Seymour Solar Farm

Noise Assessment

Goulburn Valley Water

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SLR Project No.: 640.031305.00001

30 May 2024

Revision: 01

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
01	30 May 2024	BF	SD	SD

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Goulburn Valley Water (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Executive Summary

This technical report has been prepared as part of the Goulburn Valley Water 5 MW Seymour Solar Farm planning application submission on behalf of Goulburn Valley Water (GVW).

SLR Consulting Pty Ltd (SLR) has been engaged by GVW to conduct a noise assessment to support the Planning Application of the proposed solar farm.

The Project is located within the Seymour wastewater management facility, approximately 1 km east of the township of Seymour. Thirty noise sensitive receivers were assessed within 1.5 km of the Project. All isolated dwellings with the surrounding farming zone were assessed and representative receivers of the most exposed suburban dwellings within the assessment area were chosen for assessment.

The predicted noise levels at the receivers were assessed against the various requirements of the EPA (EP Act, EP Regulations and Noise Protocol limits and GED).

Compliance is expected at all assessed receivers, by a significant margin.

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1.0 Introduction

Goulburn Valley Water (GVW) is proposing to develop a 5 MW solar farm located at their Seymour wastewater management facility (WMF).

SLR Consulting Pty Ltd (SLR) has been engaged by GVW to conduct a noise assessment to support the Planning Application of the proposed solar farm.

2.0 Project Description & Location

The proposed site is on PUZ1 (Service & Utility) zoned land within the Seymour WMF, located 1 km north east of the township of Seymour.

The 5 MW solar farm consists of a SMA 4400 inverter which feeds into the grid via Dead Horse Lane.

Noise sensitive receivers were identified for assessment within a 1.5 km radius of the site boundary. The closest noise sensitive receivers to the Project are isolated dwellings within the surrounding Farming Zone (FZ). Clusters of suburban dwellings are also located within the 1.5 km radius in General Residential Zone (GRZ1) in the outskirts of Seymour. Rather than assessing all suburban dwellings, representative receivers were selected from the most exposed dwellings. All isolated dwellings in the Farming Zone were identified for assessment.

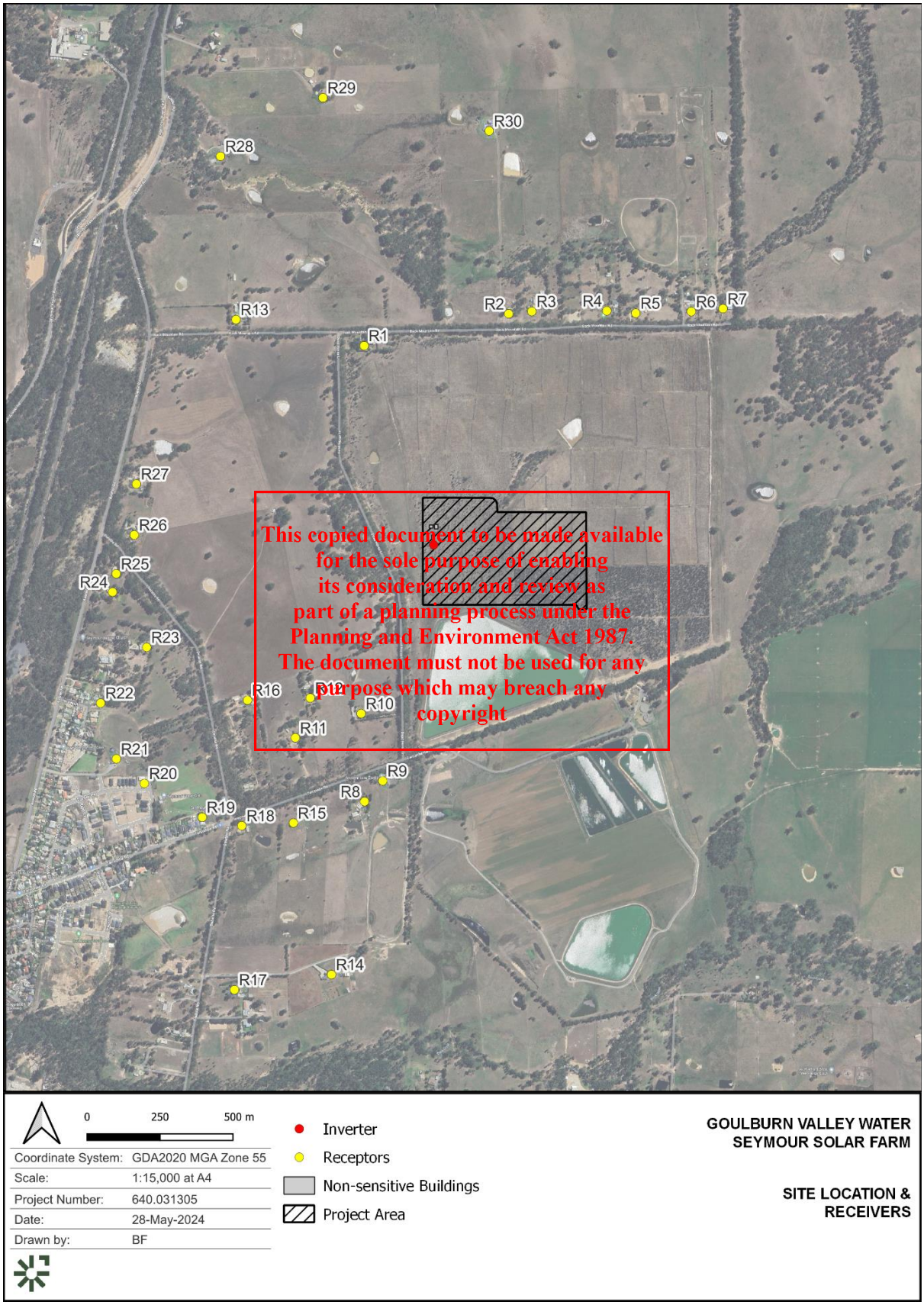
A total of thirty noise sensitive receivers were identified for assessment. **Figure 1** shows the identified receivers with respect to the project area and **Table 1** summarises the receiver locations (UTM coordinates in GDA 2020 Zone 55) and the distance to the proposed inverter location.

Table 1 Noise Sensitive Receivers

Receiver ID	Address	Land Use Zone	Easting (m)	Northing (m)	Distance to Inverter (m)
R1	70 Back Mountain Rd	FZ	336766	5903532	720
R2	115 Back Mountain Rd	FZ	337261	5903642	830
R3	135 Back Mountain Rd	FZ	337341	5903650	870
R4	155 Back Mountain Rd	FZ	337598	5903652	1000
R5	165 Back Mountain Rd	FZ	337697	5903644	1050
R6	185 Back Mountain Rd	FZ	337888	5903650	1190
R7	195 Back Mountain Rd	FZ	337996	5903660	1280
R8	230 Tarcombe Rd	FZ	336767	5901969	910
R9	240 Tarcombe Rd	FZ	336829	5902040	830
R10	15 Dead Horse Ln	FZ	336755	5902271	630
R11	225 Tarcombe Rd	FZ	336530	5902188	810
R12	235 Tarcombe Rd	FZ	336581	5902324	670
R13	25 Back Mountain Rd	FZ	336326	5903622	1030
R14	190 Delatite Rd	FZ	336654	5901375	1520
R15	220 Tarcombe Rd	FZ	336523	5901896	1070

Receiver ID	Address	Land Use Zone	Easting (m)	Northing (m)	Distance to Inverter (m)
R16	260 Delatite Rd	FZ	336366	5902317	830
R17	180 Delatite Rd	FZ	336321	5901323	1670
R18	230 Delatite Rd	FZ	336346	5901886	1170
R19	199 Tarcombe Rd	GRZ1	336210	5901915	1230
R20	11 Pony Promenade	GRZ1	336012	5902031	1290
R21	42B Avenel Rd	GRZ1	335916	5902115	1310
R22	10 Hickey Ct	GRZ1	335862	5902307	1260
R23	90 Avenel Rd	GRZ1	336020	5902498	1050
R24	98 Avenel Rd	GRZ1	335903	5902687	1110
R25	108 Avenel Rd	GRZ1	335915	5902750	1090
R26	110 Avenel Rd	FZ	335977	5902883	1030
R27	120 Avenel Rd	FZ	335985	5903058	1040
R28	150 Seymour-Avenel Rd	FZ	336273	5904182	1520
R29	160 Seymour-Avenel Rd	FZ	336624	5904383	1580
R30	105 Back Mountain Rd	FZ	337195	5904269	1430
The General Residential Zone (GRZ1) receivers, R19 through R25, are located in the outskirts of Seymour and represent a cluster of dwellings. Farming Zone receivers are isolated dwellings.					

Figure 1 Project Area and Nearby Sensitive Receivers



3.0 Victorian Regulations

3.1 General Environmental Duty

The general environmental duty (GED) is at the centre of the Environment Protection Act 2017 (EP Act), and it applies to all Victorians. GED states that a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.

The concept of minimising risks of harm to human health and the environment, so far as reasonably practicable, requires the person:

- to eliminate risks of harm to human health and the environment so far as reasonably practicable; and
- if it is not reasonably practicable to eliminate risks of harm to human health and the environment, to reduce those risks so far as reasonably practicable.

Under the Act, harm, in relation to human health or the environment, means an adverse effect on human health or the environment (of whatever degree or duration) and includes:

- an adverse effect on the amenity of a place or premises that unreasonably interferes with or is likely to unreasonably interfere with enjoyment of the place or premises; or
- a change to the condition of the environment to make it offensive to the senses of human beings; or
- anything prescribed to be harm for the purposes of the Act or the regulations.

Harm may arise due to the cumulative effect of harm arising from an activity combined with harm arising from other activities or factors.

To determine what is (or was at a particular time) reasonably practicable in relation to the minimisation of risks of harm to human health and the environment, regard must be had to the following matters:

- the likelihood of those risks eventuating,
- the degree of harm that would result if those risks eventuated,
- what the person concerned knows, or ought reasonably to know, about the harm or risks of harm and any ways of eliminating or reducing those risks,
- the availability and suitability of ways to eliminate or reduce those risks,
- the cost of eliminating or reducing those risks.

In the assessment of noise impacts with reference to GED, consideration must first be given to eliminating risks so far as reasonably practicable, and then to reducing those risks so far as reasonably practicable.

3.2 Regulated Noise Criteria

Certain types of noise within Victoria are regulated. The following sections provide an overview of how regulated noise is assessed in Victoria.

3.2.1 EP Act 2017

In Victoria, the EP Act prescribes that a person must not, from a place or premises that are not residential premises—

- emit an unreasonable noise; or
- permit an unreasonable noise to be emitted

Unreasonable noise means noise that—

- is unreasonable having regard to the following—
    - its volume, intensity, or duration
    - its character
    - the time, place, and other circumstances in which it is emitted
    - how often it is emitted
    - any prescribed factors, or
- is prescribed to be unreasonable noise.

For the purposes of the above definition, 'frequency spectrum' is a prescribed factor.

The EP Act prescribes that, noise emitted from commercial, industrial and trade premises is prescribed to be aggravated noise if:

- in the case of noise emitted during the day period, the effective noise level exceeds the lower of the following:
    - 75 dBA
    - the noise limit plus 15 dB, and
    - in the case of noise emitted during the evening period, the effective noise level exceeds the lower of the following:
    - 70 dBA
    - the noise limit plus 15 dB, and
    - in the case of noise emitted during the night period, the effective noise level exceeds the lower of the following—
    - 65 dBA
    - the noise limit plus 15 dB.

3.2.2 EP Regulations and Noise Protocol 2021

The Environmental Protection Regulations 2021 (EP Regulations) support the EP Act by providing clarity and further detail for duty holders on how to fulfil their obligations. Regulations are used to deal with matters in detail and may contain their own penalties for breaches.

In Victoria, noise emissions from commercial, industrial and trade premises are not permitted to be unreasonable or aggravated, and are subject to the provisions of the Regulations, and

the "*Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*", EPA Publication 1826.4 (the Noise Protocol).

The Noise Protocol presents the methodology for determining the noise limit (maximum allowable level of noise emitted from a premise) when measured in a noise sensitive area. Noise sensitive areas are defined in the Regulations as that part of the land within the boundary of a parcel of land that is within 10 m of the outside of the external walls of a place where people generally sleep (homes, dormitories, hotels, hospitals, correctional facilities etc.), schools (including childcare centres) and tourist establishments in rural areas (campgrounds, caravan parks, etc.).

Table 2 presents the assessment periods prescribed by the Regulations**.**

Table 2 Definitions of Day, Evening and Night Periods

Period	Day	Time
Day	Monday to Saturday (except public holidays)	7 am – 6 pm
Evening	Monday to Saturday Sunday and public holidays	6 pm – 10 pm 7 am – 10 pm
Night	Monday to Sunday	10 pm to 7 am

Rural Method – Noise Limits

The Noise Protocol noise limits for receivers in a rural environment take into consideration both influence of the zoning map categories (and changes in zoning categories), the background noise, and the distance between the zoning boundary and receiver (where different zones apply).

The generating zone is PUZ1 (Service & Utilities) and the receiving zone for receivers R1 through to R18 and RR26 to R30 are FZ (Farming Zone). Receivers R19 to R25 are representative of the GRZ1 (General Residential Zone) dwelling clusters. Note both FZ and GRZ1 receivers have the same Zone Level

Project Specific Noise Limits

The receivers are deemed to be not located in background relevant areas, therefore the project specific noise limits are the highest of the distance-adjusted[1] levels and the base noise limit of 45/37/32 dBA, day/evening/night respectively, as defined in Regulation 118(2)(a) of the Environment Projection Regulations 2021. The project specific noise limits are shown in **Table 3**.

[1] The distance adjustment is determined in accordance with Clause 20 of the Noise Protocol:

a. If the noise generator and receiver are covered by the same contiguous zone, the distance adjustment is 0 dB

b. If the noise generator and receiver are not located in land use zones with the same zone code subtract 1 dB for every 100 m of receiver distance.

Table 3 Project Specific Noise Limits

Receiver	Receiver Zone	Zone Level D/E/N, dBA	Distance Adjustment, dBA	Noise Limit, D/E/N, dBA
R1 to R7	FZ	48/43/38	0	48/43/38
R8 to R10	FZ	48/43/38	-1	47/42/37
R11 to R13	FZ	48/43/38	-3	45/40/35
R14 & R15	FZ	48/43/38	-4	45/39/34
R16	FZ	48/43/38	-5	45/38/33
R17 to R30	FZ & GRZ1	48/43/38	-6 to -9	45/37/32
Note: the noise limits for the day/evening and night periods are the highest of the *distance adjusted limit* and the *base noise limit* in rural areas (45/37/32 dBA for day/evening/night respectively). The base noise limit is defined in Reg 118(2)(b).				

Protocol Assessment

The effective noise level is determined for noise from commercial, industrial and trade premises, as a 30-minute equivalent sound pressure level ($L_{Aeq, 30min}$) adjusted for character, including tonality, intermittency, and duration, where relevant.

The adjusted noise level is compared with the noise limit to determine whether or not the premises complies with the Noise Protocol.

As the proposed solar farm is potentially able to operate during sunlight hours (day and evening), applicable worst-case limits for the current assessment are during the evening period.

3.2.3 Low frequency noise guidelines

EPA Publication 1996 *"Noise guidelines: Assessing low frequency noise"* (LFNG) provides guidance for acoustic consultants and other qualified professionals who assess low frequency noise (10Hz – 160Hz).

Frequency spectrum is a prescribed factor under the EP Act and subordinate legislation. The assessment of frequency spectrum applies to noise from commercial, industrial and trade premises only.

Low frequency noise emitted from commercial, industrial and trade premises should be assessed by comparing its frequency spectrum to the relevant threshold levels. Specifically, Z-frequency weighted (unweighted or linear) measurements in one-third octave bands from 10 Hz to 160 Hz are compared with low frequency threshold levels.

The threshold levels are not set limits. Rather, they are levels that indicate a potential risk of problematic low frequency noise. The disturbance from low frequency noise depends on the:

- noise level,
- characteristics that can increase annoyance with the noise, for example, tonality, frequency modulation,
- baseline noise levels in the absence of the noise of concern.

Table 4 details the outdoor noise threshold criterion to be used for outdoor measurements. The noise threshold level for outdoor low frequency is based on the assumed façade noise reductions given in Downey and Parnell (2017).

Table 4 Outdoor One-third Octave Low Frequency Noise Threshold Levels

Outdoor one-third octave low frequency noise threshold levels													
One-third Octave band (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Leq (dB)	92	89	86	77	69	61	54	50	50	48	48	46	44

4.0 Noise Modelling

A 3D noise model was constructed within the modelling software SoundPLAN 8.2 and used to predict noise levels at the nearby sensitive receivers.

Noise modelling was conducted using the ISO 9613-2[2] algorithms incorporated in the noise modelling software. The ISO 9613-2 algorithm predicts the A-weighted sound pressure levels under meteorological conditions favourable to propagation from sources of known sound power levels. This enhanced propagation is equivalent to downwind propagation or a moderate ground-based temperature inversion. The model also includes attenuation due to air absorption, ground attenuation and shielding.

4.1 General Modelling Assumptions

The following general assumptions are made based on best-practice modelling method to suit the project:

- The reflection-order of other buildings was set to three (3), indicating that the noise model allowed for three (3) reflections off facades.
- The inverter source height was set to 3.2 m.
- Receivers were set 1.5 m above ground level.
- All equipment is assumed to be in operation for the entire 30 minute assessment period.
- Ground topography within 2 km of the proposed site was sourced from publicly available 1 second digital elevation data (approx. 30 m spatial) from Geoscience Australia.
- Ground absorption is modelled by a single number parameter between 0 (hard – reflective) and 1 (soft – absorptive). Bodies of water were modelled as hard ground, all other ground surfaces were modelled with a ground absorption parameter of 0.6, suitable for rural farmland.

4.2 Sound Power Levels

The primary noise producing item in the solar farm is the inverter. Noise data, including the 1/3 octave spectrum of the SMA 4400 inverter was provided by the original equipment manufacturer (OEM). **Table 5** shows the noise spectrum and overall A-weighted sound power level. Note that the inverter was modelled with the 1/3 octave data but is summarised in **Table 5** as octaves for convenience.

[2] ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*

Table 5 Noise Spectrum – Sound Power Level

Item	Octave Band Centre Frequency, Hz -linear weighting, dBZ									dBA
	31.5	63	125	250	500	1k	2k	4k	8k	
Inverter	91	91	92	92	87	85	83	88	82	**93**

5.0 Results

5.1.1 Noise Characteristics

The Noise Protocol contains provisions for adjustments for undesirable noise characteristics such as tonality, impulsiveness and intermittency. If one or more of these characteristics are present at the receiver, then an adjustment is applied to the overall level.

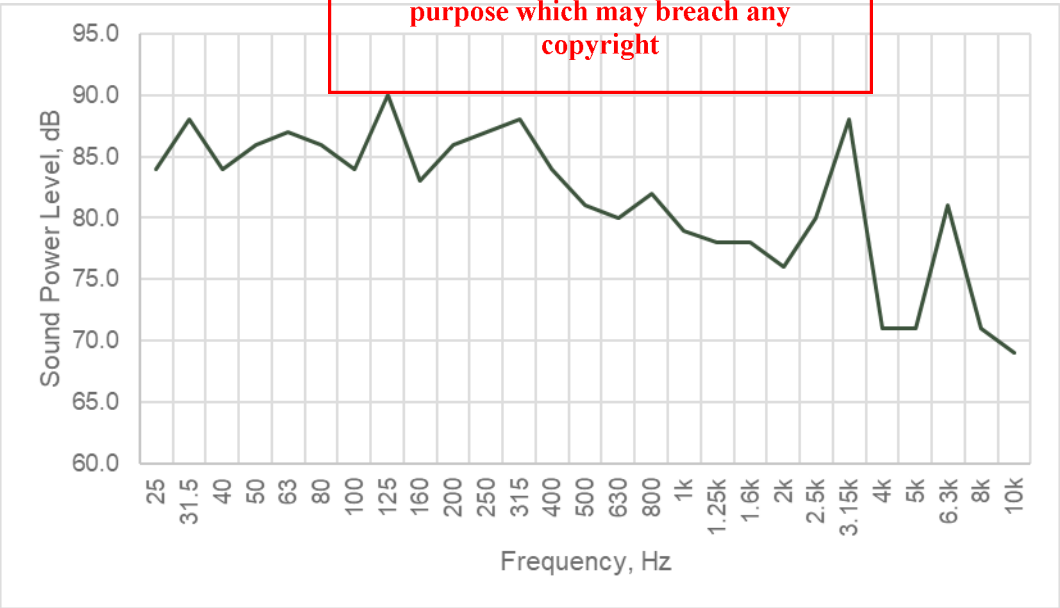
The following outlines the noise characteristics and discusses whether the adjustments are relevant to this assessment.

Tonality

Data provided by the OEM suggests that the inverter fan has tonal characteristics. Tones are shown at 125 Hz, 3.15 kHz and 6.3 kHz, as shown in **Figure 2**.

Tonality is judged (subjectively) at the receiver in context with the ambient environment. Given the propagation distances to the receivers (the closest receiver, R10 is 630 m from the source) and the relatively low levels of predicted noise (<20 dBA at R10), it is expected that tonal characteristics of the inverter will not be distinguishable at the closest noise sensitive receivers.

Figure 2 Inverter Sound Power Spectrum



Impulsiveness

The impulsiveness characteristic refers to a dominant sudden pressure peak, or series of peaks, or a single burst with multiple pressure peaks whose amplitude decays with time or a sequence of bursts. Noise due to inverter is not impulsive in nature.

Intermittency

Intermittency is present when the noise increases in level rapidly, and by at least 5 dB, on at least two occasions during a 30 minute period and maintains the higher level for at least one-minute. The inverter cooling fan is expected to cycle up and down as required to cool the unit. However the noise from the inverter cooling system is expected to be relatively constant over the entire day and is therefore not considered intermittent.

Therefore, no characteristic adjustments have been applied to the following results.

5.2 Noise Protocol Assessment Results

The predicted noise level at the identified receivers within 1.5 km of the project site are presented in **Table 6**. A noise contour plot of this scenario is shown in **Figure 3**.

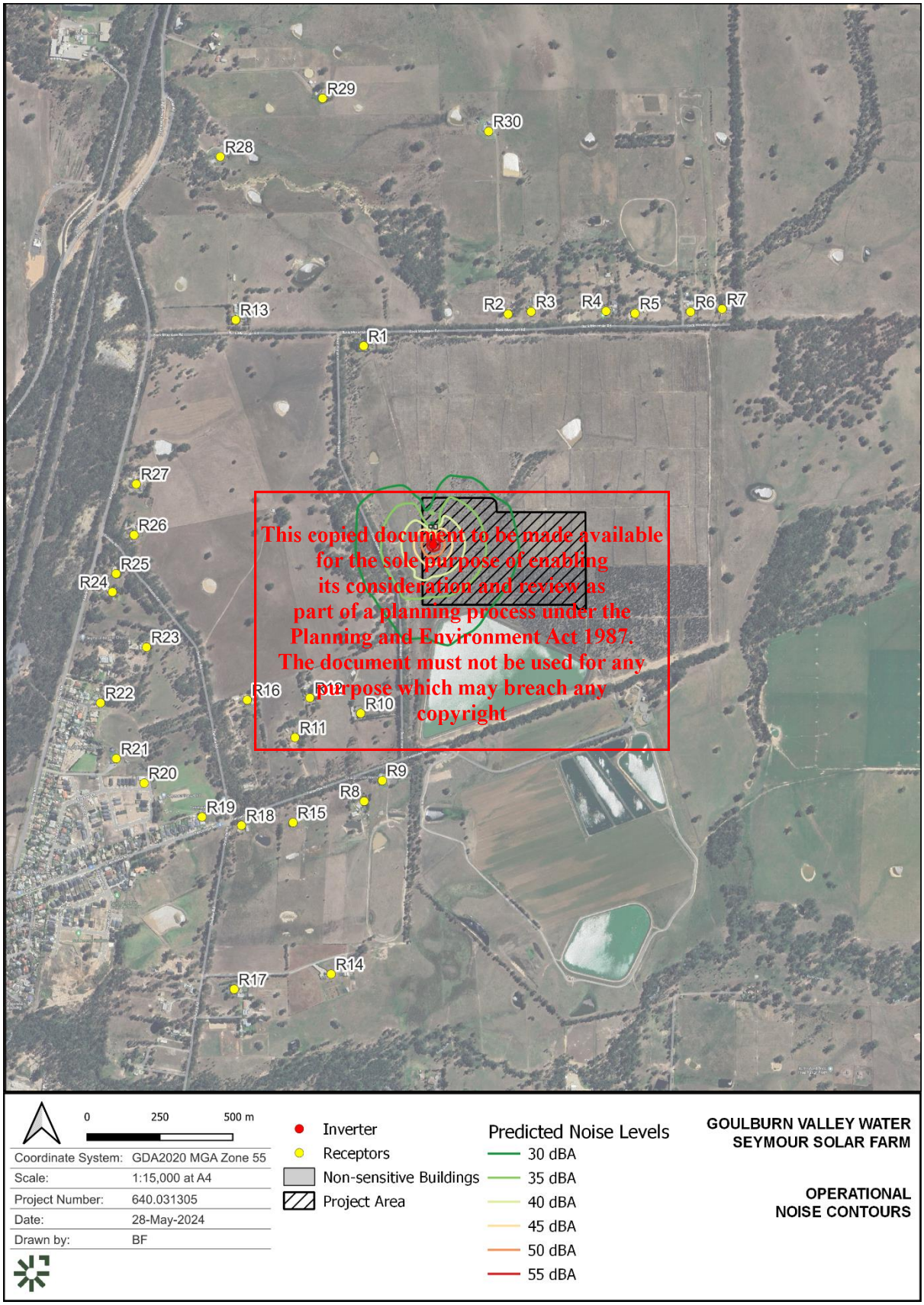
Compliance with the day and evening time criteria is predicted at all receivers.

Table 6 Noise Assessment Results

Receiver	Predicted Noise Level, dBA	Noise Limit		Margin of Compliance, dBA	
		Day	Evening	Day	Evening
R1	< 15	48	43	35	30
R2	< 15	48	43	34	29
R3	< 15	48	43	34	29
R4	< 15	48	43	36	31
R5	< 15	48	43	37	32
R6	< 15	48	43	38	33
R7	< 15	48	43	39	34
R8	15	47	42	32	27
R9	16	47	42	31	26
R10	19	47	42	28	23
R11	< 15	45	40	31	26
R12	17	45	40	28	23
R13	< 15	45	40	33	28
R14	< 15	45	39	36	30
R15	< 15	45	39	32	26
R16	< 15	45	38	31	24
R17	< 15	45	37	37	29
R18	< 15	45	37	35	27
R19	< 15	45	37	35	27
R20	< 15	45	37	36	28
R21	< 15	45	37	36	28
R22	< 15	45	37	36	28
R23	< 15	45	37	34	26
R24	< 15	45	37	36	28

Receiver	Predicted Noise Level, dBA	Noise Limit		Margin of Compliance, dBA	
		Day	Evening	Day	Evening
R25	< 15	45	37	34	26
R26	< 15	45	37	33	25
R27	< 15	45	37	33	25
R28	< 15	45	37	38	30
R29	< 15	45	37	42	34
R30	< 15	45	37	37	29

Figure 3 Operational Noise Contours



5.3 Low Frequency Noise

The EPA guideline for low frequency noise (LFN) considers the one-third octave bands ranging from 10 Hz to 160 Hz. The OEM provided noise spectra for their units between 25 Hz to 10 kHz.

The Noise Guidelines: *Assessing Low Frequency Noise* (Publication 1996) adopts a low frequency threshold level as a screening tool to identify the potential risk of problematic low frequency noise.

Table 7 shows the predicted low frequency noise levels at the most exposed receiver R10, compared with the low frequency noise threshold. No exceedances of the LFN thresholds are predicted. The incomplete supplier data and limitations of modelling low frequency noise with ISO9613 algorithm should be acknowledged, however the assessment is consistent with SLR's expectation that low-frequency noise is unlikely to be an issue for the solar farm.

Table 7 Low Frequency Noise Assessment Results

	Frequency, Hz												
	10	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
LFN Threshold	92	89	86	77	69	61	54	50	50	48	48	46	44
Predicted LFN at R10 (Leq)	-	-	-	-	19	22	18	20	21	20	12	18	11
Margin of Compliance	**-**	**-**	**-**	**-**	**50**	**39**	**36**	**30**	**29**	**28**	**36**	**28**	**33**

6.0 Closure

This noise assessment was prepared as part of the planning application for the proposed 5 MW Seymour Solar Farm. This report presents applicable noise criteria, assessment methodology and results that show compliance with the day and evening time noise goals.

Compliance is expected at the closest noise sensitive receivers, by a significant margin.

Making Sustainability Happen