with their locations, for the combined Solar Facility and BESS Project provided in Appendix B.

Daytime periods are defined as occurring between 07:00-22:00, while night-time periods fall between 22:00-07:00. The combined Solar Facility and BESS 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

Seventeen (17) receptors located within and bordering the 1.5km study area were identified as potentially being the most impacted by the combined Solar Facility and BESS Project. Receptors were identified through satellite imagery. It should be noted that thirteen (13) receptors were assessed in the previous assessment, and four (4) additional receptors, R14 through R17 inclusive, were identified for this assessment. To be conservative, all receptors were modelled as two-storey buildings, with a representative receptor height of 4.5m. These receptors are considered representative of the receptors expected to be the most impacted by the noise from the proposed Project and other nearby facilities. Table 4-1 shows the receptor details.

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			
R01	342112	5736252	Two-Storey	4.5m	1280m N
R02	344132	5734640	Two-Storey	4.5m	1320m E
R03	343949	5734167	Two-Storey	4.5m	1150m E
R04	343575	5734082	Two-Storey	4.5m	780m E
R05	343632	5733869	Two-Storey	4.5m	890m SE
R06	343555	5733054	Two-Storey	4.5m	1360m SE
R07	341899	5733184	Two-Storey	4.5m	1030m S
R08	341107	5734309	Two-Storey	4.5m	920m W
R09	341963	5735415	Two-Storey	4.5m	450m N
R10	343958	5735966	Two-Storey	4.5m	1540m NE
R11	340938	5733138	Two-Storey	4.5m	1520m SW
R12	340906	5736001	Two-Storey	4.5m	1530m NW
R13	343757	5736180	Two-Storey	4.5m	1560m NE
R14	343554	5733114	Two-Storey	4.5m	1310m SE
R15	343647	5732925	Two-Storey	4.5m	1520m SE
R16	342157	5735992	Two-Storey	4.5m	1150m N
R17	342165	5736123	Two-Storey	4.5m	1020m N

4.4 Existing Third-Party Regulated Energy-Related Facilities

A search for active and approved regulated energy-related facilities and pumping wells within 3km of the combined Solar Facility and BESS Project boundary was conducted in May 2024. 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 any existing and approved AUC regulated facilities. GCR identified seventeen (17) AER regulated facilities and two (2) AUC

regulated facilities that were considered to have the potential to influence cumulative sound levels. No other existing or approved AUC regulated facilities have been identified within the assessment area.

Table 4-2 lists the third-party energy-related facilities identified within 3km of the combined Solar Facility and BESS Project that have the potential to influence cumulative sound levels. Information was gathered using the AER and AUC eFiling databases.

Table 4-2 – Third-Party Sound Sources

Map Label	Name	Type	Operator Name	UTM Coordinates (NAD 83, Zone 12N)	
				Easting	Northing
AER1	PNG TWINING 102/14-14-032-24W4	Gas Test Battery	AlphaBow Energy Ltd.	341017	5735633
AER2	TWINING 08-22-032-24 W4 SWB	Gas Single-Well Battery	Pine Cliff Energy Ltd.	340047	5736394
AER3	RIFE TWINING 01-25-032-24W4	Crude Oil Single-Well Battery	Artis Exploration Ltd.	343440	5737521
AER4	BEAU TWINING EQUITY	Gas Gathering System	Pine Cliff Energy Ltd.	344570	5731878
AER5	THREE HILLS EQUITY GAS PLANT	Gas Multiwell Group Battery	Pine Cliff Energy Ltd.	344562	5731871
AER6	SOC TWINING 5-15-32-24	Pumping Well (Oil)	Pine Cliff Energy Ltd.	340002	5736225
AER7	SOC TWINING 10-15-32-24	Pumping Well (Gas)	Pine Cliff Energy Ltd.	340047	5736394
AER8	SOC TWINING 10-14-32-24	Pumping Well (Gas)	Pine Cliff Energy Ltd.	341458	5736829
AER9	SOC TWINING 14-14-32-24	Pumping Well (Gas)	Pine Cliff Energy Ltd.	341654	5737367
AER10	SOC TWINING 2-22-32-24	Pumping Well (Oil)	Pine Cliff Energy Ltd.	343440	5737521
AER11	SOC TWINING 8-22-32-24	Pumping Well (Gas)	Pine Cliff Energy Ltd.	344569	5731878
AER12	SOC TWINING 10-23-32-24	Pumping Well (Gas)	Pine Cliff Energy Ltd.	342665	5731674
AER13	TQN DD TWINING 2-26-32-24	Pumping Well (Gas)	TAQA North Ltd.	341412	5732099
AER14	ARTIS TWINING 1-24-32-24	Pumping Well (Oil)	Artis Exploration Ltd.	340047	5736394
AER15	SOC TWINING 10-6-32-23	Pumping Well (Oil)	Pine Cliff Energy Ltd.	340943	5735734
AER16	SOC TWINING 6-1-32-24	Pumping Well (Gas)	Pine Cliff Energy Ltd.	341654	5737367
AER17	SOC TWINING 10-2-32-24	Pumping Well (Gas)	Pine Cliff Energy Ltd.	343440	5737521
AUC1	Three Hills 770S	Substation	Atco Power Canada Ltd.	343699	5734225
AUC2	Three Hills Solar	Solar PV Generating Plant	Three Hills Solar Power Corp.	345785	5733898

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

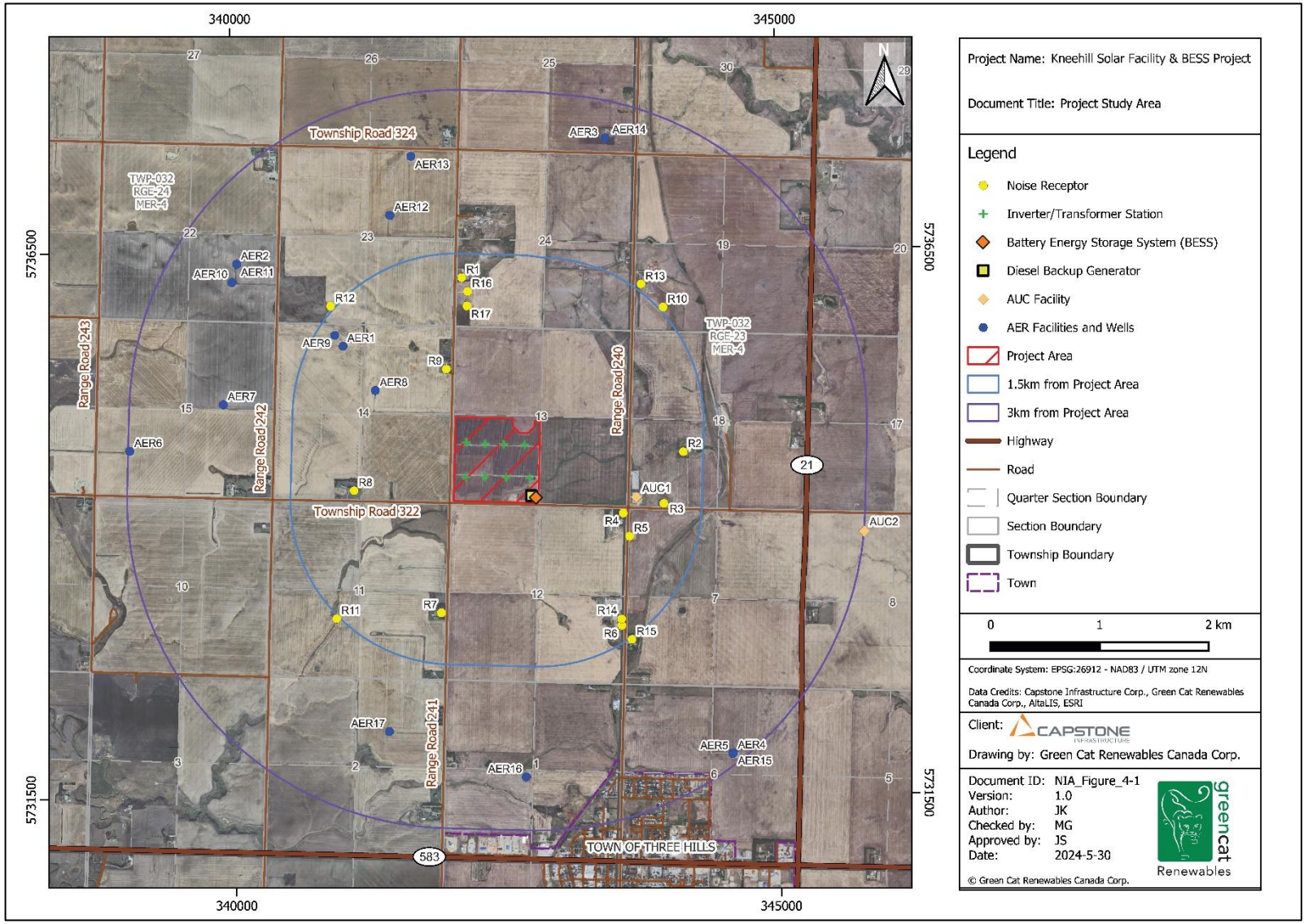


Figure 4-1 – Solar Facility and BESS Project Study Area

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, road and 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[4]	40	43	46
Category 2[5]	45	48	51
Category 3[6]	50	53	56

The assessed receptors in the study area have been evaluated to determine their category for both dwelling density and proximity to transportation. Table 4-4 identifies the categories for the assessed receptors.

All receptors have been assessed as category 1 for dwelling density and proximity to transportation.

4.5.2 Determination of Ambient Sound Level (ASL)

The combined Solar Facility and BESS Project is located in an area typical of rural Alberta (including agricultural and oil & gas industries). 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'.[7] This results in a night-time ASL between 35 dB(A) and a daytime ASL of 45 dB(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

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

[4] 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.
[5] 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.
[6] Category 3—dwelling(s) distance is less than 30 m from heavily travelled roads, or rail lines or subject to frequent aircraft flyovers.
[7] 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

Receptor 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
R11	1	1	40	35	45	40	50
R12	1	1	40	35	45	40	50
R13	1	1	40	35	45	40	50
R14	1	1	40	35	45	40	50
R15	1	1	40	35	45	40	50
R16	1	1	40	35	45	40	50
R17	1	1	40	35	45	40	50

4.5.4 AER Facility Sound Power Levels

GCR conducted a site visit in May 2024 to verify operating statuses of the third-party facilities located within the assessment area. Facility access was only granted for the facilities operated by Artis Exploration Ltd. (Artis) and TAQA North Ltd. (TAQA) within the assessment area. Through field verification and consultation with the operators, one (1) facility was confirmed to be operational but not noise producing; two (2) facilities were field verified to be absent and/or not audible; and one (1) facility sub-type was verified to be different than what was listed in the AER databases. No field measurements for third-party facility sound power levels were conducted.

Sound power levels for all third-party facilities, including both AER and AUC facilities, were sourced from internal noise measurement databases and third-party NIAs that included measurements of similar facilities. The quoted sound power level is deemed typical and representative of the facility type.

Table 4-5 provides relevant site details for the AER facilities within the assessment area.

Table 4-5 – AER Facility Access and Site Details

Facility ID	Facility Access?	Operational Status	Source of Sound Spectra
AER1	No	Unable to confirm; Assumed Active	Internal Noise Database
AER2	No	Unable to confirm; Assumed Active	Internal Noise Database
AER3	Yes	Active; Operator confirmed no audible noise-producing sources on-site	N/A
AER4	No	Unable to confirm; Assumed Active	Internal Noise Database
AER5	No	Unable to confirm; Assumed Active	Internal Noise Database
AER6	No	Unable to confirm; Assumed Active	Internal Noise Database
AER7	No	Unable to confirm; Assumed Active	Internal Noise Database
AER8	No	Unable to confirm; Assumed Active	Internal Noise Database
AER9	No	Unable to confirm; Assumed Active	Internal Noise Database
AER10	No	Inactive; No visible or audible wellhead	N/A
AER11	No	Inactive; No visible or audible wellhead	N/A
AER12	No	Unable to confirm; Assumed Active	Internal Noise Database
AER13	Yes	Active; verified to be a gas well	Internal Noise Database
AER14	Yes	Active	Internal Noise Database
AER15	No	Unable to confirm; Assumed Active	Internal Noise Database
AER16	No	Unable to confirm; Assumed Active	Internal Noise Database
AER17	No	Unable to confirm; Assumed Active	Internal Noise Database
AUC1	No	Unable to confirm; Assumed Active	Third-party NIA[8]
AUC2	No	Active AUC Proceeding[9]	Theoretical prediction, manufacturer test report, Third-party NIA[10]

For the purposes of this assessment, all noise producing AER and AUC facilities were deemed to operate at full load and produce noise continuously.

Table 4-6 shows the octave band sound power levels for the included AER regulated energy-related facilities within 3km of the combined Solar Facility and BESS Project.

[8] AUC Exhibit 23044_X0018: *Three Hills 770S Substation Noise Impact Assessment* (August 2010)
[9] AUC Proceeding 28086 (Active proceeding as of June 2024)
[10] Facility sound sources and locations identified from AUC Exhibit 28086_X0004: *Noise Impact Assessment - Abacus Power Ltd Solar Facility* (November 2022)

Table 4-6 – Octave Band Sound Power Levels for AER Regulated Facilities

Map Label	Facility	Octave Band Centre Frequency, Hz									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
AER1	PNG TWINING 102/14-14-032-24W4	59.5	73.8	80.7	74.7	71.6	69.7	67.8	62.8	59.7	103.6	83.1
AER2	TWINING 08-22-032-24 W4 SWB	65.5	72.0	79.2	85.0	92.0	87.6	87.2	86.8	79.0	106.8	95.6
AER3	RIFE TWINING 01-25-032-24W4	--	--	--	--	--	--	--	--	--	--	--
AER4	BEAU TWINING EQUITY	68.8	76.9	78.0	77.5	80.6	78.9	76.1	71.8	67.6	109.5	86.4
AER5	THREE HILLS EQUITY GAS PLANT	69.7	79.6	85.7	90.1	92.9	95.1	94.8	89.4	79.9	111.8	100.3
AER6	SOC TWINING 5-15-32-24	56.2	64.1	70.5	73.0	81.1	82.4	82.0	82.9	78.1	97.9	88.8
AER7	SOC TWINING 10-15-32-24	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4
AER8	SOC TWINING 10-14-32-24	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4
AER9	SOC TWINING 14-14-32-24	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4
AER10	SOC TWINING 2-22-32-24	--	--	--	--	--	--	--	--	--	--	--
AER11	SOC TWINING 8-22-32-24	--	--	--	--	--	--	--	--	--	--	--
AER12	SOC TWINING 10-23-32-24	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4
AER13	TQN DD TWINING 2-26-32-24	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4
AER14	ARTIS TWINING 1-24-32-24	56.2	64.1	70.5	73.0	81.1	82.4	82.0	82.9	78.1	97.9	88.8
AER15	SOC TWINING 10-6-32-23	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4

Map Label	Facility	Octave Band Centre Frequency, Hz									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
AER16	SOC TWINING 6-1-32-24	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4
AER17	SOC TWINING 10-2-32-24	27.9	40.4	38.1	45.6	64.2	69.3	66.7	61.0	53.7	74.7	72.4

Table 4-7 shows the octave band sound power levels for the included AUC regulated energy-related facilities within 3km of the combined Solar Facility and BESS Project.

Table 4-7 – Octave Band Sound Power Levels for AUC Regulated Facilities

Map Label	Facility/Equipment	Octave Band Centre Frequency, Hz									Total	
		31.5	63	125	250	500	1000	2000	4000	8000	dB	dB(A)
AUC1	Three Hills 770S Substation (Transformer Casing)	40.6	49.8	75.9	73.4	87.8	81.0	72.2	60.0	49.9	95.2	89.1
AUC1	Three Hills 770S Substation (Transformer Fans)	42.6	63.8	68.9	77.4	80.8	80.0	78.2	74.0	64.9	93.6	85.8
AUC1	Three Hills 770S Substation (144kV Capacitor Bank)	35.6	52.8	67.9	64.4	74.8	76.0	70.2	54.0	48.9	86.9	79.5
AUC2	Three Hills Solar (Facility Inverters)[11]	52.0	66.1	75.7	84.0	83.3	84.4	84.2	89.1	81.3	98.6	93.0
AUC2	Three Hills Solar (Facility Transformers)[12]	47.1	55.3	67.4	70.9	75.3	67.5	61.7	56.5	48.4	89.9	77.7

4.6 Total Baseline Sound Levels

Baseline sound levels include the noise contributions from existing adjacent sound 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.

[11] Sound Power Kodiak 2.0 SC4xxx-UP Noise Measurement (SMA Solar Technology AG, 2020)
[12] Based on theoretical prediction (Crocker, 2007)

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
R01	15.7	15.7	35	45	35.1	45.0
R02	25.7	25.7	35	45	35.5	45.1
R03	33.6	33.6	35	45	37.4	45.3
R04	34.3	34.3	35	45	37.7	45.4
R05	29.4	29.4	35	45	36.1	45.1
R06	19.0	19.0	35	45	35.1	45.0
R07	14.0	14.0	35	45	35.0	45.0
R08	13.9	13.9	35	45	35.0	45.0
R09	16.8	16.8	35	45	35.1	45.0
R10	12.5	12.5	35	45	35.0	45.0
R11	10.1	10.1	35	45	35.0	45.0
R12	25.0	25.0	35	45	35.4	45.0
R13	12.1	12.1	35	45	35.0	45.0
R14	19.0	19.0	35	45	35.1	45.0
R15	19.5	19.5	35	45	35.1	45.0
R16	16.2	16.2	35	45	35.1	45.0
R17	16.4	16.4	35	45	35.1	45.0

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

5 Solar Facility & BESS Project Sound Levels

The operational Solar Facility consists of solar PV arrays using ground mounted, single-axis trackers. The solar arrays are connected to eight (8) inverter/transformer stations, with a total generating capacity of up to 25.0 MW_{AC}. The BESS Project will consist of eight (8) BESS units accompanied by eight (8) BESS inverters and four (4) BESS transformers, with a total BESS capacity of 10MW/20MWh. A 30 kW diesel back-up generator is installed on-site for the Solar Facility, which was confirmed by Kneehill Solar to only be operational during daytime periods under standard conditions. The combined Solar Facility and BESS Project also consists of several auxiliary switching station transformers, but these were not included in this assessment given their small size (<250 kVA) and their consequently negligible noise impact.

For the purposes of the noise assessment, it has been assessed that the only significant noise producing elements of the combined Solar Facility and BESS Project are the inverters/transformer stations, BESS units, BESS inverters, BESS transformers and the diesel back-up generator (for the Solar Facility). All noise producing sources were modelled as omni-directional point sources.

In general, each single-axis tracker is expected to be quieter than the inverter/transformer stations. 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 dependent on time of year). Due to the trackers' infrequent and asynchronous operation, and their uniform distribution across solar sites, it was assessed that they would have limited potential to contribute to overall project sound levels and would not be considered significant noise producing Project elements.

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 combined Solar Facility and BESS 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 Solar Facility

5.1.1 Inverter/Transformer Stations

The inverter/transformer stations for the approved and constructed PV electricity generating facility are the Sungrow SG3600UD units. An assessment of the sound power levels for these units was conducted using the manufacturer's noise test report. The sound data measurements for these inverters provided by the equipment manufacturer are shown in Appendix D .

Table 5-1 shows the linear, 'A', and 'C' frequency weighted octave band sound power spectra derived for the Sungrow SG3600UD inverter/transformers.

Table 5-1 – Octave Band Sound Power Levels for Sungrow SG3600UD Inverter/Transformer units

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	90.8	51.2	87.6
63	91.8	65.4	90.8
125	92.8	76.5	92.4
250	91.8	83.0	91.6
500	96.8	93.4	96.6
1000	87.8	87.6	87.6

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
2000	86.8	87.8	86.4
4000	82.8	83.6	81.8
8000	79.8	78.5	76.6
Sum	**100.9**	**95.9**	**100.5**

A site visit was conducted by GCR staff in May 2024 to take field measurements of the operating Sungrow SG3600UD units on-site at the Solar Facility. The aim of the measurements was to verify the data presented in Table 5-1. Measurements were conducted at Inverter Skid #4, at a distance of 1m from the skid at opposite ends; on the side closest to the inverter and on the side closest to the transformer. The measurement locations aligned spatially with those specified in the manufacturer's noise test report. Field measurements were conducted while the inverter was operating at full load.

Table 5-2 compares the measured data to the sound pressure levels provided in the manufacturer's noise test report at the corresponding measurement locations.

Table 5-2 – Comparison of Field-Measured Sound Pressure Levels of SG3600UD Unit Operating at Full Load

Location	Source	Total dB(A)
Inverter Side	GCR Field Measurement – Inverter Side	80.3
	Sungrow Test Report – Measurement #10 (Inverter Side)	79.6
	Difference	**0.7**
Transformer Side	GCR Field Measurement – Transformer Side	59.7
	Sungrow Test Report – Measurement #7 (Transformer Side)	58.8
	Difference	**0.9**

Field measurements indicated that the operation of the installed inverter/transformer stations closely aligned with the manufacturer's noise test report; within 1dB(A) of the reported broadband A-weighted sound pressure levels at the corresponding measurement locations. Considering the difference in measurement distance (GCR measured at a distance of 1m, which is closer than the 1.25m reported in the manufacturer test report), differing ambient conditions at the time of measurement, and the difference in the devices used for the measurements, the discrepancies between the measured and reported sound pressure levels are considered marginal. Therefore, it is concluded that the sound data presented in the manufacturer's test report for the Sungrow SG3600UD inverters is representative of real-world conditions and is valid for use in this assessment.

5.1.2 Diesel Backup Generator

The approved and constructed Solar Facility also includes an on-site 30 kW diesel backup generator which was confirmed by Kneehill Solar to be only operational during daytime periods under standard conditions. Under standard operation, the generator will complete a reliability test cycle during daytime hours once per month, lasting for a minimum of 20 minutes. During unplanned outages, the backup generator may be required to operate during night-time.

Octave band sound power data was not provided for the diesel generator. In the absence of this data, sound spectra for a 30kW propane generator were provided by Kneehill Solar, which report an A-weighted sound pressure level of 62.1 dB(A) measured at 7m and an A-weighted sound power level of 89.7 dB(A). Both generator types feature a sound attenuated level 2 enclosure.

Kneehill Solar confirmed that the equivalent diesel generator would have sound pressure levels of up to 13 dB(A) greater than those reported for the propane generator. Thus, a linear adjustment of 13 dB(A) was applied to the propane generator sound power octave band spectrum to derive a reasonable estimation of the sound spectra for the diesel generator. The resultant broadband sound power level for the selected diesel generator is 102.7 dB(A).

The noise data of a 30kW propane generator provided to GCR can be found in Appendix E.

Table 5-3 shows the linear, 'A', and 'C' frequency weighted octave band sound power spectra derived for the 30kW diesel backup generator.

Table 5-3 – Octave Band Sound Power Levels for the 30 kW Diesel Backup Generator

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	104.4	65.0	101.4
63	114.4	88.2	113.6
125	105.7	89.6	105.5
250	107.3	98.7	107.3
500	98.8	95.6	98.8
1000	94.0	94.0	94.0
2000	90.3	91.5	90.1
4000	90.6	91.6	89.8
8000	90.3	89.2	87.3
Sum	**116.1**	**102.7**	**115.4**

5.2 BESS Project

5.2.1 Energy Storage Battery Racks

The proposed battery energy storage units are the CanadianSolar Solbank S-2967-2h units. The primary source of noise arising from the unit will be from the cooling fans. For the purpose of this assessment, it has been assumed that the cooling fans will operate at full load during all night-time and daytime hours.

The sound pressure levels (SPL) for the Solbank S-2967-2h units were provided by the manufacturer[13], which included broadband values measured at points around the battery container as well as octave band spectra data measured on the front side of the battery container, all measured at a distance of 1m. A weighted sound pressure level of 63.5 dB(A) was obtained from logarithmically averaging all 15 broadband measurements, and an adjusted octave band spectra was obtained by applying the difference between the front side SPL and omni-directional SPL to the given octave band spectra. A measurement surface area correction was then applied to the adjusted octave band spectra to derive the modelled sound power level of 83.7 dB(A) for the selected BESS units.

5.2.2 BESS Inverters

The proposed inverters for the BESS are the EPCPower CAB1000 units. The noise test report provided includes the unweighted one-third octave band sound power level spectra, which was used in modelling the BESS inverters. The noise test report for these inverters is shown in Appendix F.

Table 5-4 shows the linear, 'A' and 'C' frequency weighted one third octave band sound power data for the selected BESS inverters.

Table 5-4 – One Third Octave Band Sound Power Levels for the EPCPower CAB1000 BESS Inverters

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
50	73.3	43.1	72
63	70	43.8	69.2
80	74.2	51.7	73.7
100	82.1	63	81.8
125	76.4	60.3	76.2
160	75.7	62.3	75.6
200	87.9	77	87.9
250	79	70.4	79
315	81.2	74.6	81.2
400	78.6	73.8	78.6
500	78	74.8	78
630	79.3	77.4	79.3

[13] 0.5P-0.67P_SolBank Noise Level Testing Report (Canadian Solar, 2023)

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
800	78	77.2	78
1000	77.5	77.5	77.5
1250	75.9	76.5	75.9
1600	73.4	74.4	73.3
2000	72.2	73.4	72
2500	75.7	77	75.4
3150	75.7	76.9	75.2
4000	67.5	68.5	66.7
5000	73.2	73.7	71.9
6300	74.5	74.4	72.5
8000	71.3	70.2	68.3
10000	69.3	66.8	64.9
Sum	**92.3**	**87.6**	**92.1**

5.2.3 BESS Transformers

The proposed MV transformers for the BESS are 3MVA each. Sound levels for the transformers accompanying the BESS units have not been specified by the manufacturer; however, sound levels produced by the 3MVA transformers are expected to be significantly lower in comparison to other noise producing project elements. Nevertheless, a typical transformer of a suitable type has been modelled. The BESS transformers have been modelled in Oil Natural Air Natural (ONAN) conditions.

The linear 'A' and 'C' frequency weighted octave band sound power spectra for the 3MVA BESS transformers is shown in Table 5-5.

Table 5-5 – Octave Band Sound Power Levels for the 3MVA BESS Transformers[14]

Octave Band Frequency (Hz)	Sound Power (dB)	Sound Power (dBA)	Sound Power (dBC)
31.5	84.7	45.3	81.7
63	79.7	53.5	78.9
125	81.7	65.6	81.5
250	77.7	69.1	77.7
500	76.7	73.5	76.7
1000	65.7	65.7	65.7

[14] Based on theoretical prediction method (Crocker, 2007).

2000	58.7	59.9	58.5
4000	53.7	54.7	52.9
8000	47.7	46.6	44.7
Sum	**88.1**	**75.9**	**86.7**

5.3 Modelling Results

Predicted sound levels for the combined Solar Facility and BESS Project are shown in Table 5-6. It is assumed that the on-site backup diesel generator runs during daytime hours only. Otherwise, all other equipment is assumed to be operational 24/7.

Table 5-6 – Predicted Project Case Sound Levels

Receptor ID	Project Sound Level, DT (dBA)	Project Sound Level, NT (dBA)
R01	25.0	24.2
R02	27.5	26.2
R03	29.0	27.7
R04	34.4	32.1
R05	31.9	30.7
R06	26.3	24.5
R07	29.9	28.9
R08	31.2	30.3
R09	31.9	31.4
R10	21.8	19.6
R11	23.9	22.6
R12	21.3	20.0
R13	21.5	19.5
R14	25.7	23.3
R15	25.5	23.9
R16	26.4	25.7
R17	26.9	26.2

Receptor R04 is expected to be the receptor experiencing the highest Project sound levels, having a maximum sound pressure level of 34.4dB(A). The combined Solar Facility and BESS Project sound level contours for daytime and night-time are shown in Appendix G and Appendix H, respectively.

5.4 Low Frequency Assessment

Table 5-7 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 5-7 – Low Frequency Noise Assessment

Receptor ID	Predicted Sound Level (dBA)	Predicted Sound Level (dBC)	Difference dBC – dBA
R01	25.0	38.6	13.5
R02	27.5	41.5	14.0
R03	29.0	43.0	14.0
R04	34.4	50.1	15.7
R05	31.9	45.0	13.2
R06	26.3	41.3	15.0
R07	29.9	42.5	12.7
R08	31.2	45.2	14.0
R09	31.9	42.7	10.8
R10	21.8	38.0	16.1
R11	23.9	38.3	14.4
R12	21.3	36.6	15.3
R13	21.5	37.7	16.2
R14	25.7	41.5	15.8
R15	25.5	40.5	15.0
R16	26.4	39.3	12.8
R17	26.9	39.8	12.8

6 Cumulative Impact Assessment

The cumulative impact assessment incorporates sound level contributions from the baseline and combined Solar Facility and BESS 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-Time (NT) and Daytime (DT) Periods

Receptor ID	Baseline Sound Level (dBA)		Solar Facility & BESS 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	35.1	45.0	24.2	25.0	35.4	45.0	40	50	5	5
R02	35.5	45.1	26.2	27.5	36.0	45.1	40	50	4	5
R03	37.4	45.3	27.7	29.0	37.8	45.4	40	50	2	5
R04	37.7	45.4	32.1	34.4	38.7	45.7	40	50	1	4
R05	36.1	45.1	30.7	31.9	37.2	45.3	40	50	3	5
R06	35.1	45.0	24.5	26.3	35.5	45.1	40	50	5	5
R07	35.0	45.0	28.9	29.9	36.0	45.1	40	50	4	5
R08	35.0	45.0	30.3	31.2	36.3	45.2	40	50	4	5
R09	35.1	45.0	31.4	31.9	36.6	45.2	40	50	3	5
R10	35.0	45.0	19.6	21.8	35.1	45.0	40	50	5	5
R11	35.0	45.0	22.6	23.9	35.3	45.0	40	50	5	5
R12	35.4	45.0	20.0	21.3	35.5	45.1	40	50	4	5
R13	35.0	45.0	19.5	21.5	35.1	45.0	40	50	5	5
R14	35.1	45.0	23.3	25.7	35.4	45.1	40	50	5	5
R15	35.1	45.0	23.9	25.5	35.4	45.1	40	50	5	5
R16	35.1	45.0	25.7	26.4	35.5	45.1	40	50	4	5
R17	35.1	45.0	26.2	26.9	35.6	45.1	40	50	4	5

Cumulative sound levels at the most impacted receptor (R04) were assessed to be 38.7dB(A), falling below its respective PSL of 40dB(A). The cumulative sound levels at all other assessed receptors are shown to be below their respective PSLs by a minimum margin of 2dB. Worst-case combined Solar Facility and BESS Project impacts are therefore assessed to be compliant with the requirements of AUC Rule 012.

Compared to the previous assessment, the incremental increase in cumulative sound levels for the assessed receptors is 0.9dB(A). This increase is attributable to the BESS Project that was included in this assessment. A comparison of cumulative sound levels between the previous and current NIA is shown in Table 6-2. Note that receptors R14 through R17 (inclusive) were not included in the original assessment.

Table 6-2 – Cumulative Sound Level Comparison between Previous and Current Assessments for Night-Time (NT) and Daytime (DT) Periods

Receptor ID	Cumulative Sound Level, Previous Assessment (dBA)		Cumulative Sound Level, Current Assessment (dBA)		Difference in Cumulative Sound Level (dBA)	
	NT	DT	NT	DT	NT	DT
R01	35.4	45.0	35.4	45.0	0.0	0.0
R02	35.8	45.1	36.0	45.1	0.2	0.0
R03	37.7	45.4	37.8	45.4	0.1	0.0
R04	38.0	45.5	38.7	45.7	0.8	0.1
R05	36.5	45.3	37.2	45.3	0.7	0.0
R06	35.7	45.1	35.5	45.1	-0.2	0.0
R07	35.3	45.1	36.0	45.1	0.6	0.0
R08	35.4	45.1	36.3	45.2	0.9	0.1
R09	36.0	45.1	36.6	45.2	0.6	0.1
R10	35.1	45.0	35.1	45.0	0.0	0.0
R11	35.1	45.0	35.3	45.0	0.1	0.0
R12	35.8	45.1	35.5	45.1	-0.2	0.0
R13	35.2	45.0	35.1	45.0	0.0	0.0
R14	--	--	35.4	45.1	--	--
R15	--	--	35.4	45.1	--	--
R16	--	--	35.5	45.1	--	--
R17	--	--	35.6	45.1	--	--

7 Conclusions

Seventeen (17) receptors, within 1.5km of the Kneehill Solar Facility and BESS Project site boundary, were selected to assess potential noise impacts arising from the proposed BESS Project. Worst-case sound power levels were used to model sound emissions from the combined Solar Facility and BESS Project during day and night periods.

While the BESS Project could operate at anytime within a 24hr period, the Solar Facility operates 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 Facility operates during periods of 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 are periods when the combined Solar Facility and BESS Project will operate in standby mode where sound emissions are much lower than the peak sound output levels assumed throughout this assessment. Based on the above, the current assessment is considered to be conservative.

Receptor R04 was assessed to be the receptor most impacted by the BESS Project as well as the combined Solar Facility and BESS Project, with night-time cumulative sound levels of 38.7 dB(A), falling below its respective PSL. Cumulative sound levels at all other receptors considered in this NIA were assessed to be below PSLs by a minimum margin of 2dB. Compared to the previous assessment of the Solar Facility (dated November 2022), the maximum increase in cumulative sound levels for the assessed receptors was 0.9dB. A LFN assessment determined that sound from the proposed BESS Project is not expected to produce any significant LFN effects.

It is therefore concluded that the Kneehill Solar Facility and BESS Project would operate in compliance with AUC Rule 012 requirements at all assessed receptors, aligning with the conclusion of the previously conducted NIA.

8 Acoustic Practitioners' Information

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

Table 8-1 – Summary of Practitioners' Information

Name	Joshua Kim	Justin Lee	Merlin Garnett	Cameron Sutherland
Title	Renewable Energy E.I.T.	Renewable Energy E.I.T.	Principal Noise Consultant	Technical Director
Role	• Co-Author • Acoustic noise modelling	• Co-Author • Acoustic noise modelling	• Technical Reviewer • Discipline lead • Acoustic noise modelling • Fieldwork lead	• Technical Reviewer and Approver • Technical Assessment Lead
Experience	• Experience with acoustic modelling (iNoise & CadnaA) of renewable energy projects in Alberta. • Analyst on multiple noise assessments for renewable energy projects in Alberta (2023-Present).	• Experience with acoustic modelling (iNoise & CadnaA) of renewable energy projects in Alberta. • Analyst on multiple noise assessments for renewable energy projects in Alberta (2021-Present). • Current INCE associate.	• Acoustic and environmental consultancy for projects in the U.K. and Alberta (2011-Present). • Completed the UK Institute of Acoustics (IOA) diploma in 2015. • Full member of the IOA. • Author and reviewer of NIAs for multiple renewable energy projects in Alberta (2020-Present).	• Acoustic and environmental consultancy (2005-Present). • 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 (2019-23).

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[15]. 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.

[15] 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 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: Locations of all Noise Producing Sources

Noise Source	UTM Coordinates (NAD83, Zone 12N)	
	Easting	Northing
Solar Facility – Inverter and Transformer Station #1	342142	5734742
Solar Facility – Inverter and Transformer Station #2	342316	5734729
Solar Facility – Inverter and Transformer Station #3	342483	5734724
Solar Facility – Inverter and Transformer Station #4	342675	5734718
Solar Facility – Inverter and Transformer Station #5	342132	5734423
Solar Facility – Inverter and Transformer Station #6	342306	5734426
Solar Facility – Inverter and Transformer Station #7	342504	5734420
Solar Facility – Inverter and Transformer Station #8	342720	5734413
Solar Facility – Diesel Backup Generator	342735	5734247
BESS Unit #1	342789	5734232
BESS Unit #2	342788	5734219
BESS Unit #3	342790	5734257
BESS Unit #4	342789	5734242
BESS Unit #5	342790	5734254
BESS Unit #6	342789	5734229
BESS Unit #7	342788	5734217
BESS Unit #8	342789	5734244
BESS Transformer and Inverter Skid #1	342782	5734256
BESS Transformer and Inverter Skid #2	342782	5734243
BESS Transformer and Inverter Skid #3	342781	5734231
BESS Transformer and Inverter Skid #4	342781	5734218

Appendix C: Supplemental Noise Source Information

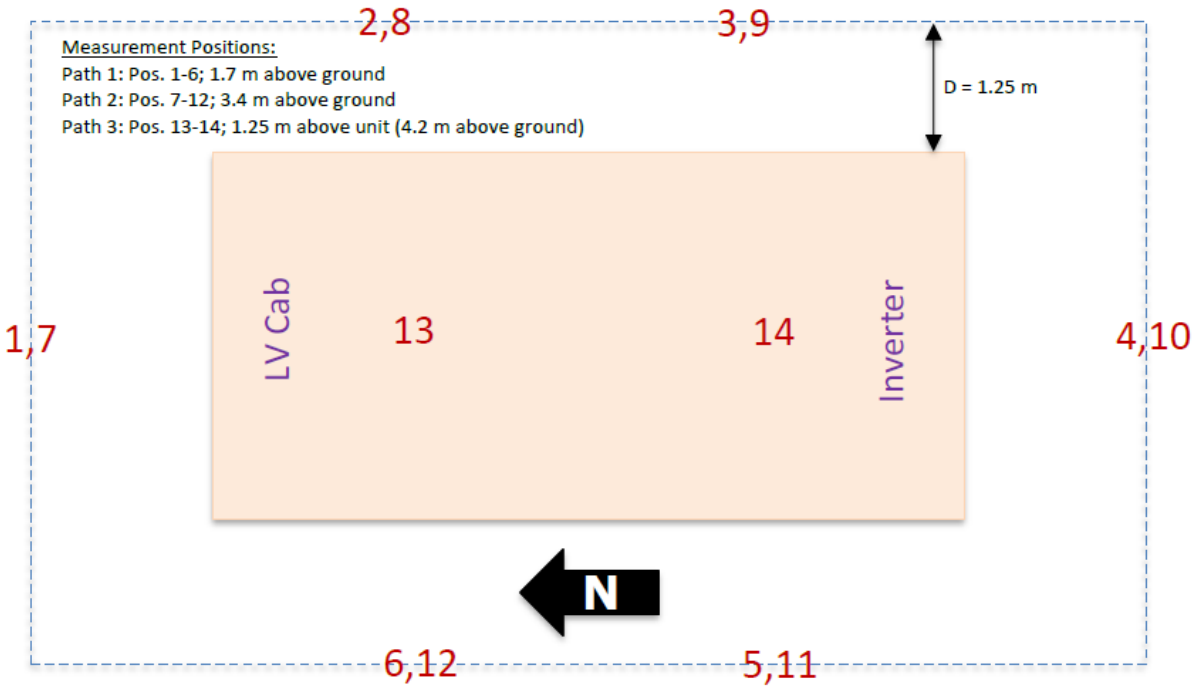
Receptor ID	Project		Third-Party	
	Nearest Significant Project Noise Source	Distance to Nearest Significant Project Noise Source	Nearest Third-Party Facility Noise Source	Distance to Nearest Third-Party Facility Noise Source
R01	Inverter/Transformer Station	1510m S	AER12	870m NW
R02	Inverter/Transformer Station	1430m W	AUC1	600m SW
R03	Inverter/Transformer Station	1250m NW	AUC1	260m W
R04	Inverter/Transformer Station	920m NW	AUC1	190m NE
R05	Inverter/Transformer Station	1060m NW	AUC1	360m N
R06	Inverter/Transformer Station	1600m NW	AUC1	1180m N
R07	Inverter/Transformer Station	1260m N	AER17	1190m SW
R08	Inverter/Transformer Station	1030m E	AER8	940m N
R09	Inverter/Transformer Station	700m SE	AER8	680m SW
R10	Inverter/Transformer Station	1790m SW	AER3/14	1640m NW
R11	Inverter/Transformer Station	1750m NE	AER17	1140m SE
R12	Inverter/Transformer Station	1760m SE	AER9	270m SE
R13	Inverter/Transformer Station	1820m SW	AER3/14	1380m NW
R14	Inverter/Transformer Station	1540m NW	AUC1	1120m N
R15	Inverter/Transformer Station	1750m NW	AUC1	1300m N
R16	Inverter/Transformer Station	1380m S	AER12	1000m NW
R17	Inverter/Transformer Station	1250m S	AER12	1090m NW

Appendix D: Sungrow SG3600UD Noise Test Report Data

Table 1. Sound Measurement Data, dB

Position	Octave Band Center Frequency, Hz									dBA	dBZ
	31.5	63	125	250	500	1000	2000	4000	8000		
1	69	68	68	67	68	63	62	57	52	69.2	75.6
2	66	67	68	67	67	63	63	57	51	68.9	74.6
3	69	68	70	71	75	66	64	62	58	74.3	79.0
4	71	71	74	71	78	71	71	66	64	78.0	81.8
5	69	68	70	71	76	66	63	60	59	74.3	79.2
6	66	67	65	66	69	62	60	56	51	68.7	74.2
7	61	64	64	58	58	54	45	40	35	58.7	69.0
8	65	68	71	65	66	64	59	56	50	68.2	75.2
9	69	69	69	72	75	65	66	61	55	74.0	79.0
10	70	73	74	71	81	71	68	67	62	78.6	83.3
11	69	69	72	72	73	67	65	60	55	73.6	79.0
12	67	68	67	66	70	63	62	58	52	69.9	75.3
13	64	68	68	65	71	60	56	51	47	68.5	74.9
14	69	71	73	71	74	64	63	57	51	72.4	79.2
Average	**68**	**69**	**71**	**69**	**74**	**66**	**64**	**61**	**57**	**73.3**	**78.4**
L_W	**91**	**92**	**93**	**92**	**97**	**88**	**87**	**83**	**80**	**95.9**	**100.9**

Figure 2. Measurement Positions, Overhead View



Appendix E: Propane Generator (30kW) Sound Data

Sound Pressure Level @ 7 meters, dB(A)

See notes 1-6 listed below

Configuration		Position (note 1)								8 Position Average
		1	2	3	4	5	6	7	8	
Standard – unhoused	Infinite Exhaust	77.3	74.7	73.5	74.3	70.8	74.3	74.0	73.4	74.4
F231-2 – sound attenuated level 1	Mounted	69.1	66.3	62.9	61.9	59.6	61.5	60.5	67.1	64.9
F217-2 – sound attenuated level 2	Mounted	61.9	63.7	61.9	62.3	60.7	61.2	59.9	63.8	62.1

Sound Power Level, dB(A)

See notes 2-4, 7, 8 listed below

Configuration		Octave band center frequency (Hz)										Overall Sound Power Level
		31.5	63	125	250	500	1000	2000	4000	8000	16000	
F231-2 – sound attenuated level 1	Mounted	50.9	75.3	75.5	85.7	83.3	82.4	80.9	85.6	77.9	67.5	91.4
F217-2 – sound attenuated level 2	Mounted	52	75.2	76.6	85.7	82.6	81	78.5	78.6	76.2	66.3	89.7

Exhaust Sound Power Level, dB(A)

See notes 2, 9 listed below

Open Exhaust (no muffler) @ rated load	Octave band center frequency (Hz)										Overall Sound Power Level
	31.5	63	125	250	500	1000	2000	4000	8000	16000	
	37.0	78.9	91.8	102.5	99.9	103.8	104.6	99.3	98.3	91.0	109.9

Note:

1. Position 1 faces the generator front per ISO 8528-10. The positions proceed around the generator set in a counter-clockwise direction in 45° increments. All position are at 7 m (23 ft) from surface of the generator set and 1.2 m (48 in.) from floor level.
2. Sound levels are subject to instrumentation, measurement, installation and manufacturing variability.
3. Data based on full rated load.
4. Sound data with generator sets with infinite exhaust do not include exhaust noise.
5. Sound pressure levels are measured per ANSI S1.13 and ANSI S12.18, as applicable.
6. Reference sound pressure is 20 µPa.
7. Sound power levels per ISO 3744 and ISO 8528-10, as applicable.
8. Reference power = 1 pw (10^{-12} W).
9. Exhaust sound power levels are per ISO 6798, as applicable.

Appendix F: EPCPower CAB1000 Noise Test Report

HMMT Partners Oy **H03-0043-02** 1(1)

M.Sc. (Tech.) Mika Hanski, M.Sc. (Tech.) Timo Markula 2022-11-24

EPC Power

INVERTER NOISE LEVELS

Applicable device: CAB1000 at 1500 kVA apparent power

Client: EPC Power Oy
Contact: Antti Eerola

Sound pressure level measurements were conducted according to IEC 60076-10:2016 in the TVO Olkiluoto BESS site on 2022-10-03.

The operating conditions of the unit during measurements, measurement details and measured A-weighted equivalent noise levels L_{Aeq} [dB] are presented in *Figure 1*.

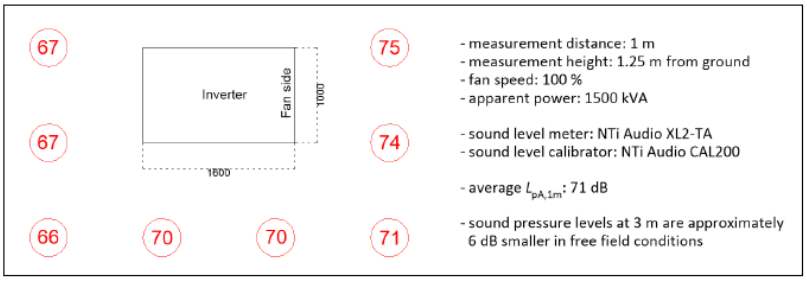


Figure 1. Measured L_{Aeq} [dB] (within red circles), operating condition during the measurements and measurement details.

The sound level meter complies with IEC 61672-1:2013 Class 1 requirements. The sound level calibrator complies with IEC 60942 Class 1 requirements.

The calculated total A-weighted sound power level L_{WA} for this load condition is **88 dB**. The unweighted spectrum of the sound power level in 1/3-octave bands is presented below. The sound power level has been determined according to the spatial average sound pressure level ($L_{pA,1m}$ 71 dB) according to the sound pressure level method defined in IEC 60076-10:2016. The relative sound pressure level differences between the sides shown in *Figure 1* can be used as directivity information in noise mapping.

f [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
L_W [dB]	73.3	70.0	74.2	82.1	76.4	75.7	87.9	79.0	81.2	78.6	78.0	79.3

f [Hz]	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
L_W [dB]	78.0	77.5	75.9	73.4	72.2	75.7	75.7	67.5	73.2	74.5	71.3	69.3

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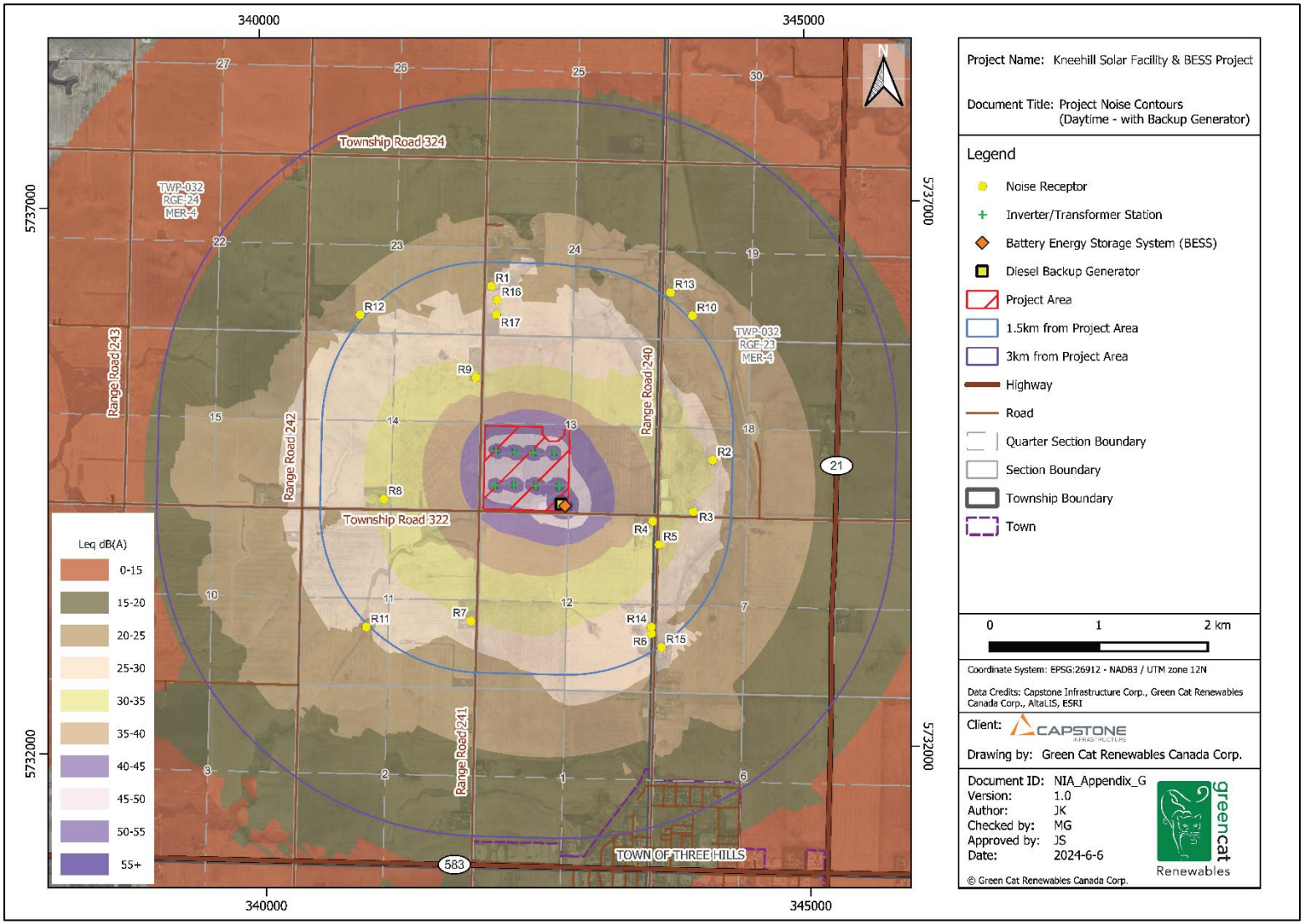
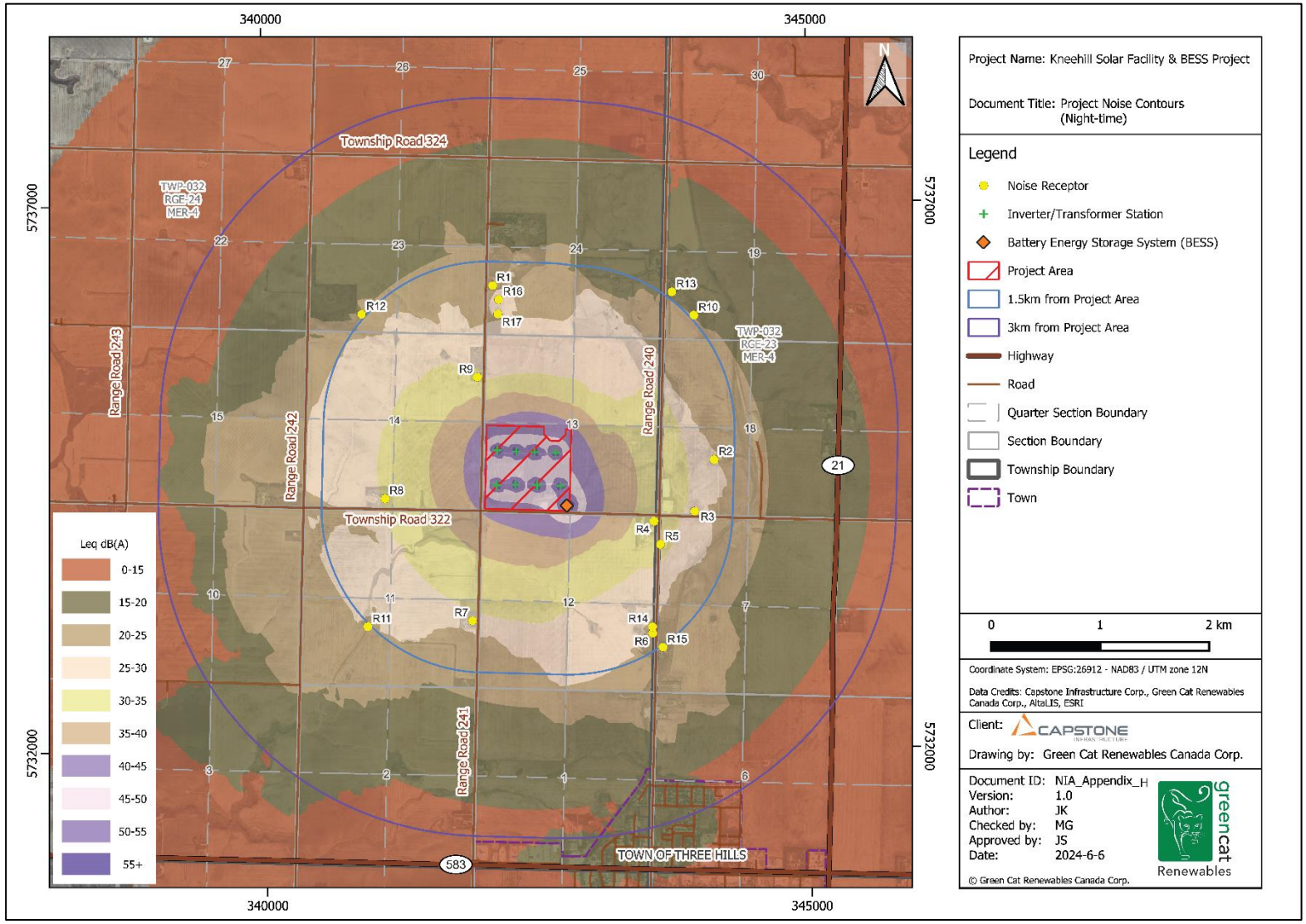
Appendix G: Project Sound Level Contours (Daytime)



Appendix H: Project Sound Level Contours (Night-time)



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