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OCTOBER 2023

CONFIDENTIAL

ELAINE SOLAR FARM

NOISE IMPACT ASSESSMENT

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Elaine Solar Farm
Noise Impact Assessment

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ADVERTISED PLAN

REV	DATE	DETAILS
5	09/10/2023	Update Issue following Elgin Comments

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GLOSSARY

A-weighting	The overall level of sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter that has a frequency response corresponding approximately to that of human hearing. Peoples hearing is most sensitive to sounds at mid frequencies (500 Hz to 4 kHz), and less sensitive at lower and higher frequencies. Thus, the level of sound in dBA is a good measure of its loudness, with different sources having the same noise level in dBA generally sounding about equally loud.
dB	The human ear responds to changes in sound pressure over an extremely wide range, with the loudest (at the threshold of pain) ten million times greater than the softest (at the threshold of hearing). The decibel scale reduces this ratio to a more manageable size expressed as the logarithmic ratio of the sound pressure P, relative to the threshold of hearing P_{Ref} = 20 µPa, i.e., dB = 20 Log (P/P_{Ref})
dBA	A-weighted decibels. A single number descriptor of the overall sound pressure level.
Frequency Analysis	Frequency analysis is the process used to examine the frequency components which make up the overall noise or vibration signal. The units of frequency are measured in cycles per second or Hertz (Hz).
$L_{eq,T}$	The equivalent continuous noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying signal over the measurement period, T.
Sound, Noise	The terms "sound" and "noise" are often used interchangeably, however, in common usage "noise" is often used to refer to unwanted sound.
Sound Power Level	The sound power of a source is the rate at which it emits acoustic energy. As with Sound Pressure, Sound Power Levels are measured in decibel units (dB or dBA) commonly identified by the symbols SWL or L_W. The reference sound power unit is 1 pW (or 10^{-12} W).
Sound Pressure Level	Sound consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The symbols SPL, L or L_P are commonly used to represent the Sound Pressure Level, measured in decibels, dB
1/3 Octave Band	Provides more resolution across the frequency spectrum by dividing each octave band into three (i.e., 25 Hz, 31.5 Hz, 40 Hz, 50 Hz, 63 Hz, 80 Hz and so on).

EXECUTIVE SUMMARY

WSP Australia Pty Ltd (WSP) has been engaged by Urbis to undertake a noise impact assessment for the proposed Elgin Energy Solar Farm located on the Midland Highway and Elaine-Blue Bridge Road at Elaine, Victoria (the Project).

Operational noise criteria for the Project, in the form of statutory noise limits, have been determined in accordance with Part 2: *Noise limits – Rural area method* of EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, dated May 2021 (EPA 1826). EPA 1826 noise limits will form the primary assessment criteria to determine if the Project is likely to emit *unreasonable noise*, as defined in Section 166 of the Environment Protection Act 2017 (the Act).

To support the development of Project noise limit, background noise measurements were undertaken between 23 August and 5 September 2023 in accordance with EPA Publication 1997 *Technical guide: Measuring and analysing industry noise and music noise* (EPA 1997).

To assess operational noise from the facility, a predictive noise model was prepared based on supplied manufacturer data for all acoustically significant plant associated with the Project, which will include:

- Solar panels with approximately 4,800 x Solar panel tracking motors
- 35 x MV Power Stations with Solar Inverter and integrated MV Transformer
- 1 x Medium Voltage (MV) Switchgear
- 1 x High Voltage (HV) transformer coupled with circuit breaker switch
- Battery Energy Storage System (BESS):
  - 37 x Battery units
  - 37 x BESS Inverters
  - 37 x BESS MV Transformers

To this extent, a noise modelling assessment has been undertaken, with noise from the operational Solar Farm found to meet the relevant EPA Publication 1826 noise limits all receivers without further mitigation.

Noise mitigation options have been investigated for contingency purposes and the predictive noise modelling results indicate that noise from the operational Solar Farm site can be further reduced by up to 2 dBA at NSAs closest to noise generators through either the relocation of northern solar inverters or the construction of 3.5m barriers around these inverters.

Noise levels as a result of the infrequent activation of the emergency circuit breaker switches were predicted to have the potential to exceed the impulsive project noise criteria at four locations. It is noted the specifications and location of the circuit breaker was not known at the time of this assessment and as such a conservative approach using the maximum likely noise level at the nearest potential location to the NSAs has been adopted. This event is expected to occur very infrequently (less than once every 5 years) and with further information available the predicted noise levels would be expected to be lower. However, mitigation options have been investigated, and have identified that the selection of a circuit breaker with a sound power level below 110 dBA (maximum level) is likely to be to be the most reasonable option.

As such the residual risk that noise from the operational Solar Farm will cause adverse noise impacts is low.

1 INTRODUCTION

1.1 PROJECT DESCRIPTION

A new 150-megawatt (MW) solar farm and Battery Energy Storage System (BESS) is being proposed at Midland Highway and Elaine-Blue Bridge Road at Elaine (the Project), located 80 km west of Melbourne, Victoria. The solar farm is being developed by Elgin Energy.

The project will include a 150 MW (likely 2 hour) battery and connecting to the existing Elaine Terminal Station across the Midland Highway.

Figure 1.1 shows the Project site, layout, identified Noise Sensitive Areas (NSAs) and noise monitoring locations.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to assess the potential noise impacts from operation of the Project. Specifically, this report has the following objectives:

- To assess the existing noise environment, including the undertaking of noise monitoring to measure pre-existing background noise levels.
- To determine assessment criteria in accordance with relevant legislation, policies and guidelines.
- To assess potential operational noise impacts from the proposed premises.
- To provide recommendations for reasonable and practicable operational mitigation and management measures in accordance with relevant legislation, policies and guidelines, particularly where operational noise is predicted to emit unreasonable noise.

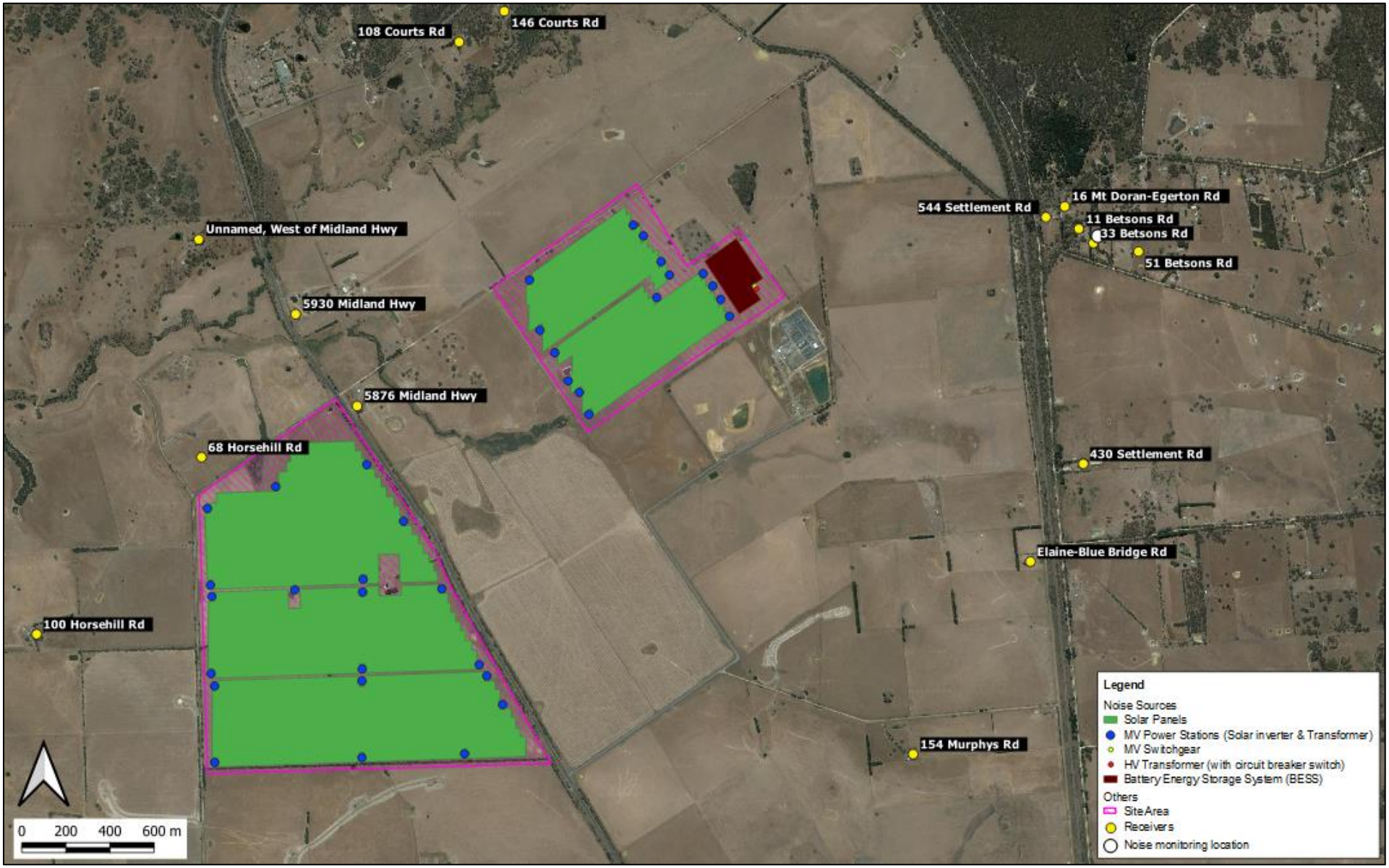

Figure 1.1 Site layout, noise sensitive receivers, NSAs and noise monitoring location

2 EXISTING ENVIRONMENT

2.1 DESCRIPTION OF EXISTING NOISE ENVIRONMENT

The existing noise environment within the study area is generally characterised as rural, primarily dominated by agricultural and rural residential land uses. The primary activities which dominate the existing noise levels include a combination of natural noises (for example cicadas and other insects), farming noise and local traffic influences. Main arterial roads in the project area include the Midland Highway and Elaine-Blue Bridge Road. No other substantial industrial noise sources were identified in the vicinity of the site.

2.2 NOISE SENSITIVE AREAS

Studies have shown that there are direct links between noise and health. Problems related to noise include stress related illnesses, high blood pressure, speech interference, hearing loss, sleep disruption, and lost productivity. Noise Sensitive Areas (NSAs) are defined in the Environment Protection Regulations 2021 (EPR), and generally include land uses potentially affected by noise impacts such as residential, educational, medical and/or outdoor recreational areas (referred to in the Environment Reference Standard (ERS)).

NSAs with the potential to be impacted by noise and vibration during operation of the project were identified by reviewing recent aerial imagery and observations made during environmental noise surveys.

25 residential NSAs have been identified within the study area. These NSAs are presented graphically with unique identifiers in Figure 1.1 and listed in Table 2.1. No non-residential NSAs have been identified within the study area.

Table 2.1 Identified Noise Sensitive Areas (NSAs)

NOISE SENSITIVE AREA (NSA) ID	RECEIVER TYPE	ADDRESS	APPROXIMATE DISTANCE TO PROJECT (M)
NSA 1	Residential	11 Betsons Rd	1,370
NSA 2	Residential	16 Mt Doran-Egerton Rd	1,335
NSA 3	Residential	33 Betsons Rd	1,420
NSA 4	Residential	51 Betsons Rd	1,620
NSA 5	Residential	67 Pearsons Rd	2,225
NSA 6	Residential	68 Horsehill Rd	120
NSA 7	Residential	78 Settlement Rd	3,410
NSA 8	Residential	87 Fords Ln	640
NSA 9	Residential	89 Jordans Ln	3,420
NSA 10	Residential	100 Horsehill Rd	770
NSA 11	Residential	108 Courts Rd	1,000
NSA 12	Residential	146 Courts Rd	988
NSA 13	Residential	154 Murphys Rd	1,645
NSA 14	Residential	205 Kingfisher Dr	2,725

NOISE SENSITIVE AREA (NSA) ID	RECEIVER TYPE	ADDRESS	APPROXIMATE DISTANCE TO PROJECT (M)
NSA 15	Residential	430 Settlement Rd	1,560
NSA 16	Residential	440 Horsehill North Rd	1,780
NSA 17	Residential	544 Settlement Rd	1,240
NSA 18	Residential	620 Mt Doran Rd	4,525
NSA 19	Residential	5328 Midland Hwy	2,800
NSA 20	Residential	5621 Midland Hwy	760
NSA 21	Residential	5876 Midland Hwy	90
NSA 22	Residential	5930 Midland Hwy	420
NSA 23	Residential	6240 Midland Hwy	3,200
NSA 24	Residential	Elaine-Blue Bridge Rd	1,510
NSA 25	Residential	Unnamed property, West of Midland Hwy	950

2.3 NOISE MONITORING

2.3.1 METHODOLOGY

Determining the existing noise environment of the study area involved quantifying and characterising the existing noise environment through monitoring existing noise levels and meteorological conditions in the study area.

The baseline environmental noise surveys involved a combination of unattended and attended noise monitoring to quantify the pre-construction noise environment at locations representative of the sensitive receivers along the project. The monitoring was carried out in accordance with the *Australian Standard 1055:2018 – Acoustics – Description and Measurement of Environmental Noise* (AS 1055) and EPA Publication 1997 *Technical guide: Measuring and analysing industry noise and music noise* (EPA 1997).

Unattended noise monitoring was carried out at a single location representative of the Project area, between 23 August and 5 September 2023 using a Rion NL-42 noise logging device. Attended noise monitoring was undertaken over a 15-minute daytime interval with the same device on 5 September 2023. Field calibration was checked before and after each measurement with no drift (±0.0 dB) observed.

In addition to unattended noise monitoring, short term attended monitoring was carried out to provide additional information on the major noise sources and assist with the characterisation of the noise environment of the area surrounding the project. This monitoring was undertaken for a 15-minute period, during daytime hours only.

Existing meteorological conditions for the study area were monitored by a David Vantage Vue weather station at the noise monitoring location to determine the suitability of weather conditions during the monitoring period. Time periods where wind exceeded 5m/s or there was any observable rainfall were excluded from the processed noise monitoring data.

2.3.2 INSTRUMENTATION AND QUALITY CONTROL

The monitoring equipment was fitted with windshields and were field calibrated before and after monitoring. No significant drifts in calibration (± 0.5 dB) were noted.

All the monitoring equipment has a current certified calibration certificate (National Association of Testing Authorities, NATA) at the time of use. Details of all equipment used to conduct the noise survey are presented in Table 2.2. Copies of the calibration certificates can be provided upon request.

Table 2.2 Noise monitoring equipment

NSA ID	SURVEY METHOD	MANUFACTURER AND MODEL NO.	SERIAL NO.	DATE OF CALIBRATION
NSA 3 33 Betsons Rd	Unattended measurement	Rion NL-42	296510	Current (25/05/2023)
	Weather station	Davis Vantage Vue weather	N/A	N/A
	Attended measurement	NTi XL2	A2A-06084-E0	Current (07/10/2021)

2.3.3 UNATTENDED NOISE MONITORING RESULTS

Unattended monitoring results are summarised in Table 2.3 with hourly noise levels and charts for the monitoring period presented in Appendix A. Monitoring locations are presented graphically in Figure 1.1.

In accordance with EPA 1997, the lowest calculated 'period-average' $L_{A90,\ 1\ hour}$ for each of the day, evening and night periods (during the time the premises operates) has been adopted.

Weather conditions during the monitoring period were obtained from the locally installed Davis Vantage Vue weather station Periods of adverse weather have been processed in accordance with the procedures outlined in Box 2 of EPA 1997, which includes the removal of any periods of rainfall and periods where wind was recorded at levels greater than 5 m/s. Following the removal of this data, 6 days of valid data was obtained.

Table 2.3 Unattended noise measurement results

NSA	MEASURED LOWEST 'PERIOD-AVERAGE' BACKGROUND NOISE LEVEL, dBL_{A90} TIME PERIOD [1]		
	Day	**Evening**	**Night**
NSA 3 33 Betsons Rd	41	35	27

(1) Time period definitions are outlined in Section 3.2.

2.3.4 ATTENDED NOISE MONITORING RESULTS

Attended monitoring results are summarised in Table 2.3 with a description of the observed noise influences at the time of testing.

Table 2.4 Attended noise measurement results

NSA	DATE AND TIME	MONITORED NOISE LEVEL dBA			NOTES
		L_{eq}	L_{90}	L_{Max}	
NSA 3 33 Betsons Rd	14/09/ 2023 12.15 – 12:30pm	52	43	71	The environment was noted to be very quiet. The noise environment was dominated by local road traffic. The loudest noted sound was from a semi-trailer truck with a peak around 70dBA. Most events from light-weight vehicles were noted to have a peak sound level most average cars had a level of 60dBA. In absence of noise events caused by traffic, occasional natural sounds were noted e.g., birds and cows.

3 LEGISLATION & GUIDELINES

The Department of Environment, Land, Water and Planning (DELWP) recently released the *Solar Energy Facilities – Design and Development Guideline* (DELWP Guideline), dated October 2022. This guideline provides an overview of the policy, legislative and statutory planning arrangements for solar energy facility projects in Victoria.

The DELWP Guideline recommends expert support and advice is considered in support of the planning permit application to identify potential risks that could potentially impact surrounding sensitive uses.

The DELWP Guideline states the following in relation to noise:

> *A facility should manage noise impacts in accordance with the Environment Protection Regulations under the Environment Protection Act 2017. More information about the laws that control noise is available on the EPA Victoria website.*
>
> *Noise attenuation measures could include:*
>
> - *ensuring any components operate to relevant standards*
> - *acoustic housing or baffles at the noise source*
> - *conducting maintenance and other operational activity during the daytime*
> - *using landscaping or locating noisier components centrally within a site.*

A summary of the relevant legislation and guidelines as managed by the Victorian Environment Protection Authority (EPA) applicable to this Project as referenced in the DELWP Guideline is provided in the following section.

3.1 RELEVANT POLICY AND GUIDELINES

The assessment has adopted regulatory guidelines and standards to establish operational noise criteria and limits to define where impacts may be experienced and to quantify the performance of any required mitigation and management measures. The relevant legislation, policy and guidance for the assessment of noise impacts from the Project are summarised in Table 3.1. Detailed descriptions and applications of relevant policies are presented throughout Section 3.

Table 3.1 Relevant Victorian Legislation and Guidelines

DOCUMENT	SUMMARY
Environment Protection Act 2017 (The Act)	The Act (as amended by the *Environment Protection Act* 2018) provides the overarching legislative framework for the protection of human health and the environment from pollution or waste in Victoria. The Act gives the EPA enhanced powers and tools to prevent and minimise the risks of harm to human health and the environment from pollution and waste. It also provides the EPA with the ability to pursue stronger sanctions and penalties to hold environmental polluters to account. While the Act does not prescribe noise limits, it does prohibit the emission of *unreasonable noise*[1] from non-residential premises. It includes environmental obligations and protections for

[1] *Unreasonable noise* is defined in Section 3(1) of the Act as 'Noise that is unreasonable having regard to the following:
(i) its volume, intensity, or duration
(ii) its character
(iii) the time, place, and other circumstances in which it is emitted
(iv) how often it is emitted
(v) any prescribed factors

DOCUMENT	SUMMARY
	all Victorians focusing on preventing waste and pollution impacts rather than managing those impacts after they have occurred. The General Environmental Duty (GED) as defined in Part 3.2 of the Act requires anyone engaging in an activity posing a risk of harm to human health and/or the environment to minimise those risks to prevent harm as far as reasonably practicable. Further to the above the Act includes subordinate legislation, of which the Environment Protection Regulations and Environment Reference Standard are discussed below.
Environment Protection Regulations 2021 (the Regulations)	The Regulations aim to further the purpose of and give effect to the Act. Part 1.2, Section 4 includes definitions of the terminology used in other subordinate policy documents, including the Noise Protocol (EPA 1826) used to assess environmental noise from commercial and industrial operations in Victoria (see below). Part 5.3 of the Regulations includes requirements specific to environmental noise, with Division 1, Section 113 stating *'a person who conducts a prediction, measurement, assessment or analysis of noise within a noise sensitive area for the purposes of the Act or these Regulations, must conduct the prediction, measurement, assessment or analysis in accordance with the Noise Protocol'.* Division 3 includes definitions and general requirements that are specific to commercial, industrial and trade premises. In accordance with Section 118 noise from these types of premises is prescribed as unreasonable if it exceeds a noise limit or alternative criterion determined in accordance with the Noise Protocol. The Act also defines 'unreasonable noise' in Section 166 of the Act. Additional matters addressed in Divisions 3 and 4 include assessment time periods, minimum noise limit values, management of cumulative noise from multiple premises, noise sensitive areas where assessment requirements apply, definition of frequency spectrum as a prescribed factor, and a definition for aggravated noise.
EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (EPA 1826)	EPA 1826, a.k.a the Noise Protocol, defines the method for setting noise limits for new and existing commercial, industrial and trade premises and entertainment venues in Victoria. It also outlines the steps that must be followed to undertake an assessment (either measurement or prediction based) of the effective noise level within a noise sensitive area or alternative assessment location. A comparison between the effective noise level and the relevant noise limit (or alternative assessment criterion) will determine whether the noise that is emitted from the premises is unreasonable under the Regulations. The noise limits are determined based on the land use zoning of the area as defined by the relevant planning scheme, and measured background noise levels, with different limits applicable during the day, evening, and night periods.
General Environmental Duty (GED)	The General Environmental Duty (GED) is outlined in Part 3.2 of the Act. The GED requires anyone engaging in an activity posing a risk of harm to human health and/or the environment from pollution (including noise), to minimise those risks to prevent harm as far as reasonably practicable. Commercial premises are therefore required to continue to review and eliminate or reduce the risk of harm from noise as far as reasonably practicable, even if compliant with the Noise Protocol. It is applied to eliminate or reduce the risk of harm to human health and the environment. This means that proportionate controls should be applied to mitigate or minimise the risk of harm

DOCUMENT	SUMMARY
	accounting for the likelihood of the risk, degree of harm, current state of knowledge, and available noise mitigation controls, and their associated costs.
Environment Reference Standard (ERS)	The current Environment Reference Standard (ERS) is detailed in Victoria Government Gazette No. S245 and is made under Section 93 of the Act. It may be used as a reference tool in the assessment of planning proposals and provision of advice and recommendations to decision makers where a proposal involves significant risks to human health or the environment. Outside 'natural areas', the ERS makes use of outdoor L_{Aeq} noise levels as indicators. Different objectives are associated with different land use categories, recognising the reality of current ambient sound levels that can reasonably be expected in developed areas. The noise levels specified in the ERS objectives are neither compliance limits, nor design criteria, but they can be used to facilitate assessing whether the environmental values are being achieved, maintained, or threatened.

3.2 *ENVIRONMENT PROTECTION ACT 2017* (THE ACT)

The General Environmental Duty (Section 25 of the Act) requires people who are engaging in any activity that may give rise to risks of harm to human health or the environment from pollution or waste to minimise those risks, so far as reasonably practicable. This requires those risks to be eliminated so far as reasonably practicable, or if that is not possible, to be reduced so far as reasonably practicable. A discussion of reasonably practicable noise management options to reduce noise from the project is provided in Section 5.

Separately, the Act also prohibits the emission of unreasonable noise. Section 166 of the Act imposes an obligation on any individual not to emit unreasonable noise or permit an unreasonable noise to be emitted. The assessment of unreasonable noise is considered in Section 4.

3.3 EPA 1826 (NOISE PROTOCOL)

EPA Publication 1826.4: Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues (EPA 1826) is the applicable legislative document for the assessment of environmental noise from commercial, industrial, and trade premises within Victoria.

The protocol prescribes a methodology to determine noise limits to protect people from noise emissions from the Project. It particularly refers to noise emissions that may affect normal domestic or recreational activities, such as sleep during the night period.

Definitions adopted by EPA 1826 are outlined in Section 5.3 (Noise) of the Environment Protection Regulations 2021 (EPR), which is subordinate legislation to support the Environment Protection Act 2017 (the Act).

A Noise Sensitive Area (NSA) is defined in the EPR as that part of the land within the apparent boundaries of any piece of land, which is within a distance of 10m outside the external walls of a noise sensitive building (such as residential buildings or building with similar types of accommodation, and sensitive educational uses). The noise limits are to be determined for the noise sensitive area that may be the worst affected by noise emitted from the proposed development.

To determine if noise is 'unreasonable' per Section 166 of the Act, the effective noise level (L_{eff}) from the industry is compared with the derived noise limits. The effective noise level (L_{eff}) is the level due to the industry measured or predicted at a residential dwelling or noise sensitive location over a continuous 30-minute period, which has had adjustments applied to account for certain characteristics such as tonality, impulsiveness, duration, intermittency, etc.

Different limits are applicable for different times of the day. Time periods defined by the EPR are presented in Table 3.2.

Table 3.2 Time Period Definitions

WEEKDAY	TIME PERIOD		
	DAY	EVENING	NIGHT
Monday to Saturday	0700 to 1800 hours	1800 to 2200 hours	2200 to 0700 hours
Sundays and Public Holidays	-	0700 to 2200 hours	

3.3.1 NOISE LIMITS (RURAL AREA METHOD)

As the Project site and surrounding noise sensitive areas are located well outside of the Melbourne Urban Growth Boundary (UGB) and any identified Major Urban Areas (i.e. UGB identified in the planning scheme where the population is greater than 7,000 people), noise limits have been derived in accordance with EPA 1826 Part I.A.2 *Noise Limits – Rural Area Method*.

The method uses land use zoning of the industry and receiver as the basis for establishing noise limits. Where the receiver is in a background relevant area (for example, where the ambient noise environment is dominated by high levels of road traffic/Freeway noise) adjustments can be applied to increase the noise limits. Other adjustments can be included where there are multiple industries, based on the distance to the industry/boundary, or where the noise source under assessment is classified as an extractive industry.

3.3.1.1 DISTANCE ADJUSTED LEVELS

Under EPA 1826.4, the Project is classified as a utility and the surrounding area is classified as a Farming Zone (FZ). Clause 31 of the protocol states that:

> *"If the utility is located in a Farming Zone, Rural Activity Zone or Green Wedge Zone and the distance adjustment is 0 dB, and unless a background level assessment is conducted in accordance with clauses 21 to 23, then:*
>
> ***a. the distance-adjusted level for each period is –***
>
> *i. Day: 45 dB(A)*
>
> *ii. Evening: 39 dB(A)*
>
> *iii. Night: 34 dB(A).*
>
> ***b. The noise limit is the distance-adjusted level defined in clause 31, unless a background level assessment is conducted in accordance with clauses 21 to 23."***

3.3.1.2 BACKGROUND LEVEL ADJUSTMENTS

Clause 32 of EPA 1826 states that where background noise monitoring has been undertaken in accordance with Clauses 21 to 23, the noise limit for each NSA is determined as per Clause 24 by comparing the distance adjusted zoning levels and background noise levels for each time period as follows:

> ***a. for the day period, the noise limit is the greater of:***
>
> *i) the distance-adjusted level*
>
> *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*
>
> *ii) the evening background level plus 5 dB*
>
> ***c. for the night period, the noise limit:***
>
> *i) is the greater of-*
>
> *- the distance-adjusted level*

- the night background level plus 5 dB

ii) Noise limits for the night period must not be greater than 55 dB(A)

3.3.1.3 SUMMARY OF OPERATIONAL NOISE LIMITS

In accordance with EPA 1826, EPA 1997 and noise monitoring results presented in Section 2.3, Table 3.3 details the noise limits derived for the identified NSAs based on the existing land use zoning. The result of noise monitoring outlined in Section 2.3 indicates that the noise environment is not influenced by high levels of traffic noise.

Table 3.3 EPA 1826 Noise Limits: Rural Method

DESCRIPTOR	NOISE LIMITS, dBA		
	DAY	EVENING	NIGHT
Zoning level (Clause 19) – Farming Zone (FZ)	46	41	36
Distance adjusted levels - Utilities (Clause 31)	**45**	**39**	**34**
Measured lowest 'period-average' background noise level L_{90} (Clause 21 – 22)	41	35	27
Background level check (Clause 24)	**49**	**40**	**32**
Project Noise limit, $L_{eq,30min}$	**49**	**40**	**34**

3.4 ENVIRONMENTAL REFERENCE STANDARD

The current Environment Reference Standard (ERS) is detailed in Victoria Government Gazette No. S245 and is made under Section 93 of the Act. It sets out the environmental values of noise that are sought to be achieved or maintained in Victoria. The noise criteria should be treated as targets and objectives, rather than statutory noise limits. The noise criteria are presented in terms of ambient noise targets (L_{Aeq}) for day and night external sound environments.

Five land use categories are assigned noise indicators and objectives, ranging from high density urban areas (CBDs) to environmental sensitive areas (uninhabited rural areas). The land use categories and associated noise level indicators and objectives are outlined in Table 3.4.

Table 3.4 ERS: Indicators and objectives for the ambient sound environment

LAND USE CATEGORY	INDICATORS	NOISE LEVEL OBJECTIVE
Category I High density urban areas (CBDs)	Outdoor $L_{Aeq, 8h}$ (10pm to 6am)	55 dBA
	Outdoor $L_{Aeq, 16h}$ (6am to 10pm)	60 dBA
Category II Medium density urban areas (outskirts of CBDs)	Outdoor $L_{Aeq, 8h}$ (10pm to 6am)	50 dBA
	Outdoor $L_{Aeq, 16h}$ (6am to 10pm)	55 dBA
Category III Low density urban areas (suburbs)	Outdoor $L_{Aeq, 8h}$ (10pm to 6am)	40 dBA
	Outdoor $L_{Aeq, 16h}$ (6am to 10pm)	50 dBA
Category IV Regional areas (rural towns)	Outdoor $L_{Aeq, 8h}$ (10pm to 6am)	35 dBA
	Outdoor $L_{Aeq, 16h}$ (6am to 10pm)	40 dBA
Category V Environmentally sensitive areas (national parks)	Qualitative	A sound quality that is conducive to human tranquillity and enjoyment having regard to the ambient natural soundscape

Under the ERS methodology, noise sensitive receivers in the Project area would be classified as Land use category IV. This is described as being *'Lower density or sparce populations with settlements that include smaller hamlets, villages and small towns that are generally unsuited for further expansion. Land uses include primary industry and farming'*.

The planning objectives adopted for the Project are:

- Outdoors L_{Aeq} (8 hour) 35 dBA
- Outdoors L_{Aeq} (16 hour) 40 dBA

It is important to note that these are neither compliance limits, nor design criteria, but they can be used to facilitate assessing whether the environmental values are being achieved, maintained, or threatened. It is noted that where compliance with the noise limits calculated in Section 3.3.1.3 is shown, noise levels will also comply with the Noise level objectives presented here.

3.5 ADJUSTMENTS FOR NOISE CHARACTER

In addition to the assessment of Project noise levels against these criteria, EPA 1997 requires the consideration of potentially annoying noise characteristics. These may include:

- Impulsive noise
- Intermittent noise
- Tonal noise
- Low frequency noise

Note that compliance with the values outlined here do not necessarily demonstrate compliance with the GED, as concerns from human health may still arise even at lower levels. For example, if a tonal noise exists (a peak of noise energy at a specific frequency), then this component of noise may cause discomfort to a listener.

3.5.1 IMPULSIVE NOISE

Impulsive noise is defined as impulses of noise from a Project with a gap between impulses of approximately 10 seconds.

When the noise is impulsive in character the following adjustments apply:

a) when the impulsive character of the noise is just detectable then a correction of +2 dB should be applied

b) when the impulsive character of the noise is prominent then a correction of +5 dB should be applied.

Circuit breaker switches form part of the emergency management system at the site and would trigger infrequently where a short circuit occurs. These switches typically generate a single, short, sharp impulse which would be categorised as impulsive.

It is noted that Clause 37 of EPA 1826 states that:

> *'Where the noise source under consideration is equipment used solely in relation to emergencies, the relevant noise limit applying to the testing or maintenance of such equipment… is increased by 10 dB for a day period and by 5 dB for all other periods'.*

Due to the infrequent nature of these events, they have been considered separately as impulsive noise events in Section 4.2.2.

3.5.2 INTERMITTENT NOISE

Clause 87 of EPA 1826 describes that an intermittency adjustment applies when the noise:

a) increases in level rapidly, and by at least 5 dB, on at least two occasions during a 30-minute period; and

b) maintains the higher level for at least a one-minute duration.

Corrections due to intermittent noise have been presented in Table 3.5.

Table 3.5 Intermittency adjustment for noise from industrial premises

TIME PERIOD	INCREASE IN LEVEL	ADJUSTMENT
Day period	> 10dB	+ 3 dB
Evening or night period	5 – 10 dB	+3 dB
	> 10dB	+5 dB

Noise from the site is not considered to be intermittent in nature and this correction has not been considered further.

3.5.3 TONAL NOISE

Annex C of EPA 1826 describes the methodology for determining the extent of tonal noise associated with a Project. This method is based on the analysis of 1/3 octave noise levels, where a single octave extends more than 3dB above the level of adjacent octave bands.

When the noise is tonal in character then the following adjustment is made to the noise level.

a) when the tonal character of the noise is just detectable then a +2 dB adjustment is made

b) when the tonal character of the noise is prominent then a +5 dB adjustment is made.

Tonal noise calculations for the primary noise sources associated with this Project have been presented in Appendix B, and in summary found that tonal noise may be a feature of the Project at some NSAs.

3.5.4 LOW FREQUENCY NOISE

EPA Publication 1996 *Assessing low frequency noise – June 2021* (EPA 1996) is the applicable guideline for duty holders of commercial, industrial, and trade premises within Victoria to manage low frequency noise emissions. It is also used by EPA officers to determine whether the emission of low frequencies from a premises are unreasonable under Section 166 of the Act. Low Frequency Noise (LFN) is defined from 10 Hz to 160 Hz (third octave bands).

LFN emitted from a premises should be assessed by comparing its frequency spectrum to the relevant threshold levels. Table 3.6 provides the EPA 1996 outdoor noise threshold criterion to be used for outdoor measurements (Table 3 in EPA 1996). It is important to note that the threshold levels are not set limits, as outlined by the EPA. 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 and duration
- Other characteristics that can increase annoyance with the noise, for example, tonality, frequency modulation
- Baseline noise levels in the absence of the noise of concern (e.g. influence from traffic or aircraft noise).

Table 3.6 Outdoor low frequency threshold criterion

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**
Threshold level, Leq (dB)	92	89	86	77	69	61	54	50	50	48	48	46	44

Where LFN is found to be a potential feature of the noise impact, further consideration should be given to management or mitigation measures to reduce the noise impact.

Appendix B outlines the results of the LFN assessment, and in summary presents a low risk that low frequency noise is a feature of the project at nearby NSAs.

4 OPERATIONAL NOISE ASSESSMENT

The Project includes noise generating plant associated with the proposed Solar Farm and associated infrastructure, introducing a risk of generating unreasonable noise to surrounding NSAs. A predictive noise assessment has been undertaken to quantify potential noise impacts and provide mitigation recommendations where required.

4.1 NOISE ASSESSMENT INPUTS

4.1.1 GENERAL MODELLING SETUP

A detailed 3-dimensional noise model has been prepared for the project to assess potential noise impacts during operation of the Project.

A noise model was created with SoundPLAN 8.2 modelling software and noise modelling of the Project was undertaken using the methodology provided in International Standard ISO9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2:1996).

This internationally recognised standard was designed to assume conditions that favour the propagation of noise from meteorological effects, described as a slight wind (1 to 5 m/s) blowing from source to receiver, or a well-developed moderate ground-based temperature inversion. As such the standard always predicts noise levels slightly higher than levels under calm or neutral propagation conditions and represents a conservative approach.

Key modelling parameters and assumptions are shown in Table 4.1.

Table 4.1 Operational noise modelling inputs and assumptions

PARAMETER	MODELLING INPUT
Ground absorption	Ground absorption factors are set 50 % hard / 50 % porous which is indicative of mixed grass/open vegetation located throughout the study area.
Terrain data	Terrain data have been provided by VICMAP. Topography within the site boundary has been flatted to account for the approximately final elevation.
Meteorological conditions	Winds (1 to 5 m/s) blowing from source to receiver, or a well-developed moderate ground-based temperature inversion (i.e. moderate worst case)
Buildings	NSAs are modelled as point receivers only (free-field levels). No buildings are included in the noise model.
Receiver height	Point receivers within 10 metres of the most exposed façade. The receiver heights are set at 1.5 m above ground level.
Location of noise sources	Refer Figure 1.1
Modelled sound power levels	As described in Section 4.1.2. Detailed information regarding noise sources was not available for all plant, therefore assumptions have been made based on similar projects as indicated.
Assessment parameter/ duration	$L_{Aeq,\ 30\ minutes}$ (all noise sources, except circuit breaker switches) Instantaneous L_{Amax} (circuit breaker switches).
Assumed hours	Operational noise may occur at any time of day (day, evening, night). Unless otherwise stated for mitigation scenarios.

4.1.2 MODELLED SOUND POWER LEVELS

The key infrastructure components associated with the proposed solar farm is captured in Table 4.2 together with estimated Sound Power Levels (SWLs). Information captured in Table 4.2 has been modelled for the Project, based on available Project information and the Concept Design. Description of the provided source data is provided in Section 4.1.2.1 with key assumptions regarding source information outlined in Section 4.1.4.

It is noted that circuit breaker switches would operate infrequently and would be a very short-term impulsive type noise event, which is not likely to impact L_{Aeq} noise levels and as such have been assessed separately as impulsive noise sources.

Table 4.2 Primary noise generating equipment at the Project Site

EQUIPMENT	MAKE	NUMBER OF PLANT (INDICATIVE)	SWL dBA, PER UNIT (INDICATIVE)	MODELLED NOISE SOURCE HEIGHT
Solar Panel Tracking motors[1]	NEXTracker	4,800	50 $L_{eq,30min}$	1.5
MV Power Station with Solar Inverter and integrated MV transformer[2]	SMA 4200 Power Station SMA SC4200 UP Solar inverter	35	93 $L_{eq,30min}$	2.3
MV Switchgear[2]	MCS6300-LV prefabricated substation	1	67 $L_{eq,30min}$	2.2
Battery Pack System[3]	2.752 MWh battery energy storage container	37	Front (3 source areas): 79 $L_{eq,30min}$ Back (1 source areas): 83 $L_{eq,30min}$	0.3 to 2.0
BESS Inverters[2]	SMA MVPS 4200-S2	37	93 $L_{eq,30min}$	2.3
HV transformer[2,4]	High Voltage (HV) transformer (33kV-220kV	1	85 $L_{eq,30min}$	1.7
BESS MV transformer[2,4]	EMC Transformer	37	68 $L_{eq,30min}$	2.2
Circuit breaker switches[2,4]	Unknown	1	95 to 115 L_{max}	1.5

(1) The solar panel tracking motor has been modelled as area sources evenly distributing the number of motors based on the area of the solar panels.

(2) Modelled as point source located at height of unit. The same noise level is emitted in all directions. Only overall level have been modelled, no spectrum was used since no data has been provided. Equipment is not expected to contain any noise tonal or low-frequency noise.

(3) Modelled as industrial building with area sources located at casing weaknesses e.g., vents for cooling fans. The adopted sound power levels match the provided sound pressure levels reported by the manufacturer (Report: *Noise Test of Liquid Cooling BESS*). The sound pressure levels from the report have been adopted, rather than the sound power levels, to better reflect the directivity of the noise emission from the batteries. Noise report stated operating condition matching "runs at full power, to simulate worst noise situation".

(4) No detailed information has been provided for this equipment. WSP have assumed the sound power level based on previous experience with previous similar projects, outlined in Section 4.1.4.

(5) Where applicable and where data is not available, WSP has made assumptions for sound power levels, based on previous experience with previous similar projects. These assumptions are outlined in Section 4.1.4.

4.1.2.1 DESCRIPTION OF PROVIDED SOURCE DATA

SOLAR PANEL TRACKING MOTORS

Noise associated with tracking motors was sourced from the NEXTracker report '*NEXTracker Motor Sound Test Summary', dated* March 2017. The report stated sound power level of 49 dBA. No spectral data was provided, and this item has therefore been modelled as an overall level per unit.

No standard or method for the testing of this noise data has been provided.

MV POWER STATION (SOLAR INVERTER AND MV TRANSFORMER)

Noise associated with MV Power Station was sourced from the SMA technical sheet '*SUNNY CENTRAL 4400 UP-US / 4600 UP-US'*. The report states a sound pressure level of 65 dBA measured at a distance of 10 metre.

No standard or method for the testing of this noise data has been provided.

No noise spectrum was provided within the noise report, WSP has therefore made reasonable assumptions based on previous experience with similar projects as detailed in Section 4.1.4.

MV SWITCHGEAR

MV Switchgear sound power data per Annex B of DEKRA Type Test Report No.: 2600305.02-MHV 21-0009 *'Type test on a MVS6300-LV High-voltage/Low-voltage prefabricated substation'*, dated 24 February 2011 for Sungrow Power Supply Co. Ltd.

The test report indicates that during testing of the enclosure, which includes the ONAN transformer and LV cabinets (including air cooling), the guaranteed sound power level was 58 dBA L_W from inside the prefabricated substation. Where the testing was undertaken with the doors open the guaranteed sound power level went up to 67 dBA L_W, the latter being used for the purposes of noise predictions.

Testing was conducted in accordance with IEC 60076 *Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air* (transformer), and IEC 61439-2 *Low-voltage switchgear and controlgear assemblies - Part 2: Power switchgear and controlgear assemblies* (low-voltage switchgear).

No noise spectrum was provided within the noise report, WSP has therefore made reasonable assumptions based on previous experience with similar projects as detailed in Section 4.1.4.

BATTERY PACK SYSTEM

Battery pack system sound power data per '*Noise Test of Liquid Cooling BESS*' (ref: AD-027/1), dated November 29, 2021 for Sungrow Power Supply Co. Ltd.

Report provides 1/3 octave spectral data, overall sound power level, and directional information. The provided 1/3 octave spectral data indicate tonal characteristics for the battery system.

Testing was conducted in accordance with DIN EN ISO 3744: 2011-02 *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane*.

4.1.3 SITE LAYOUT

The site layout is provided in Figure 1.1. BESS inverters, and BESS MV transformers and location for these have therefore been assumed based on previous similar projects. The circuit breaker has been assumed to be associated with the MV Switch.

The battery orientation has been assumed to have the front (loudest side) oriented away from the closest receivers facing southwest.

4.1.4 KEY MODELLING ASSUMPTIONS

- Equipment and layout of the Project is still being finalised, but this assessment is based on the current best available information.
- The assessment has been based on the conservative assumption that all plant has is required to operate at 100 % at all times (24-hour operation). The exception is the solar motors are assumed to not be operating during the night-time. It is, however, noted that the solar motors have a negligible noise impact for the Project.
- Plant siting as indicated by URBIS Pty Ltd drawing Elaine Solar Farm Windy Landscape Site Plan and Peters Landscape Site Plan (ref CS-002 rev A) dated 12.07.2023 (see Figure 1.1).
- Source data:
  - For the **MV Switchgear** a generic spectrum has been based on WSP measurement data for similar equipment which includes slight tones at 100 Hz and 315 Hz. The spectral data has been adjusted to match the overall level in provided source data.
  - While referenced as the SMA MVPS 4200-S2, noise levels for the proposed **BESS inverter** have been based off the available noise test report for the SMA SCS 4200 UP inverter units, which have noise levels equivalent to a sound power level of 93 dB LWA. The 1/3 octave band spectrum based on available SMA Solar data for the SC2200 inverter which includes a prominent tone at 3.15 kHz.
  - Spectrum for the **MV Power Station** has been based on the 1/3 octave band spectrum based on available SMA Solar data for the SC2200 inverter which includes a prominent tone at 3.15 kHz.
  - **BESS MV transformers** have been based on previous similar projects which have noise levels equivalent to sound power levels of up to 68 dBA. The 1/3 octave band spectrum includes tonal characteristics at 100 and 200 Hz, representing a worst-case scenario.
  - The **inverters** will only generate noise during daylight hours, which during summer could extend from 0600 hrs through to around 2100 hrs. Accordingly, there is a chance that the inverters could generate noise during the early morning night period as defined in the Noise Protocol (i.e., before 0700 hrs).

4.1.5 DISCUSSION OF POTENTIAL MODELLING UNCERTAINTY

All modelling predictions may include a degree of uncertainty due to a range of influencing factors. Specifically, the following factors have been identified as issues potentially influencing the outcomes of this assessment.

- As outlined in Section 4.1.2.1 and 4.1.4, a number of assumptions have been adopted for the sound sources (BESS and solar inverters, BESS MV transformers, and circuit breakers). WSP have based these assumptions on previous experience with similar projects and consider them to be representative. But it is acknowledged that there is a range in noise emission levels from this type of equipment and it would be recommended that when the equipment selection is finalised the model is updated, especially regarding the inverters that have been noted to be dominant noise sources.
- Noise modelling will typically adopt a potential variation of +/- 2dB to account for modelling uncertainty.

These potential sources of uncertainty have been considered and a +2dB correction has been applied to all predicted noise levels to account for this uncertainty.

4.2 PREDICTED NOISE LEVELS

4.2.1 PREDICTED OPERATIONAL NOISE LEVELS

Noise from the operational solar farm was predicted to the surrounding NSAs based on the anticipated 'worst case' conditions, assuming the inverter banks and BESS infrastructure is operating simultaneously at maximum load during all periods.

A summary of the predicted noise levels is provided in Table 4.3 which shows the predicted noise levels at each NSA for the day, evening, and night periods. Analysis of the noise penalties are outlined in Appendix B and unmitigated noise contours are presented in Appendix C.

Results are displayed without any mitigation controls in place. The modelling results show:

- Compliance with EPA 1826 noise limits is predicted for the day, evening, and night-time periods at all NSAs.
- The dominant noise sources are dependent on the location of the receiver relevant to the Project. For the worst affected receivers, the dominant noise sources are:
  - Solar inverters (at all NSAs)
  - BESS units (at a majority of the NSAs but not at the two most affected receivers)
  - BESS inverter (at a majority of the NSAs, including 5876 Midland Hwy)
- Noise sources that were noted to not affect the overall levels at all assessed NSAs included: solar panel motors, BESS inverter, BESS transformer, Circuit breaker, and MV switchgear.

Table 4.3 Predicted operational noise levels and assessment – Unmitigated levels

NSA ID	ADDRESS	NOISE LIMIT, dBA, $L_{EQ(30\ MIN)}$			PREDICTED NOISE LEVEL[1], dBA
		DAY	EVENING	NIGHT	ALL PERIODS
1	11 Betsons Rd	49	40	34	28
2	16 Mt Doran-Egerton Rd				31[2]
3	33 Betsons Rd				27
4	51 Betsons Rd				31[2]
5	67 Pearsons Rd				30[2]
6	68 Horsehill Rd				34
7	78 Settlement Rd				< 25[2]
8	87 Fords Ln				31[2]
9	89 Jordans Ln				< 25[2]
10	100 Horsehill Rd				32[2]
11	108 Courts Rd				31[2]
12	146 Courts Rd				32[2]
13	154 Murphys Rd				31[2]
14	205 Kingfisher Dr				25[2]
15	430 Settlement Rd				31[2]
16	440 Horsehill North Rd				< 25[2]
17	544 Settlement Rd				31[2]
18	620 Mt Doran Rd				< 25[2]
19	5328 Midland Hwy				< 25[2]
20	5621 Midland Hwy				28[2]
21	5876 Midland Hwy				34
22	5930 Midland Hwy				31[2]
23	6240 Midland Hwy				< 25[2]
24	Elaine-Blue Bridge Rd				31[2]
25	Unnamed Road, West of Midland Hwy				31[2]

(1) Includes +2dB correction to account for potential uncertainty in noise modelling as discussed in Section 4.1.5.

(2) Includes tonal penalties as outlined in Section 3.5.3. Derivation of tonal penalty is provided in Appendix B.

4.2.2 PREDICTED L_{AEQ} NOISE LEVELS (EMERGENCY CIRCUIT BREAKER)

Further to the noise impacts of ongoing noise sources, as discussed in Section 3.5.1, operations may involve the occasional activation of circuit breaker switches. The circuit breaker is located near the transformer in the BESS area and forms a key safety measure on site. When activated, which would be expected to occur infrequently, this item would generate high noise levels for a short period of time (less than 1 second).

When averaged across the half hour assessment period, when they occur, these events would not contribute to the steady state (L_{eq}) noise level of the site.

4.2.3 PREDICTED IMPULSIVE NOISE LEVELS (EMERGENCY CIRCUIT BREAKER)

Further to the noise impacts of steady state noise sources, as discussed in Section 3.5.1, operations may involve the occasional activation of circuit breaker switches. The circuit breaker is located near the transformer in the BESS area and forms a key safety measure on site. When activated, which would be expected to occur infrequently, this item would generate high noise levels for a short period of time (less than 1 second).

These events would not contribute to the steady state (L_{eq}) noise level, however they would be expected to generate short term maximum noise levels, potentially generating sleep disturbance impacts if occurring during the sensitive night-time period.

Table 4.4 shows the predicted noise levels at each receiver for all assessment periods. The potential for exceedance of the night-time criteria has been predicted at four NSAs.

Table 4.4 Predicted impulsive operational noise levels and assessment (Circuit breaker switches)

NSA ID	ADDRESS	NOISE LIMIT, dBA, $L_{EQ(30\ MIN)}$[1]			PREDICTED NOISE LEVEL, L_{MAX} dBA[2, 3, 4]
		DAY	EVENING	NIGHT	All periods
1	11 Betsons Rd	59	45	39	20 to 40
2	16 Mt Doran-Egerton Rd				20 to 40
3	33 Betsons Rd				20 to 40
4	51 Betsons Rd				< 38
5	67 Pearsons Rd				< 35
6	68 Horsehill Rd				< 33
7	78 Settlement Rd				< 25
8	87 Fords Ln				< 31
9	89 Jordans Ln				< 26
10	100 Horsehill Rd				< 28
11	108 Courts Rd				< 38
12	146 Courts Rd				< 39
13	154 Murphys Rd				< 35
14	205 Kingfisher Dr				< 30
15	430 Settlement Rd				< 38
16	440 Horsehill North Rd				24 to 44
17	544 Settlement Rd				< 25
18	620 Mt Doran Rd				< 25
19	5328 Midland Hwy				< 25
20	5621 Midland Hwy				< 32
21	5876 Midland Hwy				< 37
22	5930 Midland Hwy				< 36
23	6240 Midland Hwy				< 27
24	Elaine-Blue Bridge Rd				< 38
25	Unnamed Road, West of Midland Hwy				< 33

(1) Includes adjustments for infrequent emergency equipment in accordance with Section 3.5.1

(2) Includes adjustments for impulsivity in accordance with Section 3.5.1. Where the predicted raw circuit breaker noise level is below background noise, +2dB has been applied, where it is greater than background, +5dB penalty has been applied.

(3) Includes +2dB correction to account for potential uncertainty in noise modelling as discussed in Section 4.1.5.

(4) Considers the range of typical circuit breaker noise emissions.

4.2.4 PREDICTED LOW FREQUENCY NOISE

Low frequency noise was considered in accordance with the method presented in Section 3.5.4 for each identified NSA. The calculations for this assessment are presented in Appendix B and show that low frequency noise is not considered a feature of the project noise at any NSAs.

4.3 DISCUSSION

Noise levels from the operational solar farm are presented in Table 4.3 and indicate that unmitigated project operations are likely to comply with relevant EPA 1826 noise limits for day, evening, and night periods at all NSAs.

The modelling inputs and method are considered conservative, based on the anticipated 'worst case' conditions and assuming all infrastructure is operating simultaneously at maximum load during all periods.

Noise levels are predicted to be up to 34 dBA L_{eq} at the NSAs. This is equal to the night-time noise limit and is more than 10 dB below daytime limits and likely to be inaudible over existing background noise during the day, particularly considering the influences of local traffic on the Midland Highway.

Noise levels as a result of the infrequent activation of the emergency circuit breaker switches were found to have the potential to exceed the impulsive project noise criteria at four locations. It is understood that emergency circuit breaker switches may be activated at any time throughout the 24-hour period however will occur very infrequently (less than once per five years) for a period of less than one second. As such, given the maximum potential extent of exceedance is 5dB, this risk of impact is not considered substantial.

It is noted the location of the circuit breaker was not known at the time of this assessment and the selected location is a conservative approach at the closest area within the BESS to the NSAs. Additionally, the precise unit has not been determined and as such a conservative likely maximum level has been assessed. With further information available the predicted noise levels would be expected to be lower.

Mitigation measures to reduce these noise impacts further have been investigated and are presented in Section 5.

5 NOISE MANAGEMENT AND MITIGATION

5.1 INTRODUCTION

The noise modelling results presented in Section 4.2 indicate that the predicted noise from the operational solar farm will comply with the operational noise limits in all locations). No potential exceedances of the project criteria have been identified (with a potential risk noted for the circuit breaker. However, it is noted that locations with the highest predicted noise level are primarily due to noise emitted by Solar inverters.

Noise at all locations is considered low risk of emitting unreasonable noise.

The highest average noise levels were predicted at 68 Horsehill Road and 5876 Midland Highway where the noise levels were dominated by the solar inverters. As previously noted, the inverter will only generate noise during daylight conditions. However, during the summer months, there is a potential one-hour window during which noise from the inverters should be assessed against the more onerous noise limit applicable during the night period (i.e. from 0600 hrs through 0700 hrs). As the noise output from the inverters also varies significantly with load it is envisaged that the predicted noise level at these two properties will likely be noticeably lower than predicted.

From an acoustic perspective, possible strategies to mitigate noise are typically investigated in the following order (decreasing preference):

a. **Land use planning** and provision of appropriate buffer distances through Project design (omitted here due this being a measure relevant only prior to site selection)

b. **Noise control at the noise source**

c. **Noise control along the noise transfer path**

d. **Noise control at the receiver** (omitted at this stage pending confirmation of agreed mitigation).

This mitigation assessment is focused at providing reasonable and practicable mitigation options and/or combination of options to achieve compliance and minimise risk of environmental harm to the surrounding areas. The mitigation options are to be agreed in discussion with the URBIS and the client.

5.2 NOISE MITIGATION INVESTIGATION

Investigations were conducted to identify potential mitigation options to minimise noise levels at the nearest sensitive NSAs.

The following three mitigated noise scenarios have been considered:

Operational noise:

- Mitigation scenario 1: Indicative 3.5 m noise barrier around key plant items (closest Solar inverters)
- Mitigation scenario 2: Solar inverters closes to worst affected receivers relocated further away

Impulsive noise (emergency management system):

- Mitigation scenario 3: Indicative 3.5m noise barrier around circuit breaker

The assessment presented in Section 4.2.1 shows that the primary noise sources at the most affected NSAs include solar inverters and solar array. As such, the investigation of mitigation has focused on these sources.

5.2.1 EQUIPMENT NOISE SOURCE CONTROL

Generally, noise control at the source is considered as most effective in improving the overall acoustic outcome at sensitive receivers. Possible mitigation options that may reduce emitted noise levels from the equipment include:

- **Selection of equipment with a lower sound power level where possible**. To reasonably minimise noise levels and reduce risk of exceeding criteria (e.g. the circuit breaker), an overall reduction of up to 2 dBA would be required for the continuous operational noise, and 5 dBA for the impulsive noise levels.

  For the operational noise, the biggest potential for source control for the Project has been identified to be the Solar inverter and circuit breaker. Potential noise reduction would be in the order of:

  - Impulsive noise (L_{max}): Reduction of 5 dB is expected if reducing the Circuit Breaker SWL by 5 dB.
  - Operational noise (L_{Aeq}): Reduction of 2 dB is expected if reducing the Solar Inverter SWL by 5 dB.

5.2.2 OPERATIONAL L_{AEQ} NOISE MITIGATION

5.2.2.1 MITIGATION SCENARIO 1 – 3.5 M NOISE BARRIER AROUND KEY PLANT

Noise modelling results from Mitigation Scenario 1 is presented in Table 5.1. The model was modified to include a 3.5 m high enclosure around the three nearest solar inverters to reduce noise at 68 Horsehill Road and 5876 Midland Highway. The barrier was located 4 metres away from inverter enclosing three sides, open the south, to allow for access for maintenance and avoid reflections towards the closest NSAs.

The results indicate that the installation of these enclosures would effectively reduce the noise levels up to 2 dB during all periods at the nearest NSAs.

Table 5.1 Predicted mitigated operational noise levels and assessment – Mitigation Scenario 1

NSA ID	ADDRESS	NOISE LIMIT, dBA, $L_{EQ(30\ MIN)}$			PREDICTED NOISE LEVEL, dBA[1]	REDUCTION COMPARED TO UNMITIGATED SCENARIO
		DAY	EVENING	NIGHT	ALL PERIODS	
6	68 Horsehill Rd	49	40	34	32	2 dB
21	5876 Midland Hwy				32	2 dB

Includes +2dB correction to account for potential uncertainty in noise modelling as discussed in Section 4.1.5.

5.2.2.2 MITIGATION SCENARIO 2 – SOLAR INVERTERS RELOCATED

Noise modelling results from Mitigation Scenario 2 are presented in Table 5.2. Relocation of the Solar Inverters are illustrated in Figure 5.1.

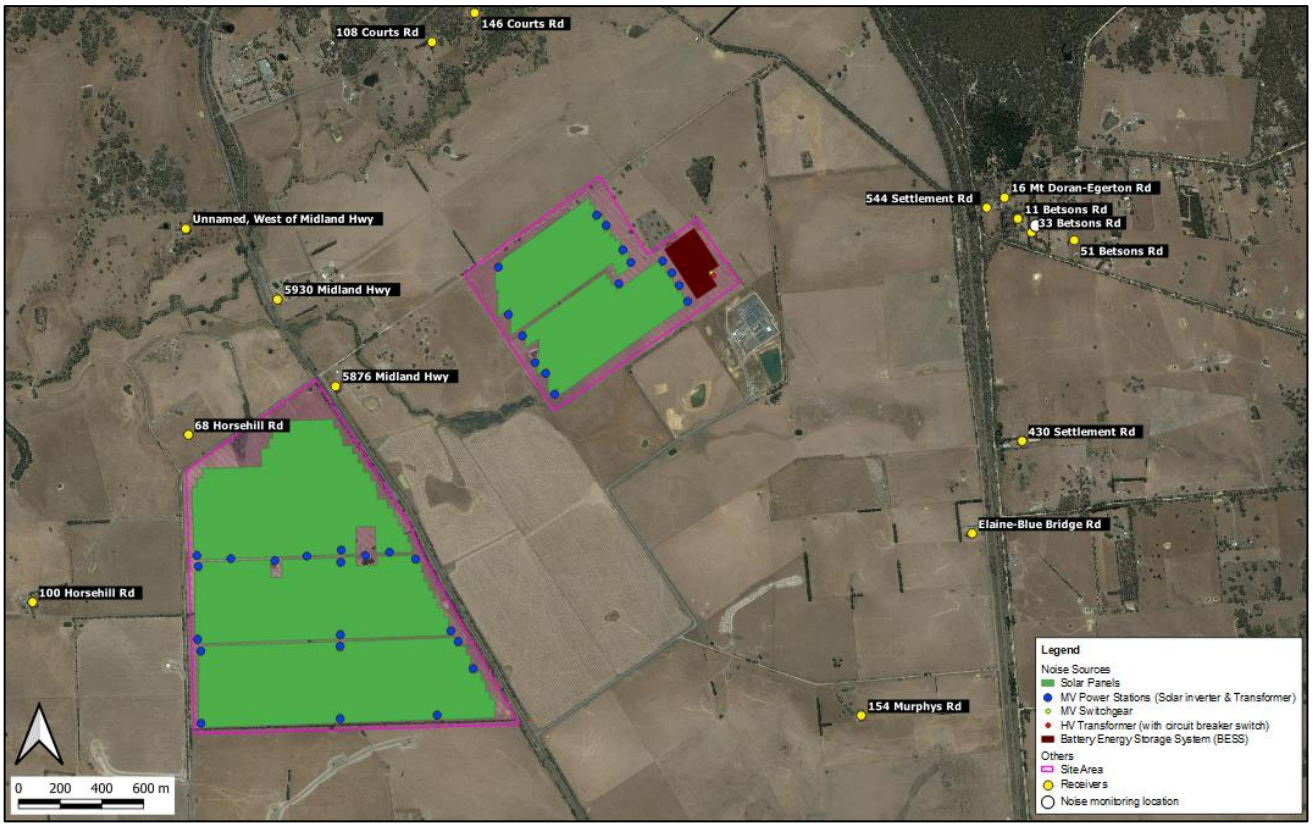

Figure 5.1 Mitigation scenario 2 – Relocation of Solar inverters

If engineering constraints permit, the relocation of the Solar Inverters would effectively reduce the noise levels by up to 2 dB during all periods at the nearest NSAs.

Table 5.2 Predicted mitigated operational noise levels and assessment – Mitigation Scenario 2

NSA ID	ADDRESS	NOISE LIMIT, dBA, $L_{EQ(30\ MIN)}$			PREDICTED NOISE LEVEL, dBA[1]	REDUCTION COMPARED TO UNMITIGATED SCENARIO
		DAY	EVENING	NIGHT	ALL PERIODS	
6	68 Horsehill Rd	49	40	34	32	2 dB
21	5876 Midland Hwy				33	1 dB

(1) Includes +2dB correction to account for potential uncertainty in noise modelling as discussed in Section 4.1.5.

5.2.2.3 DISCUSSION OF TYPICAL SITE OPERATION NOISE MITIGATION

From the assessed modelling scenarios, the most reasonable is Mitigation scenario 1 which involves placing a 3.5 m enclosure around the three inverters that are the closest to the most sensitive receivers.

5.2.3 EMERGENCY IMPULSIVE NOISE MITIGATION

5.2.3.1 MITIGATION SCENARIO 3 – 3.5 M BARRIER AROUND CIRCUIT BREAKER

Noise modelling results from Mitigation Scenario 3 are presented in Table 5.3. The model was modified to include a 3.5 m high enclosure around the circuit breaker (1.5 metre above height of unit). Barrier was located 4 metres away from inverter enclosing all sides.

Due to the NSAs located in all directions around the site, reflections from the noise barrier were found to increase the number of exceedances, although by a smaller margin. For reduce this impact, would require the internal surface of the noise barrier, that is facing the circuit breaker, to be lined with sound absorptive treatment (NRC ≥ 0.8).

The possibility of using sound absorptive treatment at the barrier surface would need to be assessed from a fire safety aspect. This option has not been further explored in this assessment.

Table 5.3 Predicted mitigated impulsive noise levels and assessment – Mitigation Scenario 3

NSA ID	ADDRESS	NOISE LIMIT, dBA, $L_{EQ(30\ MIN)}$[1]			PREDICTED NOISE LEVEL, dBA[2]	REDUCTION FROM UNMITIGATED
		DAY	EVENING	NIGHT	ALL PERIODS	
1	11 Betsons Rd	59	45	39	**< 38**	2 dB
2	16 Mt Doran-Egerton Rd				**< 39**	1 dB
3	33 Betsons Rd				**21 to 41**	N/A (1 dB increase)
4	51 Betsons Rd				**20 to 40**	N/A (2 dB increase)
5	67 Pearsons Rd				< 34	1 dB
6	68 Horsehill Rd				< 36	N/A (3 dB increase)
7	78 Settlement Rd				< 28	N/A (3 dB increase)
8	87 Fords Ln				< 33	N/A (2 dB increase)
9	89 Jordans Ln				< 27	N/A (1 dB increase)
10	100 Horsehill Rd				< 32	N/A (4 dB increase)
11	108 Courts Rd				**20 to 40**	N/A (2 dB increase)
12	146 Courts Rd				**21 to 41**	N/A (2 dB increase)
13	154 Murphys Rd				< 38	N/A (3 dB increase)
14	205 Kingfisher Dr				< 30	N/A
15	430 Settlement Rd				**20 to 40**	N/A (2 dB increase)
16	440 Horsehill North Rd				< 25	N/A
17	544 Settlement Rd				**< 39**	5 dB
18	620 Mt Doran Rd				< 25	N/A
19	5328 Midland Hwy				< 25	N/A
20	5621 Midland Hwy				< 34	N/A (2 dB increase)
21	5876 Midland Hwy				**21 to 41**	N/A (4 dB increase)
22	5930 Midland Hwy				< 38	N/A (2 dB increase)
23	6240 Midland Hwy				< 25	2 dB
24	Elaine-Blue Bridge Rd				< 39	N/A (1 dB increase)
25	Unnamed Road, West of Midland Hwy				< 37	N/A (4 dB increase)

Previous exceedances are indicated in the table with **bold green text**

(1) Includes adjustments for infrequent emergency equipment in accordance with Section 3.5.1

(2) Includes adjustments for impulsivity in accordance with Section 3.5.1. Where the predicted raw circuit breaker noise level is below background noise, +2dB has been applied, where it is greater than background, +5dB penalty has been applied.

(3) Includes +2dB correction to account for potential uncertainty in noise modelling as discussed in Section 4.1.5

(4) Considers the range of typical circuit breaker noise emissions.

5.2.3.2 DISCUSSION OF CIRCUIT BREAKER MITIGATION

Given the minor extent of noise reductions at impacted properties, the installation of a barrier around the circuit breaker switches is not considered to be a reasonable mitigation measure.

As such, given the minor extent of potential exceedance and the highly infrequent nature of night-time circuit breaker events (estimated to potentially occur less than once per 5 years) and that the event will last for less than one second, this impact is not considered to be unreasonable. However, where engineering constraints permit, the selection of switches with SWL of less than 110dB is recommended.

It is understood that due to electrical engineering constraints, the relocation of the circuit breaker is not considered to be a feasible approach to noise mitigation at this site.

5.3 RECOMMENDATIONS

As previously discussed, due to the equipment selection not yet being finalised it is not possible to present a specific set of solutions at this stage. The possible options and/or combination of options to reduce impacts have been discussed in preceding sections and are summarised in Table 5.4.

With mitigation, the noise levels from typical operations are predicted to comply with the EPA 1826 noise limits at all locations and is expected to only be audible at the closest locations.

It is recommended that once the Solar Farm is operational, commissioning noise measurements are undertaken to validate the noise modelling assumptions and ensure compliance with EPA legislation. Where noise is found to exceed the operational noise limits from EPA 1826 (or an alternative assessment criterion such as EPA 1996), additional noise mitigation measures will need to be considered beyond those presented in this report.

Table 5.4 Summary of mitigation options and expected acoustic benefit

ITEM	MITIGATION REQUIREMENT	TYPICAL MITIGATION AND EXPECTED ACOUSTIC BENEFIT		
General operational mitigation	Compliance is achieved at all locations. Consideration of mitigation measures may be considered.	Source control	Equipment selection	An overall reduction of 2 dB is expected from selecting a Solar Inverter with 5 dB lower SWL. If reasonable and feasible from an engineering perspective, it is recommended quieter solar inverters are selected.
		Transfer path control	Noise enclosure	Noise enclosures of up to 3.5 metre around key equipment (Solar Inverters) were assessed but found to provide marginal benefit and are therefore not considered a reasonable mitigation measure.
Emergency circuit breaker switches mitigation	Night-time noise limit could potentially be exceeded at the four NSAs (by up to 5 dB) during infrequent emergency activations. Mitigation measures may be considered.	Source control	Equipment selection	Selecting a circuit breaker with sound power level below 110 dBA (maximum level) would result in compliance at all locations.
		Transfer path control	Relocation	Options to relocate the circuit breaker switches are understood to be limited due to site engineering constraints.
			Noise enclosure	A noise barrier would not result in compliance at all potentially impacted properties without further considerations (e.g., sound absorbing lining on barrier side facing circuit breaker).

5.4 QUALITATIVE RISK ASSESSMENT

In support of the Project's obligations to comply with the General Environmental Duty (GED), WSP prepared a qualitative risk assessment to summarise the potential noise impacts from the project and assess the efficiency of the recommended mitigation measures to address unreasonable noise. The likelihood ranges from Rare (occurs in exceptional circumstances) to Almost Certain (occur in most circumstances). The consequence ranges from Insignificant (no measurable reduction in amenity) to Catastrophic (extended period of major reduction in amenity). The risk rating matrix is presented in Table 5.5. The risk register is detailed in Table 5.6.

Table 5.5 Risk rating

		LIKELIHOOD				
		Almost certain	Likely	Moderate	Unlikely	Rare
CONSEQUENCE	Catastrophic	Critical	Critical	High	High	Moderate
	Major	Critical	High	High	Moderate	Low
	Moderate	High	High	Moderate	Low	Low
	Minor	High	Moderate	Low	Low	Low
	Insignificant	Moderate	Low	Low	Low	Low

Table 5.6 Risk Register

RISK	HAZARD AND POTENTIAL HARM	INITIAL RISK RATING			MITIGATION MEASURES	RESIDUAL RISK RATING		
		LIKELIHOOD	CONSEQUENCE	RISK RATING		LIKELIHOOD	CONSEQUENCE	RISK RATING
1	Modelling assumptions: Under prediction from corrections (uncertainty)	Moderate	Moderate	Mod	Add +2dB modelling uncertainty to ensure mitigation measures predict compliance with noise limits	Moderate	Minor	Low
2	Noise emissions: Solar inverters	Moderate	Moderate	Mod	Select quieter equipment (if engineering constraints permit)	Moderate	Minor	Low
3	Noise emissions: Emergency circuit breakers	Rare	Moderate	Low	Selection of equipment with SWL < 110dB	Rare	Minor	Low
4	Noise emissions: BESS (A-weighted)	Moderate	Minor	Low	No specific actions	Moderate	Minor	Low
5	Noise emissions: Solar trackers	Unlikely	Minor	Low	No specific actions	Moderate	Minor	Low
6	Noise emissions: BESS (low frequency)	Unlikely	Moderate	Low	No specific actions	Unlikely	Moderate	Low

6 CONCLUSION

WSP has been retained by Urbis to assess noise from the proposed 150-megawatt solar farm located at Midland Highway and Elaine-Blue Bridge Road, Elaine.

The noise assessment has been based on supplied noise data provided by the manufacturer, the limitations of which have been discussed throughout the report.

By developing land which will introduce new sources of noise that could potentially impact surrounding land uses, the developer is required under the General Environmental Duty (GED) to minimise those risks of harm so far as reasonably practicable.

To this extent, a noise modelling assessment has been undertaken, with noise from the operational Solar Farm found to meet the relevant EPA Publication 1826 noise limits all receivers without further mitigation.

Noise mitigation options have been investigated for contingency purposes and the predictive noise modelling results indicate that noise from the operational Solar Farm site can be further reduced by up to 2 dBA at NSAs closest to significant onsite noise sources.

Noise levels as a result of the infrequent activation of the emergency circuit breaker switches were predicted to have the potential to exceed the impulsive project noise criteria at four locations by up to 5dB. Given that this event is likely to occur less than once every five years for a period of less than one second, and the minor nature of the noise exceedances, this is not considered to be a substantial impact. The selection of lower noise emitting switches may reduce this risk, and further mitigation is unlikely to be reasonable and/or feasible.

As such, the residual risk that noise from the operational Solar Farm will cause adverse noise impacts is low. However, it is nonetheless recommended that a compliance survey is undertaken once the solar farm is operational for verification purposes.

7 LIMITATIONS

This Report is provided by WSP Australia Pty Limited (*WSP*) for Urbis in response to specific instructions from the Client and in accordance with WSP's proposal PP140597 entitled *"Elaine and Shady Creek Solar Farms – Noise Impact Assessment Proposal"*, dated August 2022.

7.1 PERMITTED PURPOSE

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (*Permitted Purpose*).

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The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report or otherwise communicated to the Client.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (*Conclusions*) are based in whole or in part on information provided by the Client and other parties identified in the report (*Information)*, those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

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APPENDIX A

NOISE MONITORING RESULTS

NM01 monitoring summary – Sheet 1

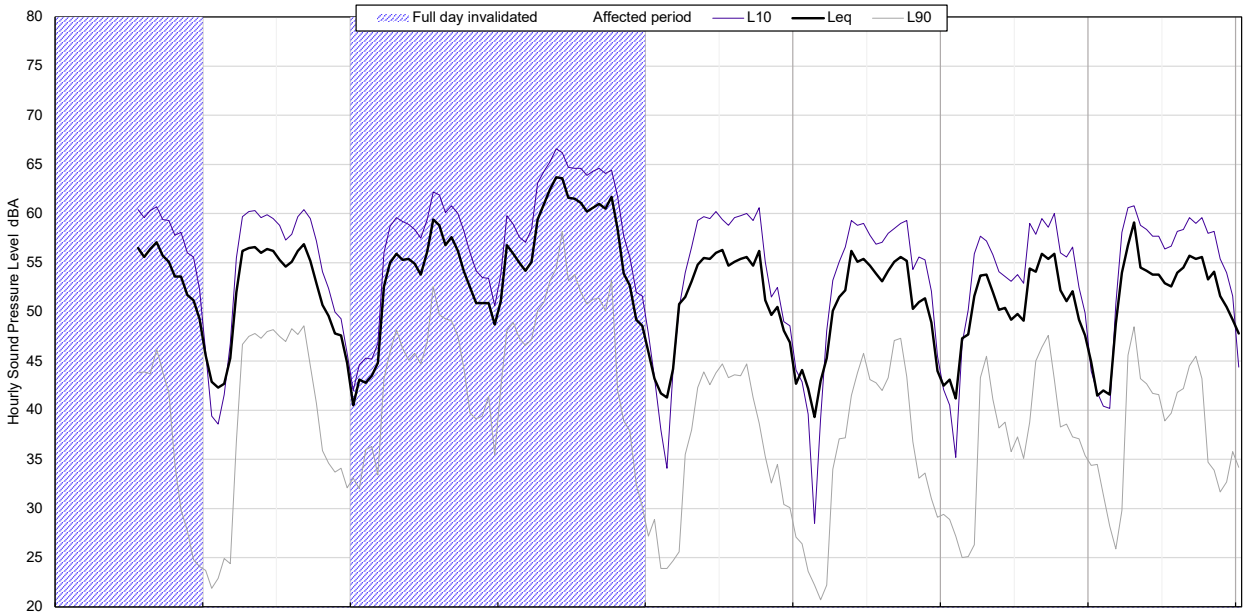
Project No.	PS206881	**Date**	18/09/2023	**Sheet**	1
Project Title	Elaine Solar Farm	**Engineer**	IC	**Rev**	1
Location	NM01			**Type**	LG

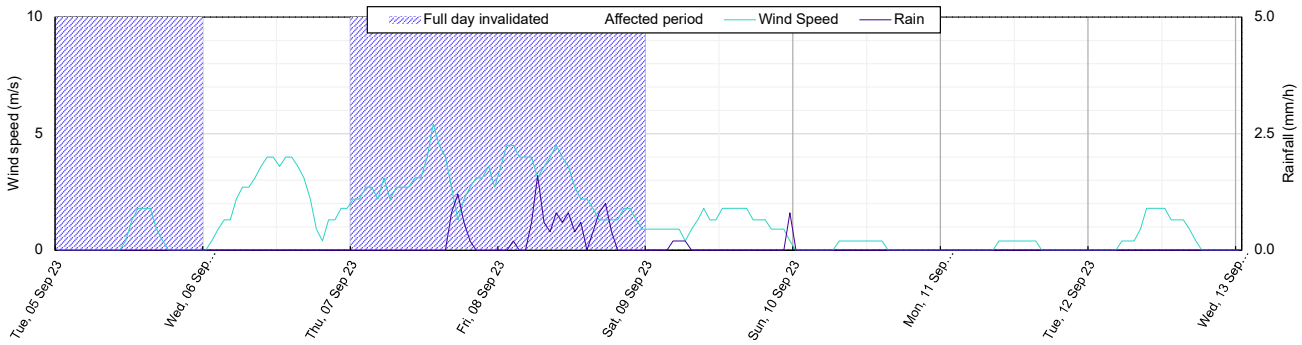
Address	5930 Midland Hwy
Microphone Position	Height: 1.2m Coordinates: 0.000000° E, 0.000000° S

		Tue, 05 Sep 2023			Wed, 06 Sep 2023			Thu, 07 Sep 2023			Fri, 08 Sep 2023			Sat, 09 Sep 2023			Sun, 10 Sep 2023			Mon, 11 Sep 2023			Tue, 12 Sep 2023		
		L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}
Daily Averages	$L_{A10,18h}$ (6am to 12am)	–			57			–			–			57			56			56			58		
	$L_{A10,12h}$ (6am to 6pm)	–			59			–			–			59			57			56			59		
	$L_{Aeq,15h}$ (7am to 10pm)		–			55			–			–			55			54			53			55	
	$L_{Aeq,16h}$ (6am to 10pm)		–			55			–			–			55			54			53			55	
	$L_{Aeq,9h}$ (10pm to 7am)		–			–			–			–			46			49			51			53	
	$L_{Aeq,8h}$ (10pm to 6am)		–			–			–			–			45			47			48			50	
	$L_{A90,Day}$ (7am to 6pm)			–			47			–			–			43			43			41			43
	$L_{A90,Evening}$ (6pm to 10pm)			–			36			–			–			35			37			39			36
	$L_{A90,Night}$ (10pm to 7am)			–			–			–			–			27			29			34			34
Hourly Values	00:00 to 01:00	–	–	–	46	46	24	*42*	*41*	*33*	*54*	*51*	*42*	48	46	27	44	43	27	42	43	29	44	45	34
	01:00 to 02:00	–	–	–	39	43	22	*45*	*43*	*32*	*60*	*57*	*48*	43	43	29	43	44	26	41	43	29	42	42	35
	02:00 to 03:00	–	–	–	39	42	23	*45*	*43*	*36*	*59*	*56*	*49*	38	42	24	40	42	24	35	41	27	40	42	31
	03:00 to 04:00	–	–	–	42	43	25	*45*	*44*	*36*	*58*	*55*	*47*	34	41	24	29	39	22	47	47	25	40	42	28
	04:00 to 05:00	–	–	–	47	45	24	*47*	*45*	*33*	*57*	*54*	*47*	*51 (44)*	*48 (44)*	*26 (25)*	39	43	21	50	48	25	51	49	26
	05:00 to 06:00	–	–	–	56	52	37	*56*	*53*	*43*	*58*	*55*	*47*	*57 (50)*	*53 (51)*	*32 (26)*	48	45	22	56	52	26	58	54	30
	06:00 to 07:00	–	–	–	60	56	47	*59*	*55*	*46*	*63*	*59*	*50*	*60 (54)*	*57 (52)*	*47 (36)*	53	50	34	58	54	43	61	57	46
	07:00 to 08:00	–	–	–	60	57	48	*60*	*56*	*48*	*64*	*61*	*51*	57	53	38	55	52	37	57	54	46	61	59	49
	08:00 to 09:00	–	–	–	60	57	48	*59*	*55*	*46*	*65*	*63*	*53*	59	55	42	57	52	37	56	52	41	59	55	43
	09:00 to 10:00	–	–	–	60	56	47	*59*	*55*	*45*	*67*	*64*	*54*	60	56	44	59	56	42	54	50	38	58	54	43
	10:00 to 11:00	–	–	–	60	56	48	*58*	*55*	*46*	*66*	*64*	*58*	60	55	43	59	55	44	54	50	39	58	54	42
	11:00 to 12:00	–	–	–	60	56	48	*58*	*54*	*45*	*65*	*62*	*53*	60	56	44	59	55	46	53	49	36	58	54	42
	12:00 to 13:00	–	–	–	59	55	48	*59*	*56*	*47*	*65*	*62*	*54*	59	56	45	58	55	43	54	50	37	56	53	39
	13:00 to 14:00	*60*	*57*	*44*	57	55	47	*62*	*59*	*53*	*65*	*61*	*52*	59	55	43	57	54	43	53	49	35	57	53	40
	14:00 to 15:00	*60*	*56*	*44*	58	55	48	*62*	*59*	*50*	*64*	*60*	*51*	60	55	44	57	53	42	59	54	39	58	54	42
	15:00 to 16:00	*60*	*56*	*44*	60	56	48	*60*	*57*	*49*	*64*	*61*	*51*	60	55	44	58	54	43	58	54	45	58	55	42
	16:00 to 17:00	*61*	*57*	*46*	60	57	49	*61*	*58*	*49*	*65*	*61*	*51*	60	56	45	59	55	47	60	56	46	60	56	45
	17:00 to 18:00	*59*	*56*	*44*	60	55	45	*60*	*56*	*48*	*64*	*61*	*50*	59	55	41	59	56	47	59	55	48	59	55	46
	18:00 to 19:00	*59*	*55*	*42*	57	53	41	*58*	*54*	*44*	*64*	*62*	*53*	61	56	39	59	55	43	60	56	43	60	56	43
	19:00 to 20:00	*58*	*54*	*35*	54	51	36	*56*	*53*	*40*	*62*	*58*	*42*	55	51	35	54	50	37	56	52	38	58	53	35
	20:00 to 21:00	*58*	*54*	*30*	52	50	35	*54*	*51*	*39*	*58*	*54*	*39*	52	50	33	56	51	33	56	51	39	58	54	34
	21:00 to 22:00	*56*	*52*	*28*	50	48	34	*54*	*51*	*39*	*56*	*53*	*38*	53	51	35	55	51	34	57	52	37	55	52	32
	22:00 to 23:00	*56*	*51*	*25*	49	48	34	*53*	*51*	*41*	*52*	*49*	*33*	49	48	30	52	49	31	53	49	37	54	51	33
	23:00 to 0:00	*52*	*49*	*24*	46	45	32	*51*	*49*	*36*	*52*	*49*	*30*	*50 (49)*	*47 (47)*	*34 (30)*	46	44	29	50	48	35	52	49	36

NOTE: Measurements affected by inclement weather (wind >5m/s or rain >0mm) or other extraneous factors have been discounted from measurement summaries. Affected periods lasting ≤3 hours have been interpolated, with original data displayed in parentheses. For affected periods lasting >3 hours, the entire day has been invalidated as indicated with asterisked data.

NM01 monitoring summary graph – Sheet 1





NM01 monitoring summary – Sheet 2

Project No.	PS206881	**Date**	18/09/2023	**Sheet**	2
Project Title	Elaine Solar Farm	**Engineer**	IC	**Rev**	1
Location	NM01			**Type**	LG

Address	5930 Midland Hwy
Microphone Position	Height: 1.2m Coordinates: 0.000000° E, 0.000000° S

		Wed, 13 Sep 2023			Thu, 14 Sep 2023			Fri, 15 Sep 2023			Sat, 16 Sep 2023			Sun, 17 Sep 2023			Mon, 18 Sep 2023			Tue, 19 Sep 2023			Wed, 20 Sep 2023		
		L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}
Daily Averages	$L_{A10,18h}$ (6am to 12am)	58			–			–			–			–			–			–			–		
	$L_{A10,12h}$ (6am to 6pm)	59			–			–			–			–			–			–			–		
	$L_{Aeq,15h}$ (7am to 10pm)		55			–			–			–			–			–			–			–	
	$L_{Aeq,16h}$ (6am to 10pm)		56			–			–			–			–			–			–			–	
	$L_{Aeq,9h}$ (10pm to 7am)		–			–			–			–			–			–			–			–	
	$L_{Aeq,8h}$ (10pm to 6am)		–			–			–			–			–			–			–			–	
	$L_{A90,Day}$ (7am to 6pm)			43			–			–			–			–			–			–			–
	$L_{A90,Evening}$ (6pm to 10pm)			39			–			–			–			–			–			–			–
	$L_{A90,Night}$ (10pm to 7am)			–			–			–			–			–			–			–			–
Hourly Values	00:00 to 01:00	44	48	34	*45*	*46*	*28*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	01:00 to 02:00	43	45	31	*41*	*43*	*27*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	02:00 to 03:00	43	44	30	*46*	*47*	*27*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	03:00 to 04:00	41	48	27	*39*	*43*	*27*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	04:00 to 05:00	54	51	27	*55*	*52*	*26*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	05:00 to 06:00	60	56	35	*62*	*58*	*38*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	06:00 to 07:00	64	60	52	*65*	*61*	*49*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	07:00 to 08:00	62	59	52	*64*	*60*	*50*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	08:00 to 09:00	58	54	43	*59*	*55*	*46*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	09:00 to 10:00	57	53	40	*58*	*54*	*45*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	10:00 to 11:00	57	53	39	*58*	*54*	*43*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	11:00 to 12:00	57	52	36	*57*	*53*	*42*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	12:00 to 13:00	56	52	38	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	13:00 to 14:00	57	53	36	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	14:00 to 15:00	58	55	42	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	15:00 to 16:00	59	55	46	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	16:00 to 17:00	61	58	49	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	17:00 to 18:00	63	59	49	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	18:00 to 19:00	61	57	45	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	19:00 to 20:00	59	55	41	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	20:00 to 21:00	57	52	36	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	21:00 to 22:00	57	53	34	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	22:00 to 23:00	55	52	33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	23:00 to 0:00	52	48	31	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

NOTE: Measurements affected by inclement weather (wind >5m/s or rain >0mm) or other extraneous factors have been discounted from measurement summaries. Affected periods lasting ≤3 hours have been interpolated, with original data displayed in parentheses. For affected periods lasting >3 hours, the entire day has been invalidated as indicated with asterisked data.

NM01 monitoring summary graph – Sheet 2

APPENDIX B

NOISE CHARACTER CALCULATIONS

1.1 Low frequency noise threshold calculations

An assessment of tonality and low frequency noise was conducted on the received noise levels at the nearest receivers to the Project.

Low frequency noise emissions from the Project have been assessed by comparing the frequency spectra to the relevant EPA outdoor threshold levels, as defined in Section 3.5 of the report. Note that emission detail is limited to 25Hz to 160Hz, for the purposes of assessing low frequency noise.

This assessment was applied to the nearest NSAs, which are expected to experience noise levels at potentially audible levels.

The results are presented in Table 1.

Table 1 Low frequency noise assessment (unmitigated) – one third octave band assessment

Receiver	Component	Outdoor Low Frequency Received Noise levels, L_{eq} dB								
		25Hz dB	31.5Hz dB	40Hz dB	50Hz dB	63Hz dB	80Hz dB	100Hz dB	125Hz dB	160Hz dB
EPA 1996 Threshold level		***69***	***61***	***54***	***50***	***50***	***48***	***48***	***46***	***44***
11 Betsons Rd	LAeq	-15.4	-9.8	-7.7	-1.3	1.4	6.2	8.1	5.8	5.3
	Lin	29.4	29.7	26.8	29.0	27.6	28.6	27.2	22.0	18.5
	LFN extent	BELOW THRESHOLD VALUE								
16 Mt Doran-Egerton Rd	LAeq	-14.1	-9	-6.9	-0.4	2.2	7	8.5	6.3	5.8
	Lin	30.7	30.5	27.6	29.9	28.4	29.4	27.6	22.5	19.0
	LFN extent	BELOW THRESHOLD VALUE								
33 Betsons Rd	LAeq	-16.8	-11.1	-8.7	-2.4	0.7	5.6	7.6	5.2	4.7
	Lin	28.0	28.4	25.8	27.9	26.9	28.0	26.7	21.4	17.9
	LFN extent	BELOW THRESHOLD VALUE								
51 Betsons Rd	LAeq	-17.6	-11.9	-9.5	-3.2	-0.1	4.7	6.6	4.2	3.7
	Lin	27.2	27.6	25.0	27.1	26.1	27.1	25.7	20.4	16.9
	LFN extent	BELOW THRESHOLD VALUE								
67 Pearsons Rd	LAeq	-15.3	-9.9	-7.6	-1.4	1.8	6.6	6.6	4.2	3.6
	Lin	29.5	29.6	26.9	28.9	28.0	29.0	25.7	20.4	16.8
	LFN extent	BELOW THRESHOLD VALUE								
68 Horsehill Rd	LAeq	-13.9	-8	-5.8	0.1	4.2	9.2	9.4	10	9.7
	Lin	30.9	31.5	28.7	30.4	30.4	31.6	28.5	26.2	22.9
	LFN extent	BELOW THRESHOLD VALUE								
78 Settlement Rd	LAeq	-25.3	-19.6	-17.2	-11	-7.9	-3.2	-2	-4	-5
	Lin	19.5	19.9	17.3	19.3	18.3	19.2	17.1	12.2	8.2
	LFN extent	BELOW THRESHOLD VALUE								
87 Fords Ln	LAeq	-17.2	-11.3	-9.1	-3.2	0.7	5.8	5.6	5.7	5.3
	Lin	27.6	28.2	25.4	27.1	26.9	28.2	24.7	21.9	18.5
	LFN extent	BELOW THRESHOLD VALUE								
89 Jordans Ln	LAeq	-24.2	-18.6	-16.1	-9.9	-6.9	-2.2	-0.8	-2.9	-3.8
	Lin	20.6	20.9	18.4	20.4	19.3	20.2	18.3	13.3	9.4
	LFN extent	BELOW THRESHOLD VALUE								
100 Horsehill Rd	LAeq	-17.8	-11.9	-9.7	-3.8	0.1	5.2	4.8	5.1	4.8
	Lin	27.0	27.6	24.8	26.5	26.3	27.6	23.9	21.3	18.0
	LFN extent	BELOW THRESHOLD VALUE								
108 Courts Rd	LAeq	-15.4	-9.9	-7.2	-0.5	1.8	6.6	8.1	6.6	6.2
	Lin	29.4	29.6	27.3	29.8	28.0	29.0	27.2	22.8	19.4
	LFN extent	BELOW THRESHOLD VALUE								

Receiver	Component	Outdoor Low Frequency Received Noise levels, L_{eq} dB								
		25Hz dB	31.5Hz dB	40Hz dB	50Hz dB	63Hz dB	80Hz dB	100Hz dB	125Hz dB	160Hz dB
146 Courts Rd	LAeq	-14.4	-8.8	-6.1	0.5	2.9	7.7	8.8	7.2	6.7
	Lin	30.4	30.7	28.4	30.8	29.1	30.1	27.9	23.4	19.9
	LFN extent	BELOW THRESHOLD VALUE								
154 Murphys Rd	LAeq	-15.1	-9.5	-6.8	-0.2	2.2	7	6.2	4.9	4.3
	Lin	29.7	30.0	27.7	30.1	28.4	29.4	25.3	21.1	17.5
	LFN extent	BELOW THRESHOLD VALUE								
205 Kingfisher Dr	LAeq	-20.7	-15.4	-12.3	-5.7	-4.5	0.1	1.9	-0.3	-1
	Lin	24.1	24.1	22.2	24.6	21.7	22.5	21.0	15.9	12.2
	LFN extent	BELOW THRESHOLD VALUE								
430 Settlement Rd	LAeq	-17.9	-12.2	-9.8	-3.5	-0.4	4.5	6.8	4.3	3.8
	Lin	26.9	27.3	24.7	26.8	25.8	26.9	25.9	20.5	17.0
	LFN extent	BELOW THRESHOLD VALUE								
440 Horsehill North Rd	LAeq	-24	-18.1	-16	-10.1	-6.2	-1.3	-2.5	-1.9	-2.6
	Lin	20.8	21.4	18.5	20.2	20.0	21.1	16.6	14.3	10.6
	LFN extent	BELOW THRESHOLD VALUE								
544 Settlement Rd	LAeq	-14.5	-9.1	-6.9	-0.5	2.2	7	8.9	6.6	6.1
	Lin	30.3	30.4	27.6	29.8	28.4	29.4	28.0	22.8	19.3
	LFN extent	BELOW THRESHOLD VALUE								
620 Mt Doran Rd	LAeq	-26.9	-21.1	-18.9	-13	-9.4	-4.6	-2.5	-5.6	-6.5
	Lin	17.9	18.4	15.6	17.3	16.8	17.8	16.6	10.6	6.7
	LFN extent	BELOW THRESHOLD VALUE								
5328 Midland Hwy	LAeq	-24.4	-18.6	-16.3	-10.2	-6.9	-2.1	-1.3	-2.9	-3.8
	Lin	20.4	20.9	18.2	20.1	19.3	20.3	17.8	13.3	9.4
	LFN extent	BELOW THRESHOLD VALUE								
5621 Midland Hwy	LAeq	-17.5	-11.7	-9.5	-3.5	0.3	5.3	4.6	4.1	3.6
	Lin	27.3	27.8	25.0	26.8	26.5	27.7	23.7	20.3	16.8
	LFN extent	BELOW THRESHOLD VALUE								
5876 Midland Hwy	LAeq	-13.4	-7.5	-5.3	0.7	4.5	9.6	10	10	9.7
	Lin	31.4	32.0	29.2	31.0	30.7	32.0	29.1	26.2	22.9
	LFN extent	BELOW THRESHOLD VALUE								
5930 Midland Hwy	LAeq	-15.9	-10.1	-7.8	-1.7	1.9	6.9	7.4	6.8	6.4
	Lin	28.9	29.4	26.7	28.6	28.1	29.3	26.5	23.0	19.6
	LFN extent	BELOW THRESHOLD VALUE								
6240 Midland Hwy	LAeq	-23.4	-17.6	-15.3	-9.1	-5.9	-1.1	0	-1.8	-2.6
	Lin	21.4	21.9	19.2	21.2	20.3	21.3	19.1	14.4	10.6
	LFN extent	BELOW THRESHOLD VALUE								
Elaine-Blue Bridge Rd	LAeq	-17.9	-12.3	-9.7	-3.3	-0.5	4.4	6.6	4.3	3.8
	Lin	26.9	27.2	24.8	27.0	25.7	26.8	25.7	20.5	17.0
	LFN extent	BELOW THRESHOLD VALUE								
Unknown 1, West of Midland Hwy	LAeq	-13.7	-8	-5.7	0.2	3.5	8.4	7.3	6.4	5.9
	Lin	31.1	31.5	28.8	30.5	29.7	30.8	26.4	22.6	19.1
	LFN extent	BELOW THRESHOLD VALUE								

1.2 Tonality threshold calculations

An assessment of tonality was conducted on the received noise levels at the nearest NSAs to the Project.

Tonality from the Project has been assessed by comparing the received frequency spectra to the relevant EPA outdoor threshold levels, as defined in Section 3.5 of the report.

The results are presented in Table 2.

Table 2 Tonality assessment (unmitigated) – one third octave band assessment

Receiver	One third octave predicted noise level, L_{eq} dB																							
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
11 Betsons Rd																								
LAeq	-15.4	-9.8	-7.7	-1.3	1.4	6.2	8.1	5.8	5.3	10.8	17.9	16.3	18.4	16	13.6	16.9	15.3	10	9.2	3	-3.6	-7	-40.4	-70.5
Bei		1.8	-2.2	1.9	-1.1	1.5	2.1	-0.9	-3.0	-0.8	4.4	-1.9	2.3	0.0	-2.9	2.5	1.9	-2.3	2.7	0.2	-1.6	15.0	-1.7	3.6
TFi		0	0	0	0	0	0	0	0	0	8.2	0	0	0	0	0	0	0	0	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	1.4	6.2	8.1	5.8	5.3	10.8	18.3	16.3	18.4	16.0	13.6	16.9	15.3	10.0	9.2	3.0	0.0	0.0	0.0	0.0
Original LAeq	26																							
Corrected LAeq	26																							
Difference	0.1	0 dB correction				26																		
16 Mt Doran-Egerton Rd																								
LAeq	-14.1	-9	-6.9	-0.4	2.2	7	8.5	6.3	5.8	11.2	18.3	16.7	19.2	16.8	14.4	18	16.5	11.4	10.6	4.7	-1.7	-4.7	-37.9	-67.5
Bei		1.5	-2.2	2.0	-1.1	1.7	1.9	-0.9	-3.0	-0.9	4.4	-2.1	2.5	0.0	-3.0	2.6	1.8	-2.2	2.6	0.3	-1.7	15.1	-1.8	3.2
TFi		0	0	0	0	0	0	0	0	0	8.2	0	0	0	0	0	0	0	0	0	0	21.625	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	2.2	7.0	8.5	6.3	5.8	11.2	18.7	16.7	19.2	16.8	14.4	18.0	16.5	11.4	10.6	4.7	0.0	21.6	0.0	0.0
Original LAeq	26																							
Corrected LAeq	28																							
Difference	1.3	2 dB correction				28																		
33 Betsons Rd																								
LAeq	-16.8	-11.1	-8.7	-2.4	0.7	5.6	7.6	5.2	4.7	10.3	16.8	15.7	17.9	15.4	12.9	16.2	14.5	9.1	8.1	1.8	-5	-8.7	-43.4	-74.4
Bei		1.7	-2.0	1.6	-0.9	1.5	2.2	-1.0	-3.1	-0.4	3.8	-1.7	2.4	0.0	-2.9	2.5	1.9	-2.2	2.7	0.3	-1.6	15.5	-1.8	3.9
TFi		0	0	0	0	0	0	0	0	0	7.5	0	0	0	0	0	0	0	0	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.7	5.6	7.6	5.2	4.7	10.3	17.3	15.7	17.9	15.4	12.9	16.2	14.5	9.1	8.1	1.8	0.0	0.0	0.0	0.0
Original LAeq	25																							
Corrected LAeq	25																							
Difference	0.1	0 dB correction				25																		

Receiver	One third octave predicted noise level, L_{eq} dB																						
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
51 Betsons Rd																								
LAeq	-17.6	-11.9	-9.5	-3.2	-0.1	4.7	6.6	4.2	3.7	9.2	16	14.6	16.6	14.1	11.5	14.7	12.8	7.3	5.8	-1.1	-8.3	-13.5	-50.9	-85.7
Bei		1.7	-2.0	1.6	-0.9	1.5	2.2	-1.0	-3.0	-0.7	4.1	-1.7	2.3	0.0	-2.9	2.6	1.8	-2.0	2.7	0.2	-1.0	16.1	-1.3	-60.3
TFi		0	0	0	0	0	0	0	0	0	7.9	0	0	0	0	0	0	0	0	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	4.7	6.6	4.2	3.7	9.2	16.6	14.6	16.6	14.1	11.5	14.7	12.8	7.3	5.8	0.0	0.0	0.0	0.0	0.0
Original LAeq	24																							
Corrected LAeq	56																							
Difference	32.6	5 dB correction				29																		
67 Pearsons Rd																								
LAeq	-15.3	-9.9	-7.6	-1.4	1.8	6.6	6.6	4.2	3.6	7.7	14.3	12.8	16.9	14	11.3	15.5	13.3	7.2	4.7	-3.4	-13.2	-21.9	-64.9	-108.4
Bei		1.6	-2.0	1.5	-0.8	2.4	1.2	-0.9	-2.4	-1.3	4.1	-2.8	3.5	-0.1	-3.5	3.2	2.0	-1.8	2.8	0.9	-0.6	17.2	0.3	-76.0
TFi		0	0	0	0	0	0	0	0	0	7.8	0	7.125	0	0	6.75	0	0	0	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	1.8	6.6	6.6	4.2	3.6	7.7	15.2	12.8	17.3	14.0	11.3	16.0	13.3	7.2	4.7	0.0	0.0	0.0	0.0	0.0
Original LAeq	23																							
Corrected LAeq	71																							
Difference	47.0	5 dB correction				28																		
68 Horsehill Rd																								
LAeq	-13.9	-8	-5.8	0.1	4.2	9.2	9.4	10	9.7	14.9	19.1	21.5	23.9	22	19.3	23.4	22.4	18.6	19.4	17.3	17.7	24.8	4.9	-0.5
Bei		1.9	-1.9	0.9	-0.4	2.4	-0.2	0.4	-2.8	0.5	0.9	0.0	2.2	0.4	-3.4	2.6	1.4	-2.3	1.5	-1.3	-3.4	13.5	-7.3	-3.3
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19.625	0	0
Corrected LAeq	0.0	0.0	0.0	0.1	4.2	9.2	9.4	10.0	9.7	14.9	19.1	21.5	23.9	22.0	19.3	23.4	22.4	18.6	19.4	17.3	17.7	26.0	4.9	0.0
Original LAeq	32																							
Corrected LAeq	33																							
Difference	0.2	0 dB correction				32																		

Receiver	One third octave predicted noise level, L_{eq} dB																						
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
78 Settlement Rd																								
LAeq	-25.3	-19.6	-17.2	-11	-7.9	-3.2	-2	-4	-5	0	5.7	4.1	5.3	2.3	-1.7	0.2	-3.8	-12.5	-19	-33.1	-51	-71.1	0	0
Bei		1.7	-1.9	1.6	-0.8	1.8	1.6	-0.5	-3.0	-0.4	3.7	-1.4	2.1	0.5	-3.0	3.0	2.4	-1.1	3.8	1.9	1.1	-45.6	35.6	0.0
TFi		0	0	0	0	0	0	0	0	0	7.3	0	0	0	0	0	0	0	7.5	0	0	0	47.1875	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	4.1	5.3	2.3	0.0	0.2	0.0	0.0	7.5	0.0	0.0	0.0	47.2	0.0
Original LAeq	12																							
Corrected LAeq	47																							
Difference	35.2	5 dB correction				17																		
87 Fords Ln																								
LAeq	-17.2	-11.3	-9.1	-3.2	0.7	5.8	5.6	5.7	5.3	10.7	15	16.6	18.9	17.2	14.1	18.3	16.9	12.7	12.9	9.7	8	11.9	-12.7	-24.9
Bei		1.9	-1.9	1.0	-0.6	2.7	-0.2	0.3	-2.9	0.5	1.4	-0.3	2.0	0.7	-3.7	2.8	1.4	-2.2	1.7	-0.8	-2.8	14.3	-6.2	-1.6
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20.6	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.7	5.8	5.6	5.7	5.3	10.7	15.0	16.6	18.9	17.2	14.1	18.3	16.9	12.7	12.9	9.7	8.0	21.1	0.0	0.0
Original LAeq	27																							
Corrected LAeq	27																							
Difference	1.0	2 dB correction				29																		
89 Jordans Ln																								
LAeq	-24.2	-18.6	-16.1	-9.9	-6.9	-2.2	-0.8	-2.9	-3.8	1.3	7.5	5.7	6.9	4	0.3	2.3	-1.5	-9.7	-15.5	-29	-46.8	-67.7	0	0
Bei		1.6	-1.9	1.6	-0.9	1.7	1.8	-0.6	-3.0	-0.6	4.0	-1.5	2.1	0.4	-2.9	2.9	2.2	-1.2	3.9	2.2	1.6	-44.3	33.9	0.0
TFi		0	0	0	0	0	0	0	0	0	7.8	0	0	0	0	0	0	0	7.6	0	0	0	45.1	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	10.6	5.7	6.9	4.0	0.3	2.3	0.0	0.0	7.6	0.0	0.0	0.0	45.1	0.0
Original LAeq	14																							
Corrected LAeq	45																							
Difference	31.2	5 dB correction				19																		

Receiver	One third octave predicted noise level, L_{eq} dB																						
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
100 Horsehill Rd																								
LAeq	-17.8	-11.9	-9.7	-3.8	0.1	5.2	4.8	5.1	4.8	10.2	14.3	16.3	19.5	17.7	15.7	20.4	19.1	14.8	14.7	11	8.6	11.3	-15.7	-32.1
Bei		1.9	-1.9	1.0	-0.6	2.8	-0.4	0.3	-2.9	0.6	1.1	-0.6	2.5	0.1	-3.4	3.0	1.5	-2.1	1.8	-0.6	-2.6	14.9	-5.3	-0.4
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.3	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.1	5.2	4.8	5.1	4.8	10.2	14.3	16.3	19.5	17.7	15.7	20.4	19.1	14.8	14.7	11.0	8.6	21.7	0.0	0.0
Original LAeq	28																							
Corrected LAeq	28																							
Difference	0.9	2 dB correction				30																		
108 Courts Rd																								
LAeq	-15.4	-9.9	-7.2	-0.5	1.8	6.6	8.1	6.6	6.2	11.8	18.8	17.5	19.5	17.5	15	18.4	16.9	11.9	11.2	5.9	0.9	0.4	-30.6	-53.2
Bei		1.4	-2.0	2.2	-1.3	1.7	1.5	-0.6	-3.0	-0.7	4.2	-1.7	2.0	0.3	-3.0	2.5	1.8	-2.2	2.3	-0.1	-2.3	15.3	-4.2	0.8
TFi		0	0	0	0	0	0	0	0	0	7.9	0	0	0	0	0	0	0	0	0	0	21.8	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	1.8	6.6	8.1	6.6	6.2	11.8	19.1	17.5	19.5	17.5	15.0	18.4	16.9	11.9	11.2	5.9	0.9	21.8	0.0	0.0
Original LAeq	27																							
Corrected LAeq	28																							
Difference	1.2	2 dB correction				29																		
146 Courts Rd																								
LAeq	-14.4	-8.8	-6.1	0.5	2.9	7.7	8.8	7.2	6.7	12.1	19.3	17.9	20.2	18.1	15.8	19.5	18.1	13.3	12.8	7.7	3	2.6	-29.7	-53.6
Bei		1.5	-2.0	2.1	-1.2	1.9	1.4	-0.6	-3.0	-0.9	4.3	-1.9	2.2	0.1	-3.0	2.6	1.7	-2.2	2.3	-0.2	-2.2	16.0	-4.2	0.8
TFi		0	0	0	0	0	0	0	0	0	8.1	0	0	0	0	0	0	0	0	0	0	22.7	0	0
Corrected LAeq	0.0	0.0	0.0	0.5	2.9	7.7	8.8	7.2	6.7	12.1	19.6	17.9	20.2	18.1	15.8	19.5	18.1	13.3	12.8	7.7	3.0	22.7	0.0	0.0
Original LAeq	28																							
Corrected LAeq	29																							
Difference	1.2	2 dB correction				30																		

Receiver	One third octave predicted noise level, L_{eq} dB																						
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
154 Murphys Rd																								
LAeq	-15.1	-9.5	-6.8	-0.2	2.2	7	6.2	4.9	4.3	8.7	15.3	14	17.4	14.8	12	16.2	13.9	7.9	5.5	-2.5	-12	-19.8	-61.3	-99.7
Bei		1.5	-2.0	2.1	-1.2	2.8	0.3	-0.4	-2.5	-1.1	4.0	-2.4	3.0	0.1	-3.5	3.3	1.9	-1.8	2.8	0.8	-0.9	16.9	-1.6	-69.1
TFi		0	0	0	0	0	0	0	0	0	7.7	0	0	0	0	6.8	0	0	0	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	2.2	7.0	6.2	4.9	4.3	8.7	16.0	14.0	17.4	14.8	12.0	16.7	13.9	7.9	5.5	0.0	0.0	0.0	0.0	0.0
Original LAeq	24																							
Corrected LAeq	65																							
Difference	40.9	5 dB correction				29																		
205 Kingfisher Dr																								
LAeq	-20.7	-15.4	-12.3	-5.7	-4.5	0.1	1.9	-0.3	-1	4.2	11.2	9	10.3	7.6	4.5	7.2	4.3	-2.7	-5.9	-15.4	-28.6	-42.5	-93.9	0
Bei		1.1	-1.8	2.7	-1.7	1.4	2.0	-0.8	-3.0	-0.9	4.6	-1.8	2.0	0.2	-2.9	2.8	2.1	-1.9	3.2	1.9	0.3	18.8	-72.7	47.0
TFi		0	0	0	0	0	0	0	0	0	8.5	0	0	0	0	0	0	0	6.7	0	0	0	0	61.4
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	0.1	1.9	0.0	0.0	4.2	13.1	9.0	10.3	7.6	4.5	7.2	4.3	0.0	6.9	0.0	0.0	0.0	0.0	61.4
Original LAeq	18																							
Corrected LAeq	61																							
Difference	49.3	5 dB correction				23																		
430 Settlement Rd																								
LAeq	-17.9	-12.2	-9.8	-3.5	-0.4	4.5	6.8	4.3	3.8	9.5	16.1	14.9	16.6	14.2	11.6	14.8	12.9	7.4	6	-0.5	-6.5	-11.3	-48.7	-82.9
Bei		1.7	-2.0	1.6	-0.9	1.3	2.4	-1.0	-3.1	-0.5	3.9	-1.5	2.1	0.1	-2.9	2.6	1.8	-2.1	2.6	-0.3	-0.6	16.3	-1.6	-58.6
TFi		0	0	0	0	0	0	0	0	0	7.6	0	0	0	0	0	0	0	0	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	4.5	6.8	4.3	3.8	9.5	16.7	14.9	16.6	14.2	11.6	14.8	12.9	7.4	6.0	0.0	0.0	0.0	0.0	0.0
Original LAeq	24																							
Corrected LAeq	55																							
Difference	30.7	5 dB correction				29																		

Receiver	One third octave predicted noise level, L_{eq} dB																						
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
440 Horsehill North Rd																								
LAeq	-24	-18.1	-16	-10.1	-6.2	-1.3	-2.5	-1.9	-2.6	2.4	6	7.5	9.5	7.1	3.4	6.8	4.2	-1.9	-4.7	-12.4	-20.5	-26.1	-65.3	-99.9
Bei		1.9	-1.9	1.0	-0.5	3.1	-0.9	0.7	-2.9	0.7	1.1	-0.3	2.2	0.6	-3.6	3.0	1.8	-1.7	2.5	0.2	-1.3	16.8	-2.3	-67.3
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	6.0	7.5	9.5	7.1	3.4	6.8	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Original LAeq	16																							
Corrected LAeq	65																							
Difference	49.3	5 dB correction				21																		
544 Settlement Rd																								
LAeq	-14.5	-9.1	-6.9	-0.5	2.2	7	8.9	6.6	6.1	11.7	18.8	17.3	19.5	17.1	14.7	18.1	16.8	11.7	11.1	5.4	-0.6	-2.9	-34.6	-62.5
Bei		1.6	-2.1	1.9	-1.1	1.5	2.1	-0.9	-3.1	-0.8	4.3	-1.9	2.3	0.0	-2.9	2.4	1.9	-2.3	2.6	0.2	-1.9	14.7	-1.9	2.8
TFi		0	0	0	0	0	0	0	0	0	8.1	0	0	0	0	0	0	0	0	0	0	21.1	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	2.2	7.0	8.9	6.6	6.1	11.7	19.2	17.3	19.5	17.1	14.7	18.1	16.8	11.7	11.1	5.4	0.0	21.1	0.0	0.0
Original LAeq	27																							
Corrected LAeq	28																							
Difference	1.1	2 dB correction				29																		
620 Mt Doran Rd																								
LAeq	-26.9	-21.1	-18.9	-13	-9.4	-4.6	-2.5	-5.6	-6.5	-1.6	1.9	2.4	3.7	0	-3.6	-1.3	-5.5	-14.1	-20.7	-35.2	-54.6	-78.8	0	0
Bei		1.8	-1.9	1.2	-0.6	1.4	2.6	-1.1	-2.9	0.7	1.5	-0.4	2.5	-0.1	-3.0	3.3	2.2	-1.0	4.0	2.5	2.4	-51.5	39.4	0.0
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.8	0	0	7.7	0	0	0	52	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	2.4	3.7	0.0	0.0	7.4	0.0	0.0	7.7	0.0	0.0	0.0	52.0	0.0
Original LAeq	10																							
Corrected LAeq	52																							
Difference	42.3	5 dB correction				15																		

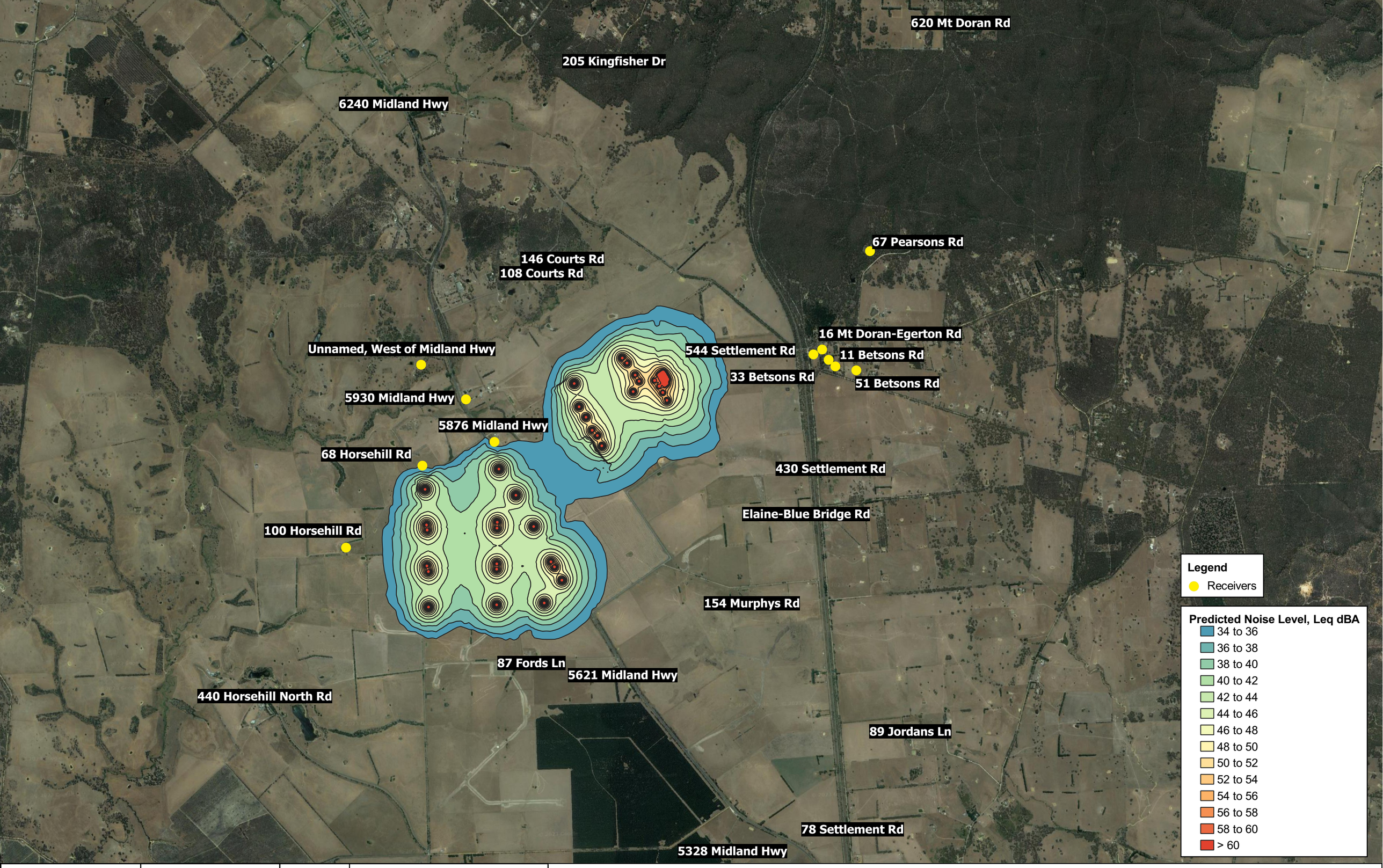
Receiver	One third octave predicted noise level, L_{eq} dB																						
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
5328 Midland Hwy																								
LAeq	-24.4	-18.6	-16.3	-10.2	-6.9	-2.1	-1.3	-2.9	-3.8	1.1	6.4	5.5	6.8	3.9	0	2.3	-1.5	-9.4	-15	-26.7	-40.9	-55.6	-108.6	0
Bei		1.8	-1.9	1.4	-0.8	2.0	1.2	-0.4	-2.9	-0.2	3.1	-1.1	2.1	0.5	-3.1	3.1	2.1	-1.2	3.1	1.3	0.3	19.2	-80.8	54.3
TFi		0	0	0	0	0	0	0	0	0	6.6	0	0	0	0	0	0	0	0	0	0	0	0	70.6
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	9.5	5.5	6.8	3.9	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.6
Original LAeq	13																							
Corrected LAeq	71																							
Difference	57.3	5 dB correction				18																		
5621 Midland Hwy																								
LAeq	-17.5	-11.7	-9.5	-3.5	0.3	5.3	4.6	4.1	3.6	8.6	13.5	14.1	17.3	14.9	11.9	15.7	13.6	8.4	6.9	1.4	-3.2	-3.1	-33.4	-54.4
Bei		1.8	-1.9	1.1	-0.6	2.9	-0.1	0.0	-2.8	0.0	2.2	-1.3	2.8	0.3	-3.4	3.0	1.6	-1.9	2.0	-0.5	-2.4	15.2	-4.7	0.6
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.8	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.3	5.3	4.6	4.1	3.6	8.6	13.5	14.1	17.3	14.9	11.9	15.7	13.6	8.4	6.9	1.4	0.0	21.8	0.0	0.0
Original LAeq	24																							
Corrected LAeq	26																							
Difference	2.1	2 dB correction				26																		
5876 Midland Hwy																								
LAeq	-13.4	-7.5	-5.3	0.7	4.5	9.6	10	10	9.7	15.1	19.7	21.2	23.6	21.8	19	23.2	22.2	18.2	18.7	15.9	15.4	21.6	0.8	-5.8
Bei		1.9	-1.9	1.1	-0.6	2.4	0.2	0.2	-2.9	0.4	1.6	-0.4	2.1	0.5	-3.5	2.6	1.5	-2.3	1.7	-1.2	-3.4	13.5	-7.1	-2.9
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19.6	0	0
Corrected LAeq	0.0	0.0	0.0	0.7	4.5	9.6	10.0	10.0	9.7	15.1	19.7	21.2	23.6	21.8	19.0	23.2	22.2	18.2	18.7	15.9	15.4	23.7	0.8	0.0
Original LAeq	32																							
Corrected LAeq	32																							
Difference	0.3	0 dB correction				32																		

Receiver	One third octave predicted noise level, L_{eq} dB																						
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
5930 Midland Hwy																								
LAeq	-15.9	-10.1	-7.8	-1.7	1.9	6.9	7.4	6.8	6.4	11.9	17.3	17.6	19.7	17.7	14.8	18.5	16.9	12.1	11.4	6.5	3	4.6	-22.7	-38.6
Bei		1.8	-1.9	1.3	-0.7	2.3	0.6	-0.1	-3.0	0.0	2.6	-0.9	2.1	0.4	-3.3	2.7	1.6	-2.1	2.1	-0.7	-2.6	14.5	-5.7	-0.9
TFi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20.8	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	1.9	6.9	7.4	6.8	6.4	11.9	17.3	17.6	19.7	17.7	14.8	18.5	16.9	12.1	11.4	6.5	3.0	20.9	0.0	0.0
Original LAeq	27																							
Corrected LAeq	28																							
Difference	0.9	2 dB correction				29																		
6240 Midland Hwy																								
LAeq	-23.4	-17.6	-15.3	-9.1	-5.9	-1.1	0	-1.8	-2.6	2.5	8.6	7.1	8.4	5.6	2.2	4.4	0.9	-6.8	-11.8	-23.9	-39.4	-56.6	-113.6	0
Bei		1.8	-2.0	1.5	-0.8	1.9	1.5	-0.5	-3.0	-0.5	3.8	-1.4	2.1	0.3	-2.8	2.9	2.1	-1.4	3.6	1.7	0.9	19.9	-85.3	56.8
TFi		0	0	0	0	0	0	0	0	0	7.5	0	0	0	0	0	0	0	7.1875	0	0	0	0	73.75
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	11.1	7.1	8.4	5.6	2.2	4.4	0.9	0.0	7.2	0.0	0.0	0.0	0.0	73.8
Original LAeq	15																							
Corrected LAeq	74																							
Difference	58.6	5 dB correction				20																		
Elaine-Blue Bridge Rd																								
LAeq	-17.9	-12.3	-9.7	-3.3	-0.5	4.4	6.6	4.3	3.8	9.4	16.2	14.8	16.5	14.1	11.5	14.6	12.6	7	7	0.1	-7.4	-12.6	-50.8	-85.9
Bei		1.5	-1.9	1.8	-1.1	1.4	2.3	-0.9	-3.1	-0.6	4.1	-1.6	2.1	0.1	-2.9	2.6	1.8	-2.8	3.5	0.3	-1.2	16.5	-1.6	-60.5
TFi		0	0	0	0	0	0	0	0	0	7.9	0	0	0	0	0	0	0	7.1	0	0	0	0	0
Corrected LAeq	0.0	0.0	0.0	0.0	0.0	4.4	6.6	4.3	3.8	9.4	16.8	14.8	16.5	14.1	11.5	14.6	12.6	7.0	10.0	0.1	0.0	0.0	0.0	0.0
Original LAeq	24																							
Corrected LAeq	56																							
Difference	32.7	5 dB correction				29																		

Receiver	One third octave predicted noise level, L_{eq} dB																							
	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz
Unknown 1, West of Midland Hwy																								
LAeq	-13.7	-8	-5.7	0.2	3.5	8.4	7.3	6.4	5.9	10.4	15.9	15.9	20.2	17.7	15	18.9	16.9	11.6	10.3	4.2	-1.5	-3	-35.4	-59.4
Bei		1.7	-1.8	1.3	-0.8	3.0	-0.1	-0.2	-2.5	-0.5	2.8	-2.2	3.4	0.1	-3.3	3.0	1.7	-2.0	2.4	-0.2	-2.1	15.5	-4.2	1.4
TFi		0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	22.1	0	0
Corrected LAeq	0.0	0.0	0.0	0.2	3.5	8.4	7.3	6.4	5.9	10.4	15.9	15.9	20.4	17.7	15.0	18.9	16.9	11.6	10.3	4.2	0.0	22.1	0.0	0.0
Original LAeq	27																							
Corrected LAeq	28																							
Difference	1.7	2 dB correction				29																		

APPENDIX C

NOISE CONTOUR MAPS



Appendix C	Author: LE
Date: 27/09/2023	Approved by: BI

To be read in conjunction with PS206881 - Elaine Solar Farm

0 400 800 1,200 m

Map Source: MetroMaps

PS206881 - Elaine Solar Farm Noise Impact Assessment

Predicted Unmitigated Noise Levels (Day / Evening / Night)
(with +2 dB correction for modelling uncertainty)

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