Hazelwood North Solar Farm

Noise Impact Assessment

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Basis of Report

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Manthos Investments c/- Robert Luxmoore Pty Ltd (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 is an attachment to the Hazelwood North Solar Farm Development Application submission on the behalf of Manthos Investments.

SLR consulting Pty Ltd (SLR) was engaged by Robert Luxmoore Pty Ltd on behalf of Manthos Investments to provide a noise impact assessment to support a development application of a proposed 450 MWp AC (560 MWp DC) Solar Farm and Battery Energy Storage System (BESS) (the Project), located on a private lot in Hazelwood with current access via Walshs Road, Traralgon, VIC.

The proposed site is located on 1,079 ha of farmland between Morwell, Traralgon and Hazelwood North, Victoria. Up to 676 ha of land will be developed.

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

The key project impacts in relation to noise is as follows:

- Noise from construction activities: Scheduling construction activities to the EPA normal working hours (e.g. day period 7.00 am to 6.00 pm), community engagement and best practice noise management controls, regular maintenance, broadband reversing beepers etc. will minimise residual risk of impact or harm to nearby receptors.
- Noise from operational activities: Compliance with the Noise Protocol is expected at all sensitive receptors for all time periods, provided that any special audible character is adequately controlled.
- It should be noted that the operational assessment is conservatively based on the assumption that all operational noise sources are operating at full load (Solar array inverters, BESS, substation etc.). It should be self evident that noise emissions from the solar array inverters are unlikely to be significant during the night period (10pm to 7am) when there is very limited or no solar influx.

It is recommended to update the noise model during detailed design once final equipment has been selected and specify any required noise mitigation to ensure compliance with the noise limits. Confirmation of compliance will be verified by post commissioning noise measurements.

Table of Contents

Tables in Text

Figures in Text

Appendices

1.0 Introduction

Manthos Investments is proposing to develop a 450 MWp AC (560 MWp DC) solar farm and battery energy storage system (BESS), located on a private lot in Hazelwood, Victoria with current access via Walshs Road, Traralgon.

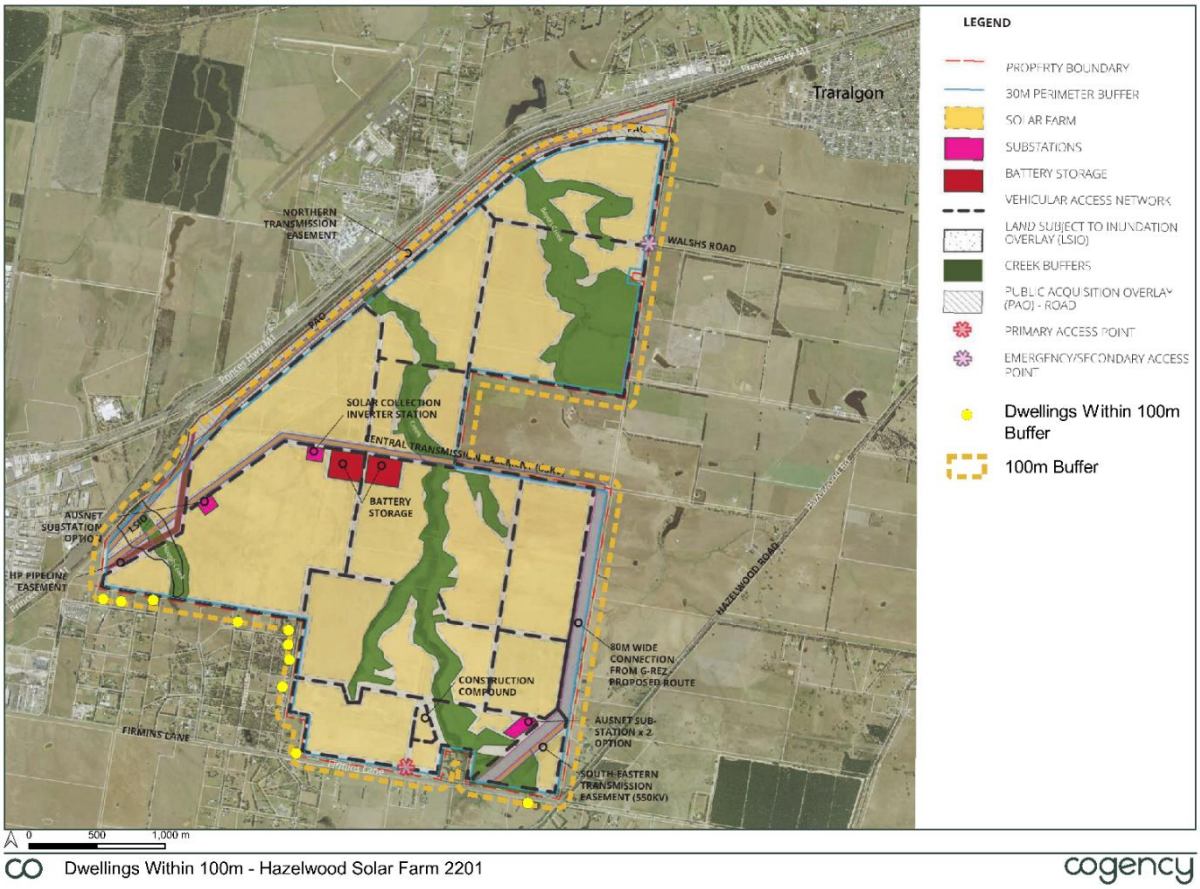
SLR Consulting Pty Ltd (SLR) has been engaged by Robert Luxmoore Pty Ltd on behalf of Manthos Investments to conduct a noise assessment to support the development application of the proposed Hazelwood North Solar Farm.

2.0 Project Area

The proposed site is located on approximately 1,079 ha of farmland between Morwell, Traralgon and Hazelwood North, Victoria. Up to 676 ha of land will be developed.

251 noise sensitive receptors were identified within 1 km of the site boundary, ten of which are situated within 100 m of the site boundary, as shown in **Figure 1**.

Figure 1 Project area and receptors within 100m



3.0 Existing Noise Environment

Noise monitoring was conducted by SLR to characterise and quantify the existing noise environment at the site and surrounding land. Continuous unattended noise logging was conducted at strategic locations around the site, indicative of the closest noise sensitive receptors.

Figure 2 shows the unattended monitoring locations. Monitoring commenced on 15 December 2023 and concluded on 22 December 2023. The objective of the unattended noise monitoring was to quantify the existing ambient and background noise levels at the nearest noise sensitive receptors to the subject site, and to assist in determining the appropriateness of nominated noise criteria for the proposed development.

The unattended noise monitoring was carried out using the equipment presented in

Table 1. The loggers were configured to record A-weighted fast statistical noise levels over consecutive hourly periods. The loggers were checked for calibration before and after the monitoring period, using an ARL ND9 Sound Level Calibrator (serial number 3011372) and no significant drift in calibration was detected. The noise loggers were located in the acoustic free field with a microphone height of 1.5 m above the existing ground level.

Figure 2 Monitoring Locations

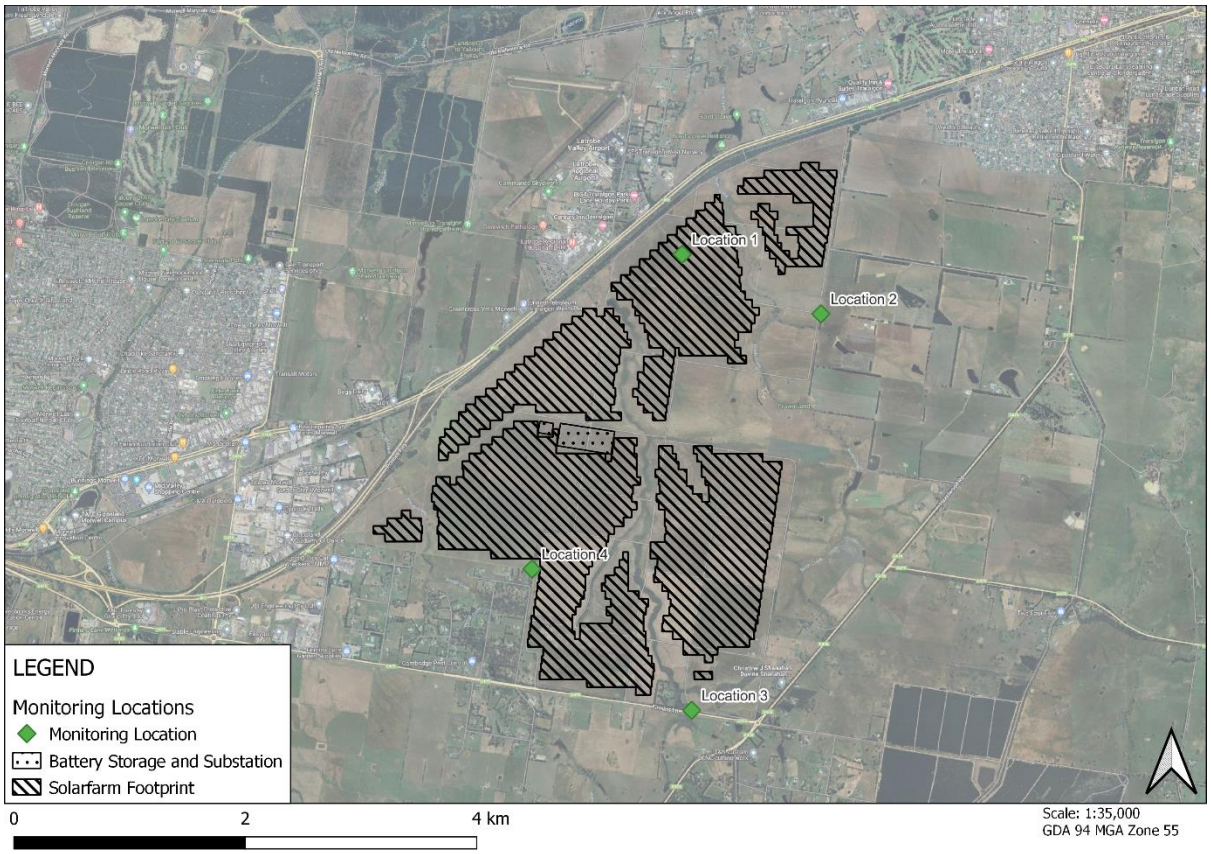


Table 1 Measurement equipment details

Location	Measurement Equipment	Calibration status
1	ARL 316 noise monitor Serial No. 16-306-047	Current (calibration due 19 July 2023)
2	ARL 316 noise monitor Serial No. 16-306-045	Current (calibration due 11 May 2024)
3	ARL 316 noise monitor Serial No. 16-203-531	Current (calibration due 8 Aug 2024)
4	ARL 316 noise monitor Serial No. 16-306-044	Current (calibration due 11 March 2023)

The noise monitoring was conducted consistent with guidelines provided in Australian Standard 1055 *Acoustics – Description and Measurement of Environmental Noise* and the EPA Publication 1826.4 (*Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*) (Noise Protocol). The acoustic instrumentation was designed to comply with Australian Standard IEC 61672.1-2004 *Electroacoustics – Sound level meters – Specifications* and carry current manufacturer calibration certificates.

Weather data for the monitoring period was obtained from the Bureau of Meteorology's Latrobe Valley Airport (Station ID: 085280), located approximately 1.5 km from the project site. Any periods of precipitation (rainfall) or wind speeds greater than 5 m/s were excluded from the analysis of existing noise levels.

Assessment periods, provided by the Regulations are presented in **Table 2**.

The complete measurement results of the unattended noise surveys are presented graphically in **Appendix A** along with photos of the installed monitoring equipment. **Table 3** contains the measured background noise levels.

Table 2 Monitored Noise Levels – Existing Noise Environment

Period	Day	Time
Day	Monday to Saturday (except public holidays)	7:00 am – 6:00 pm
Evening	Monday to Saturday Sunday and public holidays	6:00 pm – 10:00 pm 7:00 am – 10:00 pm
Night	Monday to Sunday	10:00 pm – 7:00 am

Table 3 Monitored Noise Levels – Existing Noise Environment

Location	Measured Background Noise Level, L_{90} dBA		
	Day	Evening	Night
Location 1	39	38	33
Location 2*	34	35	36
Location 3	43	40	33
Location 4	36	35	34
*Only two days of data was analysed due to mic damage.			

4.0 Victorian Regulations - Project Criteria

4.1 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.

4.2 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.

4.2.1 EP Act 2017

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.

4.2.2 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.).

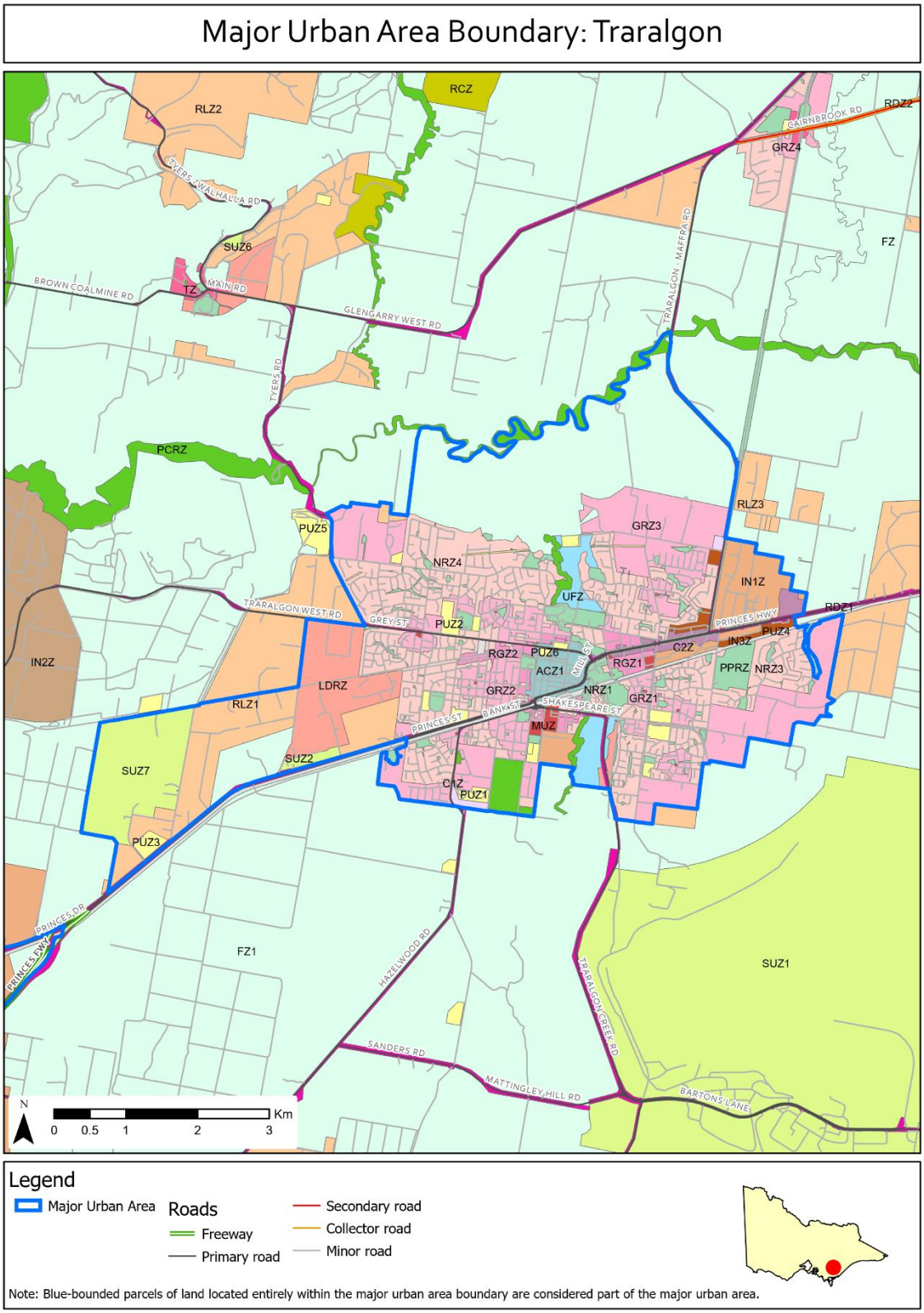
Table 4 presents the assessment periods prescribed by the Regulations.

Table 4 Definitions of Day, Evening and Night (Environmental Protection Regulations 2021)

Period	Day	Time
Day	Monday to Saturday (except public holidays)	7:00 am – 6:00 pm
Evening	Monday to Saturday Sunday and public holidays	6:00 pm – 10:00 pm 7:00 am – 10:00 pm
Night	Monday to Sunday	10:00 pm – 7:00 am

The setting of the noise limits depends on whether the sensitive receptors are within a major urban area, or a rural area. **Figure 3** defines the major urban area boundary for Traralgon. The proposed site is located in the farming zone in the bottom left of the figure. Receptors to the north of the site, from the Latrobe Regional Hospital and the surrounding caravan parks, through to the residential development to the north east of the site are all assessed under the major urban area method. Other receptors, located in Farming Zone (FZ), or Rural Living Zone (RLZ1) are assessed under the rural area method.

Figure 3 Traralgon Urban Boundary



Urban Method – Noise Limits

The Noise Protocol noise limits for receivers in an urban environment take into consideration land zoning in the vicinity of the sensitive receiver and the existing background noise environment in the absence of industry noise.

The resulting noise limit is determined from the background level classification, measured background levels and the zoning level. **Table 5** summaries the noise limit calculation methodology for each background level classification and time period.

Table 5 Urban Method Noise Limit Definitions

Background Level Classification	Time Period		
	Day	**Evening**	**Night**
High	Background + 6 dB	Background + 3 dB	Background + 3 dB[1]
Neutral	Zoning Level	Zoning Level	Zoning Level
Low	0.5*(Zoning Level + Background) + 4.5 dB	0.5*(Zoning Level + Background) + 3 dB	0.5*(Zoning Level + Background) + 3 dB
1: But not greater than 55 dBA			

Rural Method – Noise Limits

The Noise Protocol noise limits for receivers in a rural environment takes 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).

Background Relevant Areas

A background relevant area is defined in the Noise Protocol as a noise sensitive area within a rural area where background levels may be higher than usual. This includes areas where freeway or highway traffic is a significant audible background noise source.

When a background assessment has been conducted, the noise limits are:

a. For the day period, the noise limit is the greater of:
    i. The distance adjusted level or base noise level, or
    ii. The day background level plus 8 dB

b. For the evening period, the noise limit is the greater of:
    i. The distance adjusted level or base noise level, or
    ii. The evening background level plus 5 dB

c. For the night period, the noise limit
    i. Is the greater of –
        1. The distance adjusted or base noise level, or
        2. The night background plus 5 dB
    ii. Must not be greater than 55 dBA.

Noise Limits in Rural Areas for Utilities

Section 2.6 of the Protocol defines the method for determining noise limits in rural areas for utilities, which include electricity infrastructure, which is an appropriate classification for the solar farm and BESS facility.

Paragraph (31) states that if the utility is located in a Farming Zone and the distance adjustment is 0 dB then the distance-adjusted level for each period is:

- Day: 45 dBA
- Evening: 39 dBA
- Night: 34 dBA

Project Specific Noise Limits

Since the closest sensitive receptors are distributed over rural and urban areas, each with potentially different noise limits, based on surrounding zoning in the case of the urban receptors or background levels in the case of rural receptors close to Princes Highway and Firmins Road, four 'noise catchment areas' were defined and noise limits determined for each.

Instead of assessing noise to all 251 identified receptors with 1 km of the proposed site, a representative sub set of 31 receptors were chosen of the closest receptors within all directions of the site. The noise catchment areas and representative receptors are shown in **Figure 4** and are described in **Table 6**.

The noise limits, determined in accordance with the Noise Protocol, and the project specific noise limits for each noise catchment zone are detailed in **Table 7** to **Table 9** and summarised in **Table 10.**

Table 6 Noise Catchment Zone Descriptions

Zone	Description
Urban Area 1	Fronting Princes Highway and predominantly Zoned as Type 2. Contains the Latrobe Valley Hospital, Latrobe Valley Airport, and several caravan parks (Tandara Caravan Park, Village Caravan Park, Park Lane Turist Park). This includes the farming zone around Boyds Creek to the north of Princes Highway and the Traralgon car sales precint (SUZ2). Background levels driven by Princes Highway and are based on Measurement Location 1. Noise limits are based on an indicitive receptor located at Tandara Caravan Park, see **Appendix B**.
Urban Area 2	Trarlgon residental area, predominately Type 1 zoning. The closest receptors to the project site are also close to Princes Highway and thus background levels will be influenced by traffic noise. Background levels aredetermiend by Princes Highway traffic and are based on Measurement Location 1. Noise limits are based on an idicitive receptor located at Madsen Avenue, see **Appendix B**.

Zone	Description
Rural Area 1	Receptors outside the major urban zone. All are located in Farming Zone (FZ) and close to Princes Highway and/or Firmins Lane. They are considered a background relevant area and noise limits are based on Measurement Locations 1 and 2.
Rural Area 2	Receptors outside the major urban zone and are away from the Princes Highway. Noise limits are based on the base limits in rural areas for utilities

Figure 4 Noise Catchment Zones

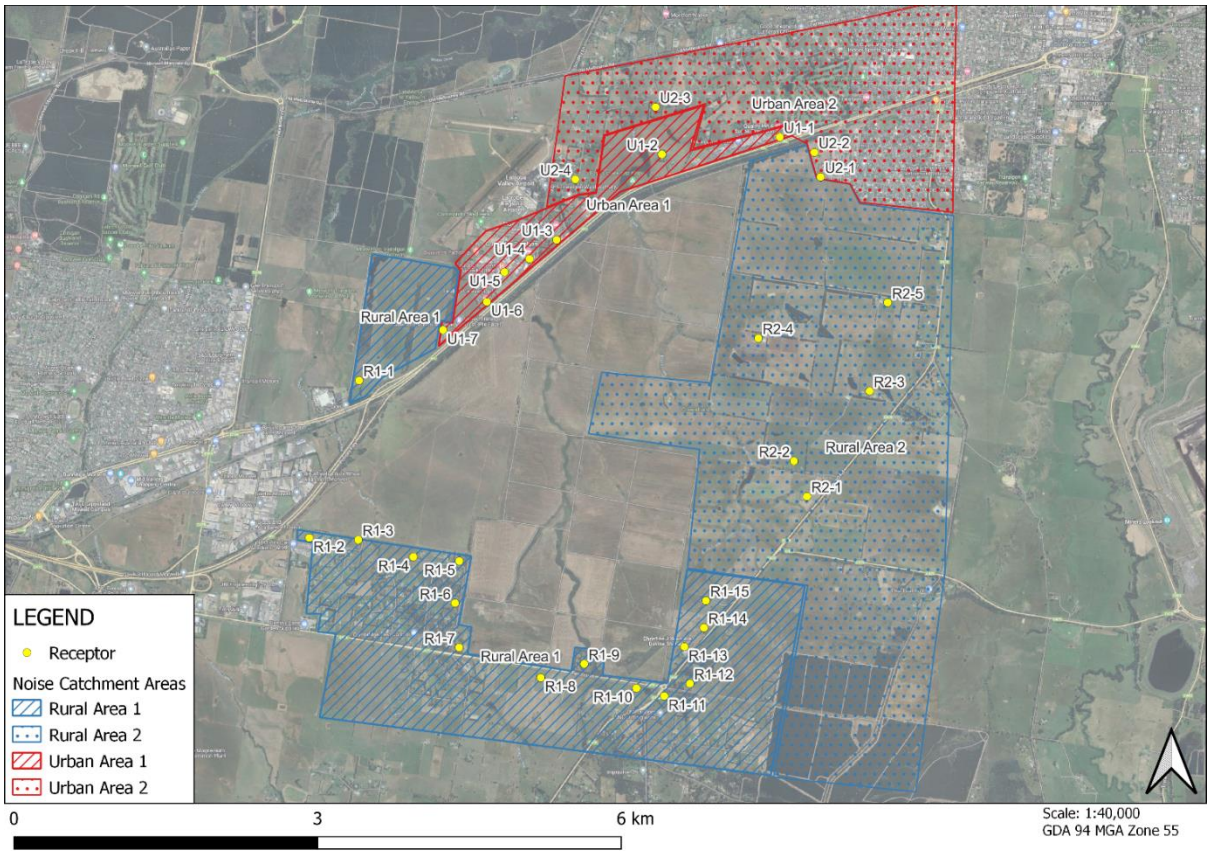


Table 7 Urban Area 1 Noise Limits

Urban Area 1	Assessment Period		
	Day	Evening	Night
Zoning Levels, dBA	59	53	48
Background noise level, dBA	42	40	36
Background level classification	Low	Low	Low
Noise limit, dBA	55	50	45

Table 8 Urban Area 2 Noise Limits

Urban Area 2	Assessment Period		
	Day	Evening	Night
Zoning Levels, dBA	53	47	42
Background noise level, dBA	42	40	36

Urban Area 2	Assessment Period		
	Day	**Evening**	**Night**
Background level classification	Neutral	Neutral	Neutral
Noise limit, dBA	**53**	**47**	**42**

Table 9 Noise Protocol Limits

Receiver	Base Levels, dBA			Adjustment, dBA	Adjusted Level, dBA		
	Day	**Evening**	**Night**		**Day**	**Evening**	**Night**
Rural Area 1	36	35	34	Background +8/+5/+5	44	40	39
Rural Area 2	45	39	34	Utilities	45	39	34

Table 10 Noise Protocol Limits (Summary)

Receiver	Noise Protocol Noise Limit, dBA		
	Day	**Evening**	**Night**
Urban Area 1	55	50	45
Urban Area 2	53	47	42
Rural Area 1	44	40	39
Rural Area 2	45	39	34

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 the premises complies with the Noise Protocol.

As the proposed solar farm and BESS facility is potentially able to operate 24-hours per day, the most stringent night-time noise limits have been applied to this assessment. It should be noted that the solar farm would only have very limited potential to operate during the night period.

4.2.3 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 11 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 11 Outdoor One-third Octave Low Frequency Noise Threshold Levels from 10 Hz to 160 Hz

Outdoor One Third Octave Low Frequency Noise Threshold Levels													
One-third Octave (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

4.3 Construction Noise – Victoria

The *Civil construction, building and demolition guide*, (EPA Publication 1834) of November 2020 replaced earlier documents EPA Publication 480 and the relevant section of EPA Publication 1254.

EPA Publication 1834 adopts a primary mechanism of reducing noise and vibration impacts through limiting the times of operation of noisy equipment, vehicles and operations. Whilst EPA Publication 1834 does not establish objective noise goals or limits for works conducted during Normal Working Hours, it states that construction noise should be minimised as far as possible in any situation and that a noise impact assessment may be used to inform the risk assessment process for construction works and to inform plans for the management of noise generated during construction.

Table 12 presents the EPA construction noise guidelines.

Table 12 EPA Publication 1834 Construction Noise Guidelines

Time of Day	Construction Noise Guidelines
Normal working hours: 7 am – 6 pm Monday to Friday 7 am – 1 pm Saturday	Minimise as far as possible in any situation
Weekend/evening work hours: 6 pm – 10 pm Monday to Friday 1 pm – 10 pm Saturday	Noise level at any residential premises not to exceed background noise (L90) by: • 10 dBA or more for up to 18 months

Time of Day	Construction Noise Guidelines
7 am – 10 pm Sunday and Public Holidays	• 5 dBA or more after 18 months
Night period: 10 pm – 7 am Monday to Sunday	Noise inaudible within a habitable room of any residential premises

EPA Publication 1834 details that whilst projects should aim to constrain works to normal working hours, where necessary, works or activities outside normal working hours may occur for:

- **Low-noise impact works** – these are inherently quiet or unobtrusive, for example, manual painting, internal fitouts, and cabling. Low-noise works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.
- **Managed-impact works** – works where the noise emissions are managed through actions specified in a noise and vibration management plan (may be part of a broader environmental management plan), to minimise impacts on sensitive receivers. Managed-impact works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.
- **Unavoidable works** – are works which pose an unacceptable risk to life or property or a major traffic hazard and can be justified. Includes an activity which has commenced but cannot be stopped. A project would need to demonstrate that planned unavoidable works cannot be reasonably moved to normal work hours. This requires additional consideration of potential noise and vibration generating activities and controls to minimise noise and vibration. These can be recorded within the noise and vibration management plan (may be part of a broader environmental management plan).

It is anticipated that most construction activities related to the Project will be able to be completed during EPA normal working hours, with the exception of unavoidable works (if required) and low-noise impact works.

5.0 Noise Modelling

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

Noise modelling was conducted using the ISO 9613-2[1] 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.

5.1 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 façades.
- Source heights were set according to the source item.
- Receivers were set 1.5 m above ground level.
- All equipment is assumed to be in operation for the entire 1 hour assessment period.
- Ground topography within 5 km of the proposed site was sourced from publicly available 1 second digital elevation data from Geoscience Australia.
- Ground absorption is modelled by a single number parameter between 0 (hard – reflective) and 1 (soft – absorptive). The substation and BESS infrastructure was modelled as hard ground, all other ground surfaces were modelled with a ground absorption parameter of 0.6, suitable for rural farmland.

5.2 Construction Noise Assessment

Construction activities are proposed to be undertaken during daytime hours only. Three construction scenarios were evaluated:

1 Clear and grade the entire site, including compaction and drainage and construction of hardstand pads for the solar farm infrastructure.

2 BESS infrastructure deliveries and installation, installation of transformers and construction of onsite buildings, including substation

3 Construction of the solar panel array.

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

5.2.1 Sound Power Levels

Sound power levels of typical mobile plant and equipment, taken from SLR's noise database of field measurements and BS 5228-1:2009[2] are summarised in **Table 13**. For a worst-case assessment it is assumed that all equipment is operating continuously over the assessment period, due to sequencing of equipment usage that often occurs on site, this is expected to represent a conservative approach.

The loudest construction activity is anticipated to be the piling of the steel columns that support the solar panel arrays, which is completed by a specialist piece of equipment. These units are typically track mounted and diesel powered with the high-speed piling achieved hydraulically. The full sequence for completing a pile, (which includes: traversing to next pile position, lifting and loading the pile into position, hammering in the pile, releasing the hammered pile), would typically take approximately 2 minutes of which half of that interval includes the hammering phase.

It is anticipated to have up to six solar farm pile drivers operating with two operating simultaneously in the same general area at any one time, the Solar Array installation scenario was modelled as an area source with all sound power located at one point. The levels calculated at each receptor with this method therefore represents an unrealistic but worst case exposure to piling noise.

The earthworks + hardstands and infrastructure delivery and instalment scenarios were modelled as area sources covering the infrastructure study area.

Table 13 Construction Equipment Sound Power Levels

Scenario	Equipment	Quantity	SWL, per item, $L_{Aeq, 15\ min}$
Solar Array Install	Solar Farm Pile Driver	6 (2 at any time & area)	112
Clear and Grade	Excavator CAT 330 30T	2	106
	Dozer CAT D8	1	113
	Grader	2	103
	Dump Truck	2	105
	Vibratory Roller	1	105
	Water cart	1	106
Infrastructure Delivery and Construction	Trucks	2	102
	Powered Hand Tools	4	102
	Forklift or Telehandler	1	102
	20 t Franna crane	1	98
	Diesel Generator	4	94
	Diesel Pumps	2	97
	Elevated Working Platform (EWP)	3	95

[2] *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise*

5.3 Operational Noise Assessment

Two alternative operating scenarios were evaluated. Scenario 1 assumes that all equipment (Solar farm, BESS & HV transformer) is operating at full load, Scenario 2 assumes that only the BESS and HV transformer are operating at full load, which is more indicative of likely night period (10pm to 7am) operations with minimal solar farm operation and solar array inverter noise emissions are unlikely to be significant during the when there is very limited or no solar influx.

5.3.1 Sound Power Levels

Sound power levels of noise producing equipment shown in **Table 14** and **Table 15** are typical of currently available equipment. All items are assumed to be in operation for the entire 1 hour assessment period, thus 15-minute and 1-hour noise data are identical.

The medium voltage power station inverters are also assumed to operate at 100% capacity (i.e. maximum fan speed) 24 hours each day.

Since only overall sound pressure levels were provided for some equipment, the spectrum for the transformers were adopted from refence data by Bies and Hanson (11.16). These spectra are shown in **Table 16**.

Table 14 Equipment Sound Power Levels – BESS & HV Transformer

Qty	Item	Sound Pressure Level (SPL), $L_{eq,\ 15\ min}$, dBA	Overall Sound Power Level (SWL), $L_{eq\ 15\ min}$, dBA
160	Inverter	65 dBA at 10 m	93 per unit
800	Battery enclosures	71 to 81 dBA at 1 m	85 dBA per unit
1	HV Transformer	N/A	103 dBA per unit
4	Auxiliary transformers	56 dBA at 1m	65 dBA per unit

Table 15 Equipment Sound Power Levels – Solar Farm

Qty	Item	Sound Pressure Level (SPL), $L_{eq,\ 15\ min}$, dBA	Overall Sound Power Level (SWL), $L_{eq\ 15\ min}$, dBA
57	Inverter	65 dBA at 10 m	93 per unit

Table 16 Nominative Noise Spectra

Item	Octave Band Centre Frequency, Hz-linear weighting, dBZ								dBA
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Inverter	66	76	84	83	84	84	89	81	**93**
BESS battery enclosure chiller	83	84	84	82	80	76	72	67	**85**
HV Transformer	106	108	103	103	97	92	87	80	**103**
Aux. Transformer	67	69	65	65	59	54	49	42	**65**

The inverter units were modelled as point sources within the solar farm areas according to the FTC Solar site plan. The BESS equipment was summed and modelled as an area source encompassing the battery storage area. The HV Transformer was modelled as a point source within the substation area.

6.0 Assessment Results

6.1 Construction Noise Results

Table 17 presents the construction noise results for the clear and grade, infrastructure construction and solar farm installation scenarios. It is anticipated that construction works would occur during the EPA normal hours (day) only.

Noise contour maps for each construction scenario are presented in **Appendix C**.

Table 17 Construction Assessment Results

Receptor ID	Clear and Grade	BESS & HV Substation Construction	Solar Install
R1-1	44	26	46
R1-2	57	21	54
R1-3	64	24	61
R1-4	54	26	55
R1-5	63	29	60
R1-6	61	24	62
R1-7	57	21	59
R1-8	58	< 20	55
R1-9	61	20	59
R1-10	51	< 20	50
R1-11	47	< 20	45
R1-12	46	< 20	44
R1-13	47	< 20	49
R1-14	46	< 20	48
R1-15	47	< 20	49
R2-1	39	< 20	38
R2-2	37	< 20	40
R2-3	31	< 20	34
R2-4	47	< 20	45
R2-5	32	< 20	35
U1-1	42	< 20	42
U1-2	46	< 20	48
U1-3	53	22	51
U1-4	51	24	50
U1-5	49	25	49
U1-6	50	27	52
U1-7	49	29	50

Receptor ID	Clear and Grade	BESS & HV Substation Construction	Solar Install
U2-1	39	< 20	41
U2-2	38	< 20	41
U2-3	38	< 20	41
U2-4	44	< 20	44

Construction noise is expected to be clearly audible at each assessed receptor at some point during the construction phase. Since construction activities are temporary and limited to day times, noise impacts at the closest residences are considered minimal.

It is important to note that the work area is very large (676 ha) for the clear and grade and solar installation scenarios. The above scenario represents a cumulative worst case scenario (i.e. all noise sources are grouped together at the closest point to each receptor), which is unrealistic but conservative. Each receptor is expected to be exposed to the predicted noise levels for only a short duration, a few days at most, before the work area moves away from the receptor. Therefore, even though construction activities may be audible during the day, the predicted levels are not considered excessive or unreasonable.

Noise mitigation and management measures for construction noise is discussed further in **Section 7.1**.

6.2 Operational Noise Results

The predicted noise levels at the nearest representative sensitive receptors for both Scenario 1 (BESS, HVT & Solar farm) and Scenario 2 (BESS & HVT only) are detailed in **Table 18**.

Noise contour plots for Scenario 1 and Scenario 2 are presented in **Figure 5** and **Figure 6** respectively.

The predicted noise levels indicate that both Scenario 1 (BESS, HVT & Solar farm) and Scenario 2 (BESS & HVT only) are able to meet the night-time noise limit at all receptors without additional mitigation.

The model results for Scenario 2 (BESS & HVT only) are more realistic of 100% load operations during the night-period and they indicate a significant margin of compliance (3 - 9 dBA) at the most exposed noise sensitive receptors to the south-west of the project site.

Table 18 Operational Noise Results

Receptor ID	Operational Noise		Night Time Noise Limit	Compliance
	Scenario 1 BESS, HVT & Solar farm	Scenario 2 BESS and HVT only		
R1-1	32	31	39	Y
R1-2	27	27	39	Y
R1-3	31	30	39	Y
R1-4	33	32	39	Y
R1-5	38	36	39	Y
R1-6	33	30	39	Y
R1-7	29	27	39	Y
R1-8	28	26	39	Y
R1-9	30	26	39	Y
R1-10	27	24	39	Y
R1-11	25	23	39	Y
R1-12	25	23	39	Y
R1-13	26	24	39	Y
R1-14	25	24	39	Y
R1-15	27	25	39	Y
R2-1	23	23	34	Y
R2-2	24	24	34	Y
R2-3	21	20	34	Y
R2-4	26	25	34	Y
R2-5	< 20	< 20	34	Y
U1-1	< 20	< 20	45	Y
U1-2	24	22	45	Y
U1-3	30	28	45	Y
U1-4	31	30	45	Y
U1-5	32	31	45	Y
U1-6	34	33	45	Y
U1-7	35	34	45	Y
U2-1	< 20	< 20	43	Y
U2-2	< 20	< 20	43	Y
U2-3	21	20	43	Y
U2-4	26	25	43	Y

Figure 5 Operational Noise Contours Scenario 1 – BESS, HVY & Solar farm

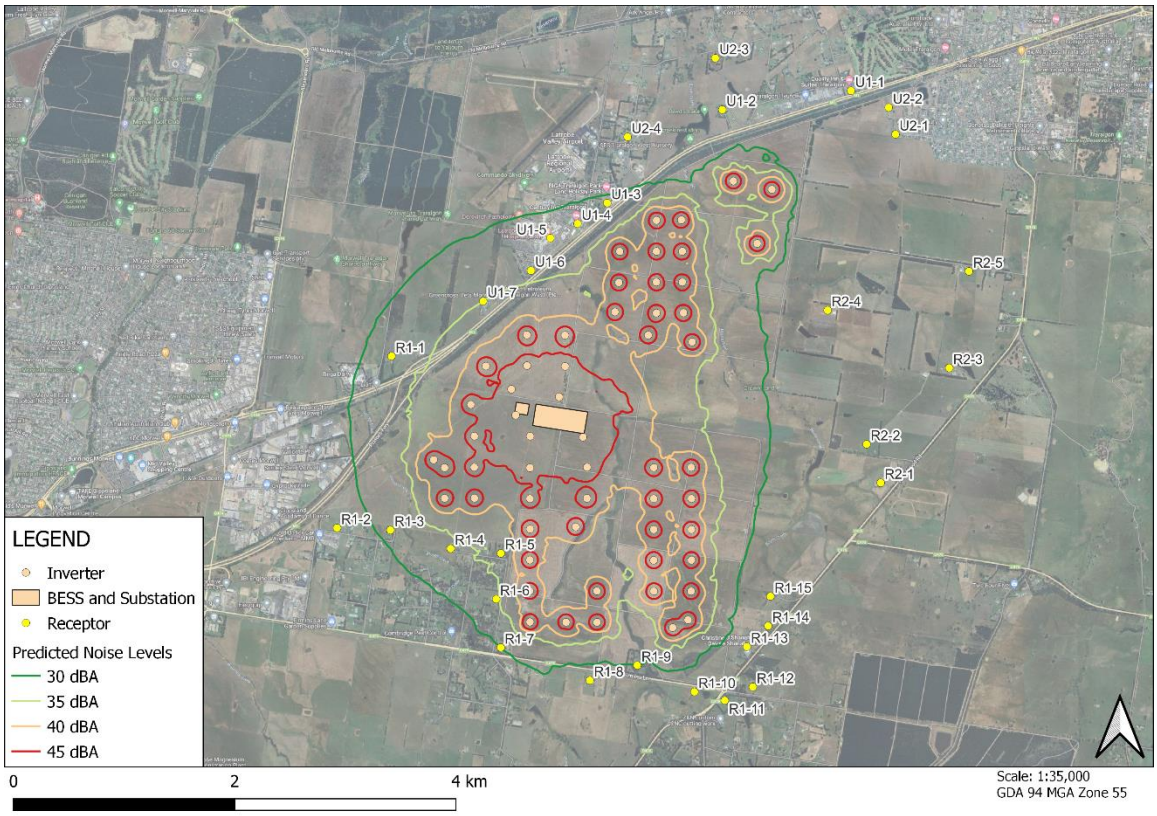
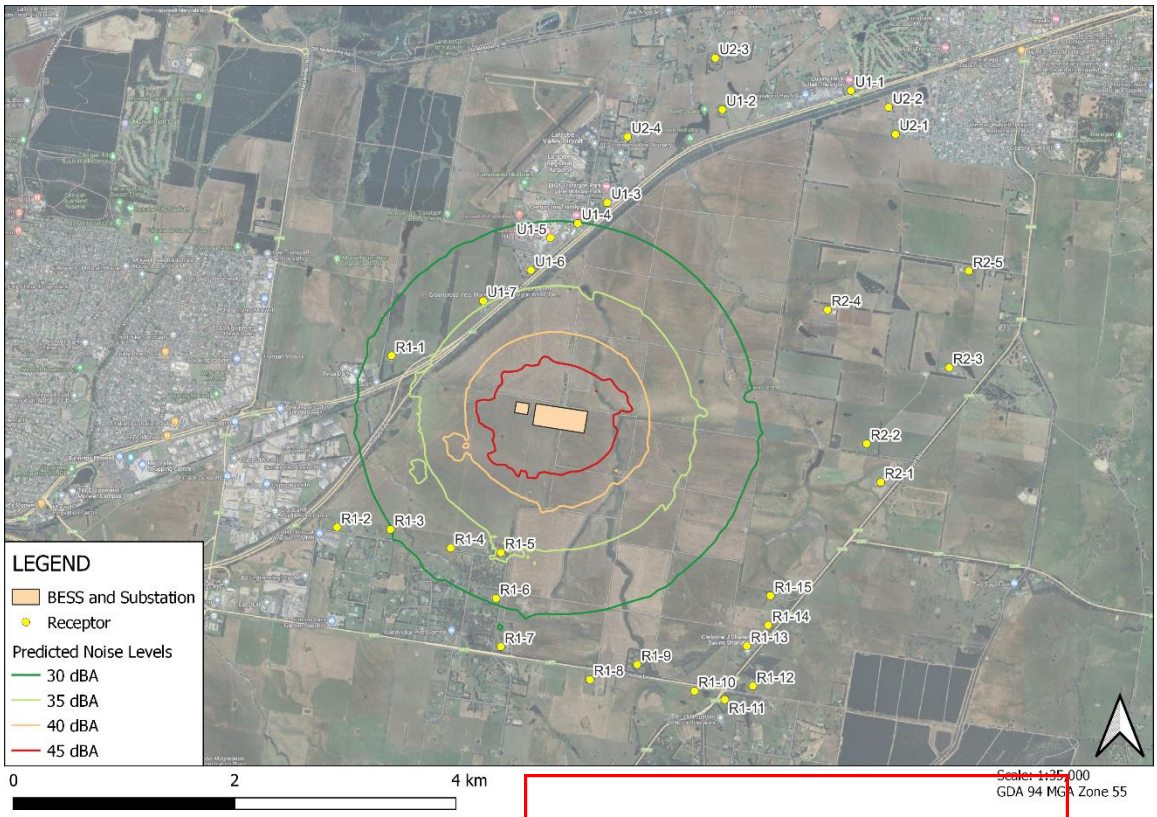


Figure 6 Operational Noise Contours Scenario 2 – BESS & HVT only



7.0 Discussion

7.1 Construction Noise

Construction of the solar farm is predicted to not adversely impact amenity of nearby sensitive receptors due to the relatively short construction period and the vastness of the project site. Earthworks and piling of the solar array steel columns will be audible from the closest receptors, but only for a short period as work is undertaken nearby.

The Australian Standard AS2436-2010 *Guide to Noise Control on Construction, Maintenance and Demolition Sites* sets out numerous practical recommendations to assist in taking all reasonable and practicable measures to prevent or minimise noise impacts.

All construction works will be completed under a Construction Environmental Management Plan (CEMP).

Noise control strategies to be considered are listed below:

- Ensure construction works to occur during EPA normal working hours (day).
- Notification of receptors of the proposed works schedule and potential noise impacts and relevant contacts for queries or complaints.
- Incorporate clear signage at the site including relevant contact numbers for community enquiries.
- The lowest noise emitting plant and equipment that can economically and efficiently undertake the work should be selected where possible.
- Maintain regular maintenance of equipment to keep it in good working order and operating at the lowest feasible noise level.
- Use less intrusive broadband reversing beepers on mobile plant where possible.
- Equipment operators are to be made aware of noise impacts and techniques to minimise emissions through training/instruction, examples include:
    - Avoid dropping materials from height into bins, trucks and receptacles.
    - Operate mobile plant and power tools in a quiet, efficient manner where possible.
    - Switch plant off when not in use
- Machines/tools found to produce excessing noise compared with industry best practice should be removed from service until repairs or modification can be made, or the machine/tool is replaced.
- Where possible avoid tonal reversing/movement alarms on machinery and replace with broadband (non-tonal) alarms or ambient noise-sensing alarms.
- Use dampened bits on impulsive tools (e.g. ratchet drivers) to avoid ‘ringing’ noise where possible.

1.1 Operational Noise

The operational noise assessment presented in this report is to be considered a conservative approach, i.e., inverters and battery cooling systems and HV transformers operating at 100% load all the time, combined with atmospheric conditions favourable to noise propagation.

Predicted operational noise levels at all sensitive receptors are less than the respective night-time noise limit for each noise catchment area for both operational scenarios. Thus compliance with the Noise Protocol can be achieved without further mitigation.

All plant will be reviewed during detailed design to ensure that compliance with the noise limits can be maintained through the selection of equipment and site layout.

8.0 Conclusions

This Noise Impact Assessment was prepared to support a Development Application for the Hazelwood North Solar Farm, Hazelwood, Victoria. This report presents applicable noise criteria, assessment methodology, results and management strategies to minimise noise impacts as far a reasonably practicable.

Construction noise impacts are controlled by works limited to EPA normal working hours only and a combination of training/equipment maintenance and community engagement.

Compliance with the relevant Noise Protocol night-time criteria can be achieved at all receptors without additional mitigation.

All plant will be reviewed during the detailed design stage to ensure that compliance with the noise goals is maintained as the acoustic performance of plant and site layout is refined, followed by post commissioning noise measurements to confirm compliance.

Sincerely,

SLR Consulting Australia Pty Ltd

Benjamin French,
Senior Project Consultant
Acoustics & Vibration

Gustaf Reutersward,
Technical Director Acoustics

Appendix A Background Noise Measurements

Hazelwood North Solar Farm

Noise Impact Assessment

Manthos Investments c/- Robert Luxmoore Pty Ltd

SLR Project No.: 640.30523.00000

30 June 2023

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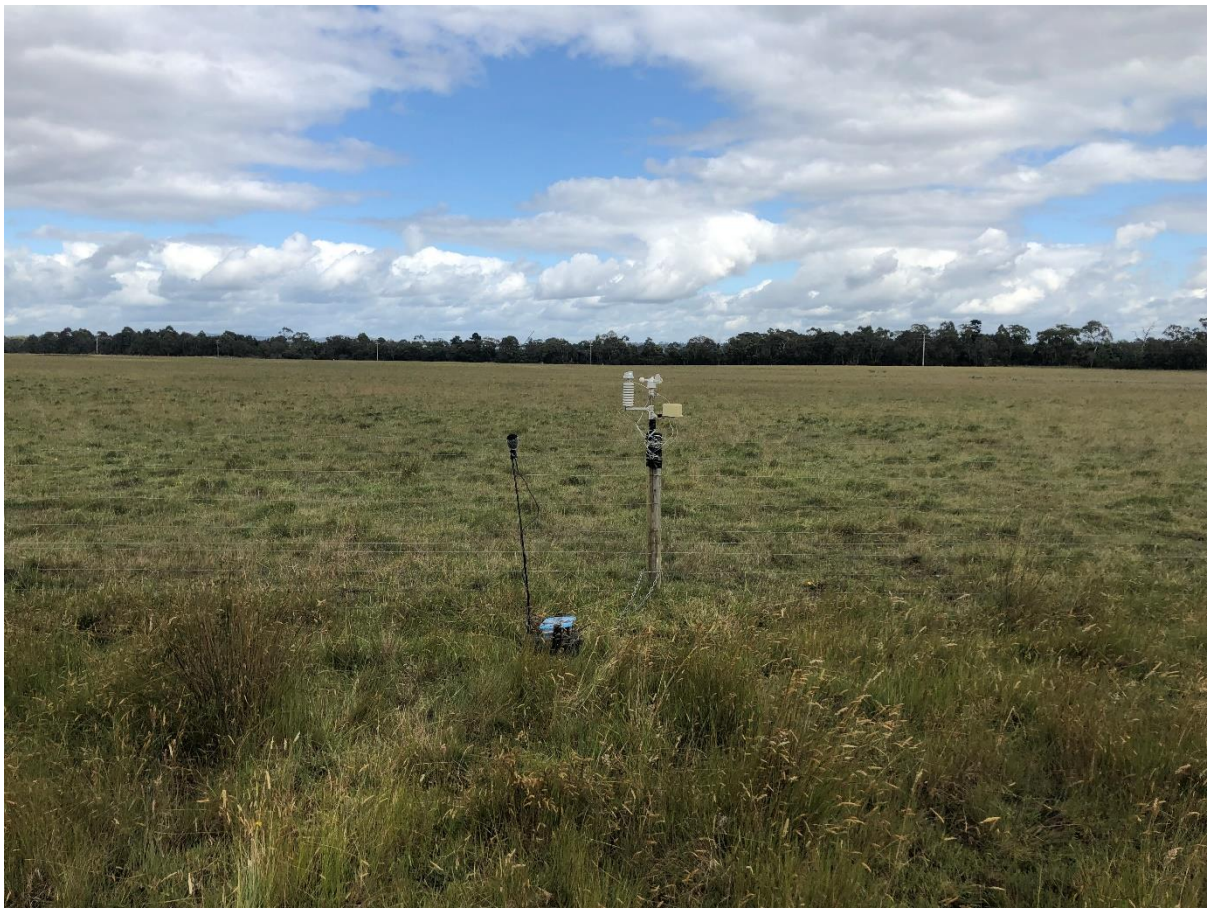
Figure 7 Location One Noise Monitor and Statistical Noise Levels



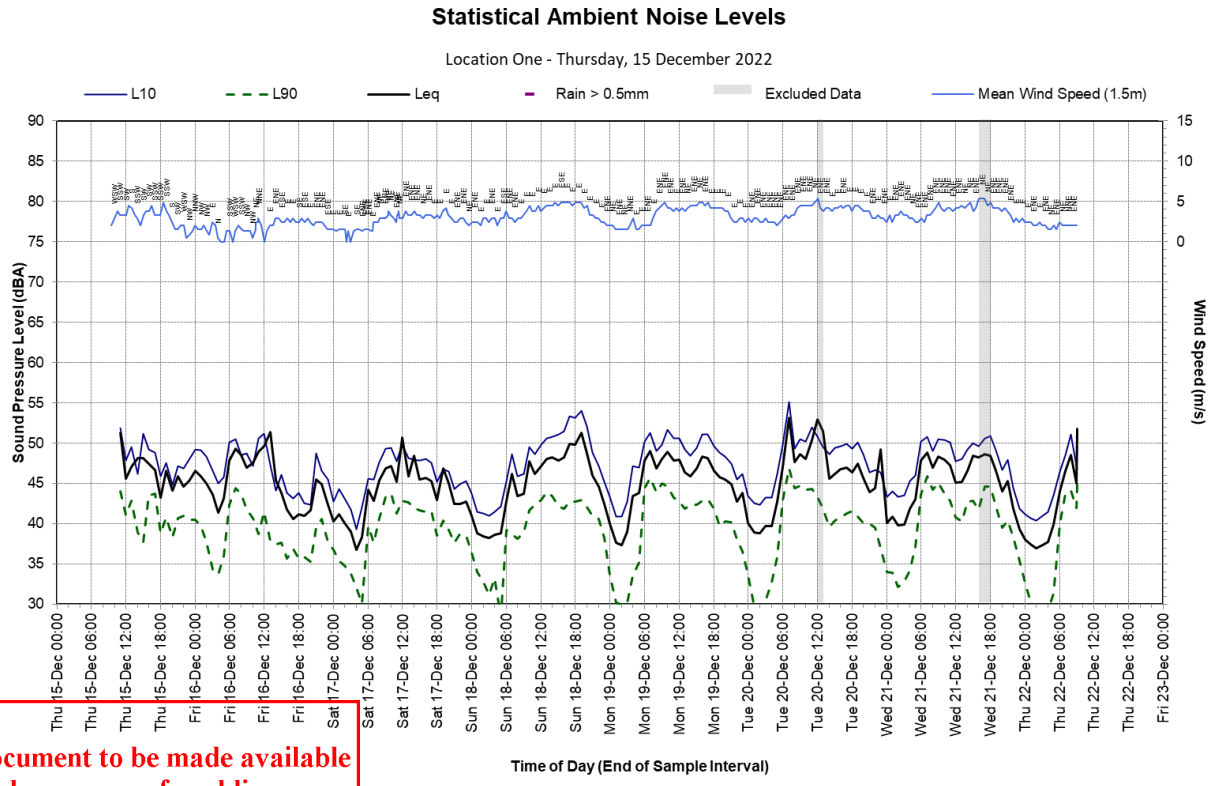


Figure 8 Location Two Noise Monitor and Statistical Noise Levels

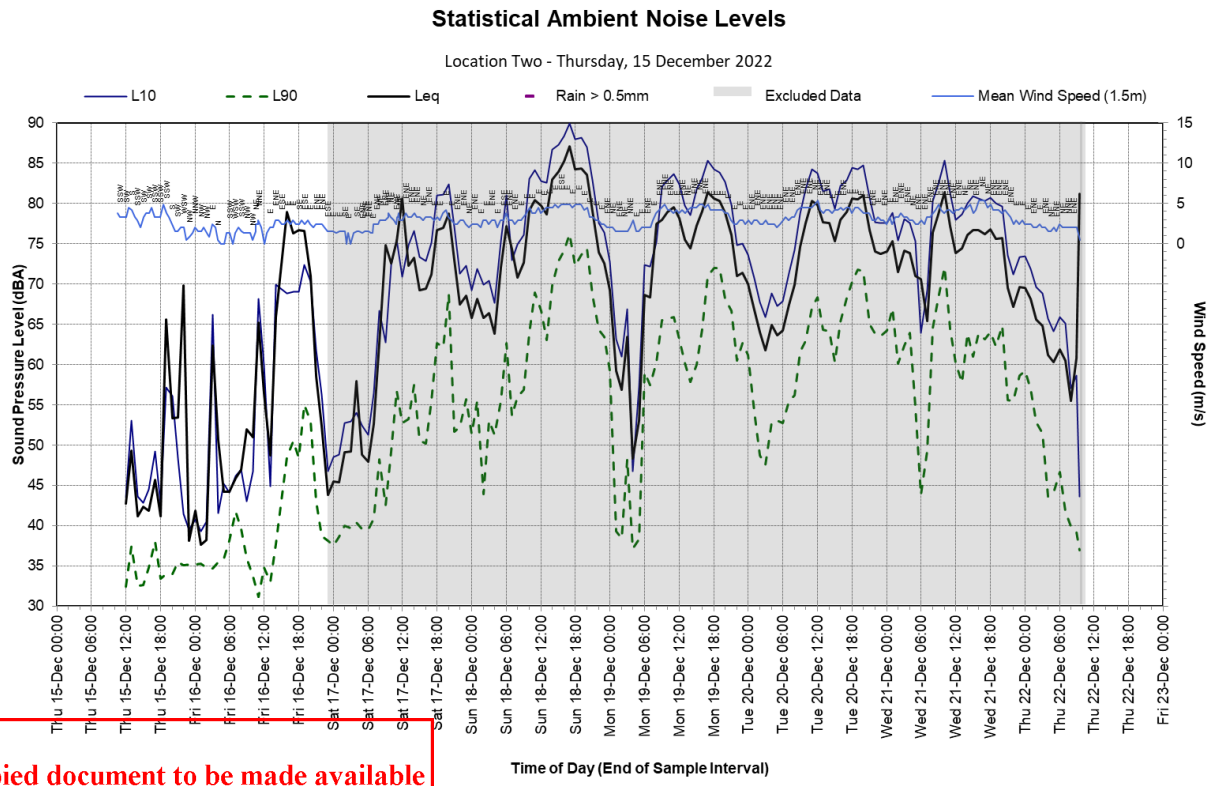


Figure 9 Location Three Noise Monitor and Statistical Noise Levels

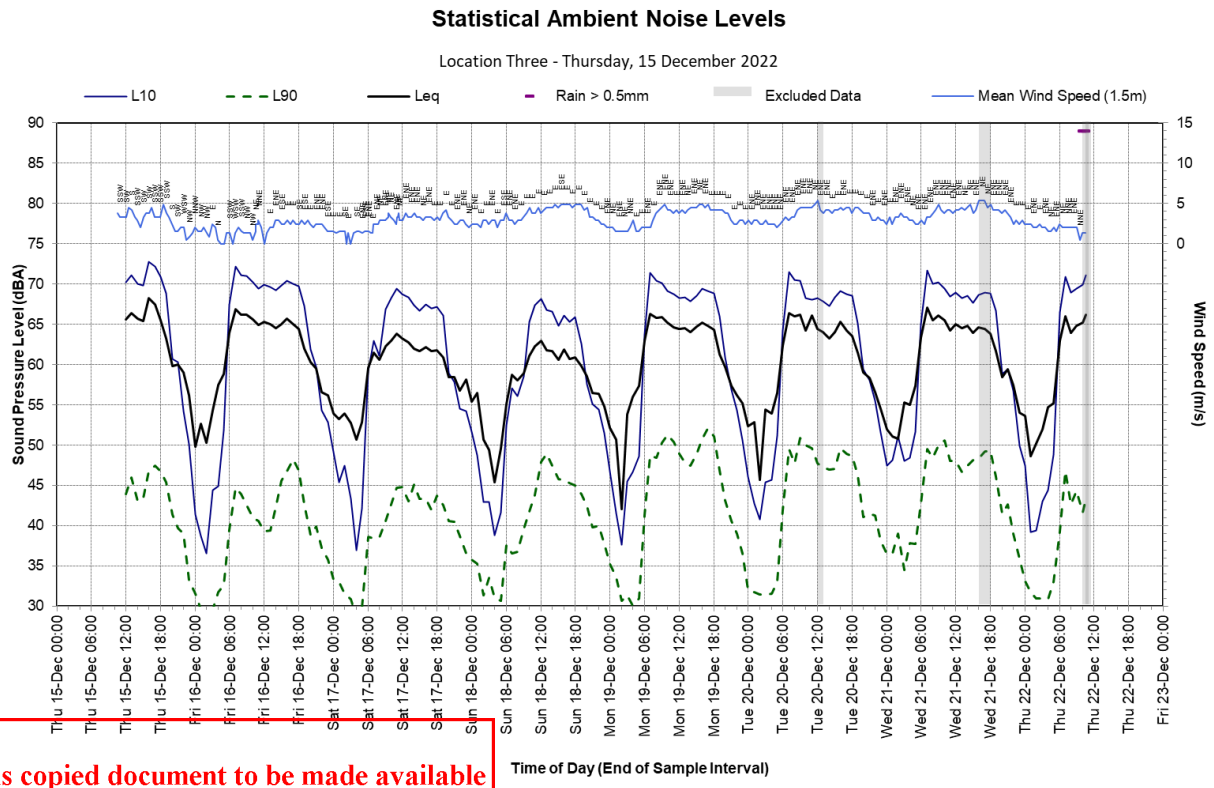
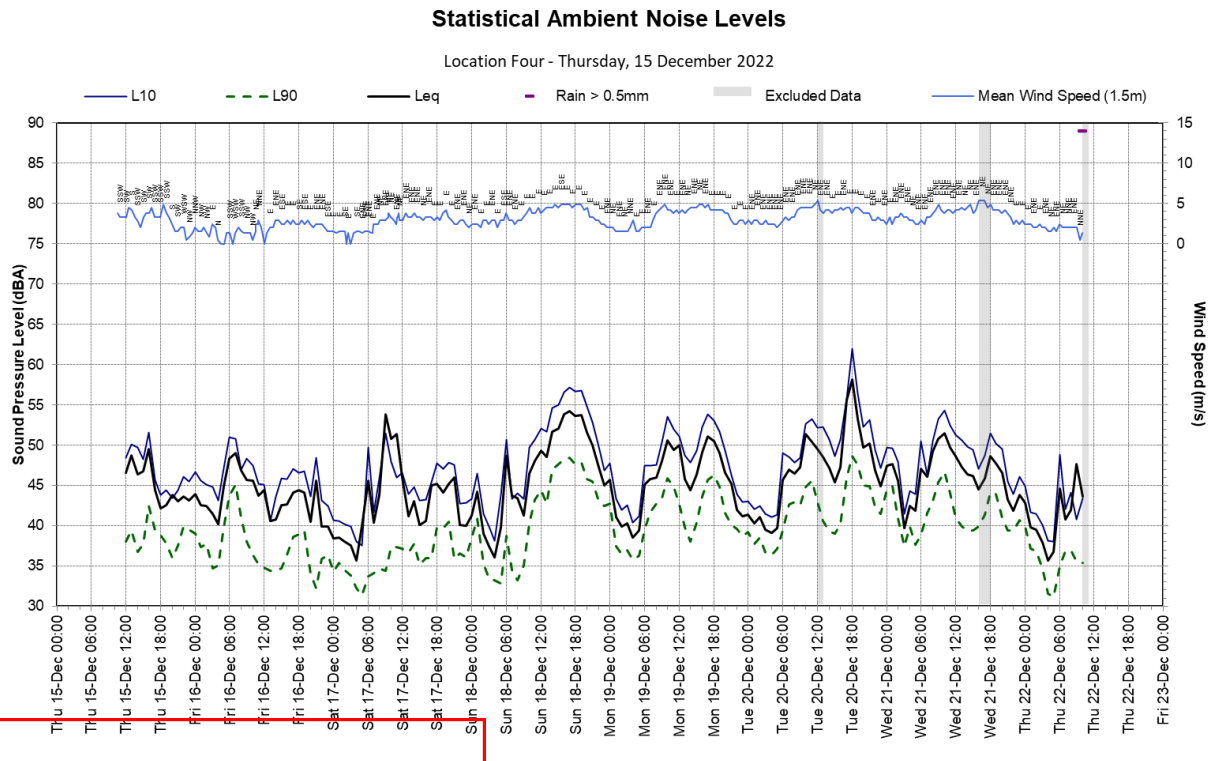


Figure 10 Location Four Noise Monitor and Statistical Noise Levels



Appendix B Urban Area Noise Limits

Hazelwood North Solar Farm

Noise Impact Assessment

Manthos Investments c/- Robert Luxmoore Pty Ltd

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Zone Type

FZ Farming Zone = Type 1
SUZ8 Health and Complementary Uses Precinct = Type 2
PUZ3 Public Use Zone Health and Community = Type 2
TRZ2 Principal Road Network = Type 2
TRZ1 State Transport Infrastructure = Type 2

INFUENCING FACTORS AND ZONING LEVELS

Tandara Caravan Park			
Zone	AREA, %		
	Type 1 (eg. Residential)	Type 2 (eg. Commercial)	Type 3 (eg. Heavy Industry)
Circle - 140m diameter	0%	15394	0%
Circle - 400m diameter	0%	100%	0%
INFLUENCING FACTOR		**0.50**	
Zoning Level, dBA	Day	Evening	Night
	59	53	48

N

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Level 11, 176 Wellington Parade
EAST MELBOURNE
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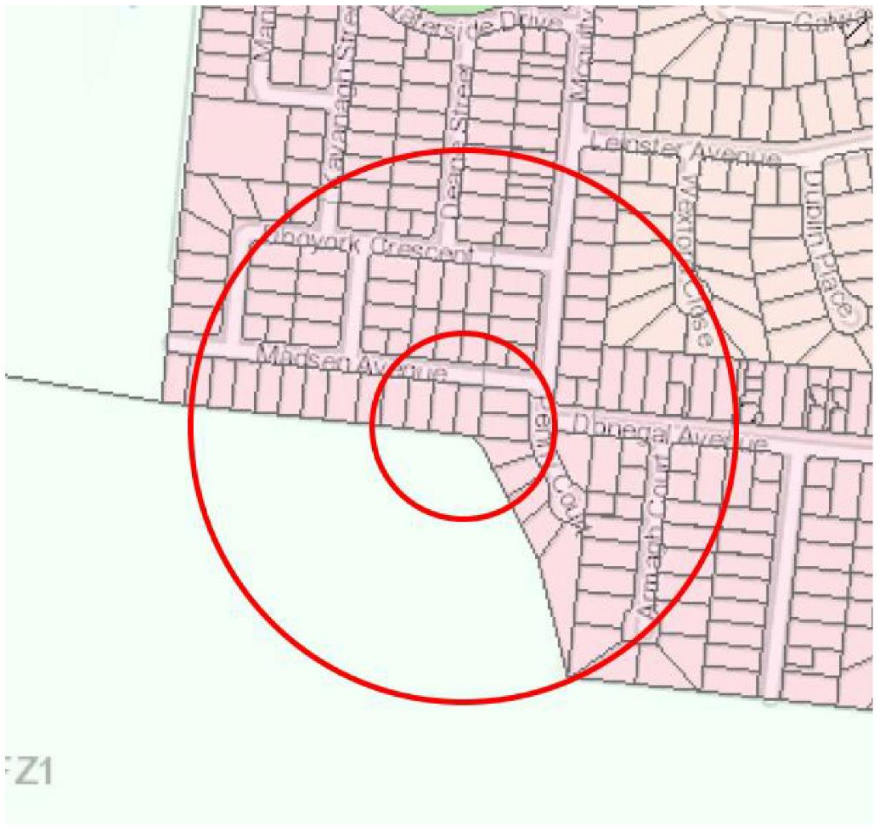
Tel: (03) 9249 9400

Appendix A:
Noise Protocol Zone Map for
Tandara Caravan Park

DRAWN	DATE	SCALE	FILE	JOB No.	DRG. No.	REVISION
BF	2023-04-12	NTS	SEPP N-1 Zoning Circle Tandara Caravan Park.XLS	640.30523	1	0

12-04-2023 2:33 PM



Zone Type
FZ1 Farming Zone = Type 2
GRZ3 General Residential Zone Schedule 3 = Type 1
NRZ4 Neighbourhood Residential Zone Schedule 4 = Type 1

INFUENCING FACTORS AND ZONING LEVELS

Madsen Avenue			
	AREA, %		
Zone	Type 1 (eg. Residential)	Type 2 (eg. Commercial)	Type 3 (eg. Heavy Industry)
Circle - 140m diameter	70%	4667	0%
Circle - 400m diameter	67%	33%	0%
INFLUENCING FACTOR	**0.16**		
Zoning Level, dBA	Day	Evening	Night
	53	47	42

N

SLR Consulting Australia Pty Ltd Level 11, 176 Wellington Parade EAST MELBOURNE VICTORIA, 3002 A.B.N. 29 001 584 612 Tel: (03) 9249 9400				Appendix A: Noise Protocol Zone Map for Madsen Avenue		
DRAWN	DATE	SCALE	FILE	JOB No.	DRG. No.	REVISION
BF	2023-04-12	NTS	SEPP N-1 Zoning Circle Madsen Avenue.XLS	640.30523	1	0

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Appendix A Construction Noise Contour Maps

Hazelwood North Solar Farm

Noise Impact Assessment

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Figure 11 Noise Contour Map Construction – Clear and Grade

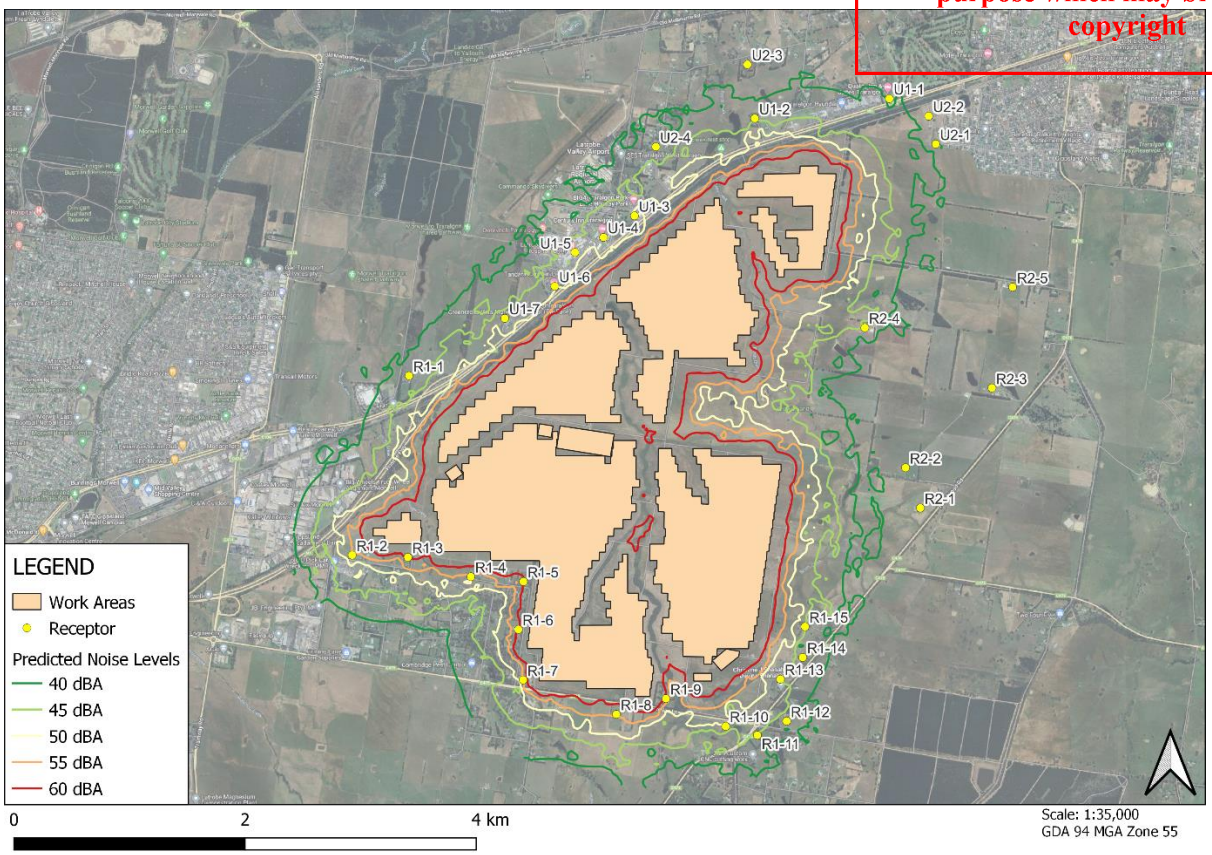


Figure 12 Noise Contour Map Construction – Infrastructure Installation

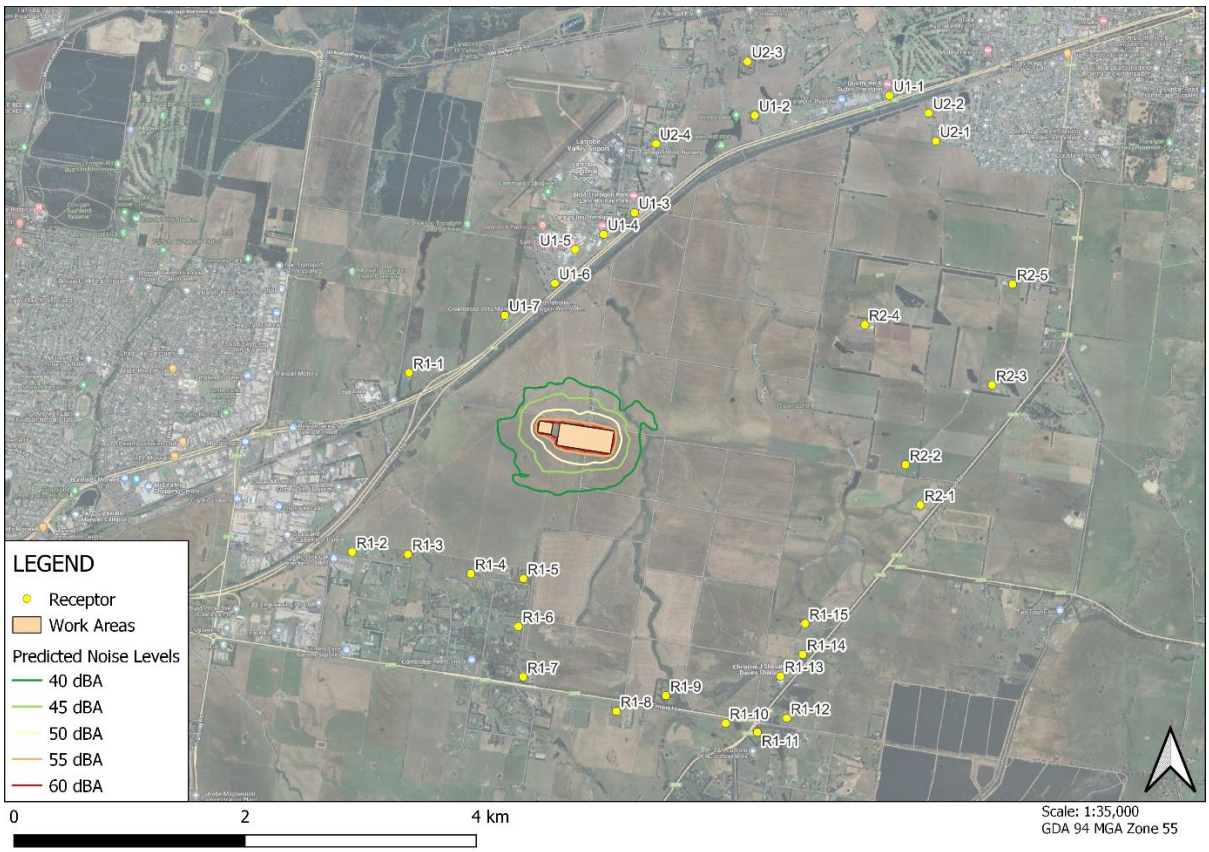
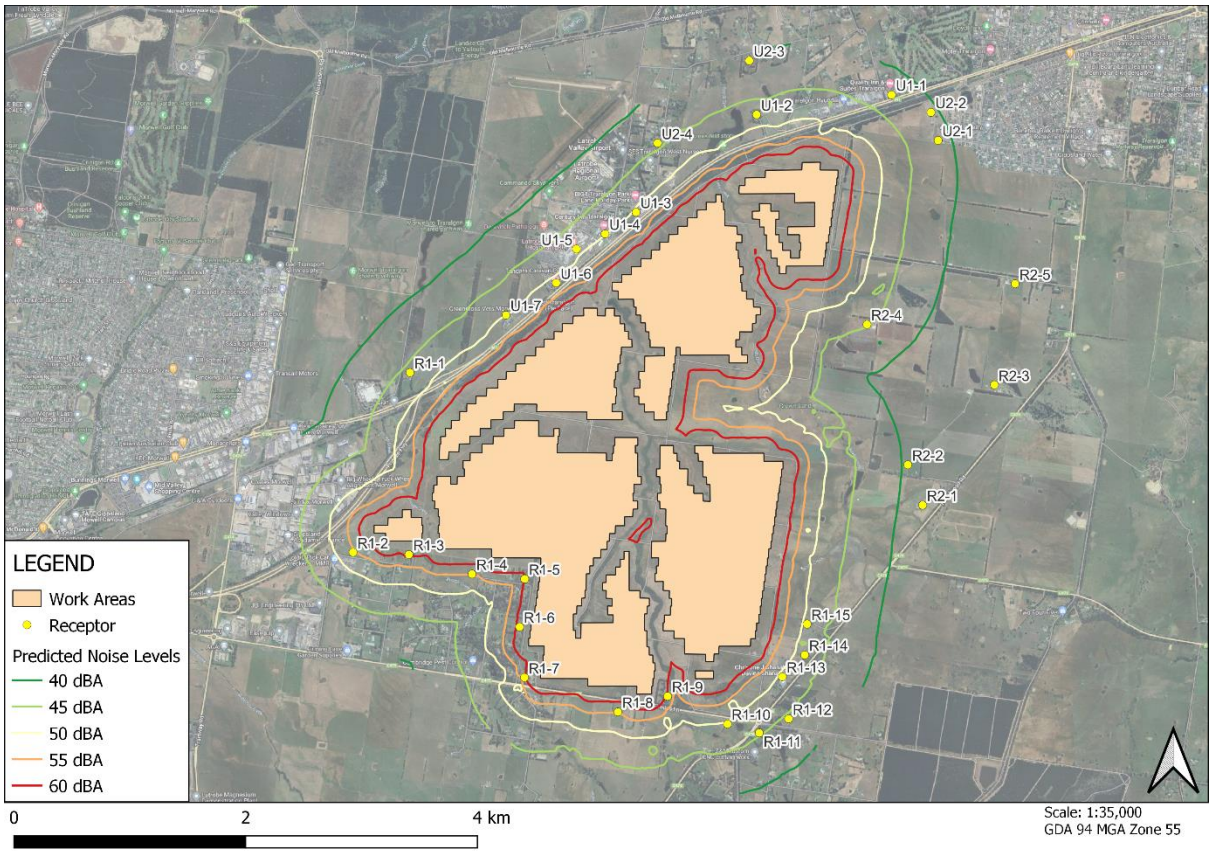


Figure 13 Noise Contour Map Construction – Solar Farm Installation



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