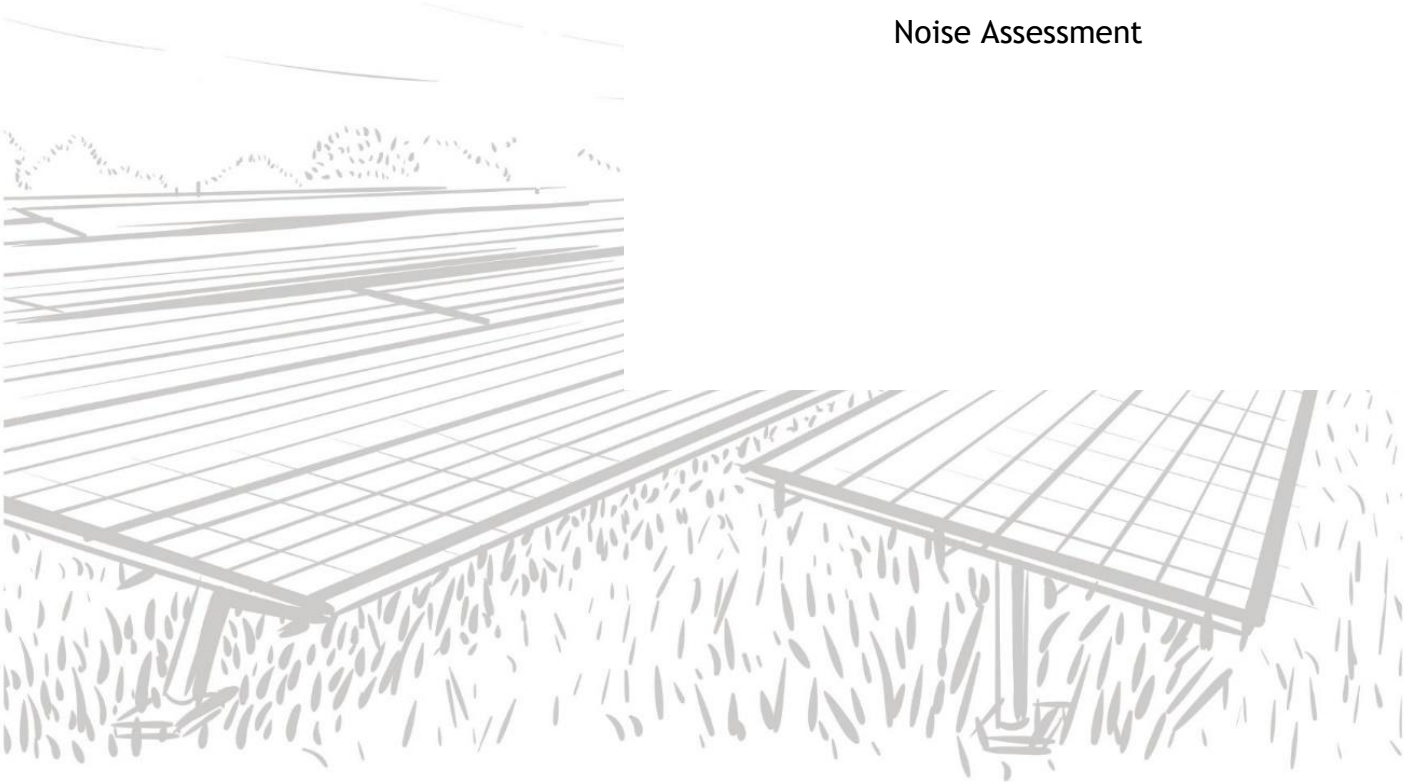
Appendix G

Noise Assessment



Noise Assessment

Tamworth Solar Farm
Somerton, NSW.

Prepared for: PROJECTe Pty Ltd
November 2019
MAC180684RP1R1

Muller Acoustic Consulting

Document Information

Noise Assessment

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CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by PROJECTe Pty Ltd (Pe) on behalf of Oriens Energy to complete a Noise Assessment (NA) for the proposed Tamworth Solar Farm near Somerton, NSW (the 'project'). This report presents the methodology and findings of the NA for the construction and operation of the project.

1.1 Purpose and Objectives

A NA is required as part of the Environmental Impact Statement (EIS) for the project. The purpose of the NA is to quantify potential environmental noise levels associated with the construction and operation of the project. Where impacts are identified, the assessment includes recommendations for potential noise mitigation and management measures.

1.2 Scope of the Assessment

The NA includes the following key tasks:

- review construction and operating activities to identify noise generating plant, equipment, machinery or activities proposed to be undertaken as part of the project;
- identify the closest and/or potentially most affected receivers situated within the area of influence to the project;
- establish existing noise levels to determine project-specific construction Noise Management Levels (NMLs), and operational noise criteria;
- undertake 3D noise modelling to predict levels that may occur as a result of the construction and operation of the project at the closest and/or potentially most affected receivers;
- provide a comparison of predicted noise levels against relevant construction NMLs and operational criteria;
- assess the potential noise impacts associated with construction and operational aspects of the project; and
- provide feasible and reasonable noise mitigation and management measures, and monitoring options, where NMLs or operational criteria may be exceeded.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A.**

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2 Project Description

2.1 Background

Oriens Energy proposes to construct and operate an 80 Megawatt (MW) DC solar farm using photovoltaic (PV) technology at Tamworth, 26km north west of Tamworth near the village of Somerton, NSW.

The project is located within the Tamworth Regional Council Local Government Area (LGA) and is approximately 10km south of the village of Somerton. The project site consists of approximately 226 hectares which is currently used for agriculture, specifically grazing. The solar farm will occupy up to 170 hectares of the project site.

2.2 Description of Proposed Construction Works

The project includes installation of groups of PV modules (approximately 2m x 1m panels) arranged in rows mounted on single axis trackers with a maximum height of approximately 4.5m above the natural ground level. An estimated 210,000 PV panels will be installed on a mounting structure comprising steel posts driven approximately 2.5m below ground using a small pile driver. Additional support structures would be attached to the piles, which would then support the PV panels.

Earthworks will primarily involve trenching which is required for cabling of each PV array/module to inverters, Battery Energy Storage System (BESS) and a substation. Construction of internal access tracks and other minor earthworks would be completed for the preparation of the site and in most cases a concrete slab would be required to support the ancillary infrastructure. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

It is anticipated that the solar farm would be constructed in one-hectare stages, with up to 10 stages in construction at any one time over a 10 to 12 month period during standard construction hours.

All vehicles would access the project from the Oxley Highway via Babbinboon Road and Warminster Road, an unsealed two-way road during the construction and operational phases.

During construction, traffic generated by the project would include employee and delivery vehicles. During the peak construction period, the traffic volume is expected to be up to 20 heavy vehicles (mostly semi-trailers) and 70 light commercial vehicles or mini buses for worker transport per day.

2.3 Description of Proposed Operation

PV infrastructure on site will comprise of groups of PV panels located above ground with a 20m set back from the site boundaries. The PV infrastructure will be mounted on support structures attached to the driven galvanized steel posts. Electrical cabling would be attached beneath the modules and would connect the individual PV modules to each other. Power Conversion Units (PCU) will be located centrally to groups of PV panels that will be connected to each other by underground cables. The PV modules will be on a single axis tracker system which will follow the sun and move in an east to west direction.

The project will be contained solely within the site, including areas required for stockpiling and materials laydown during construction as shown in Figure 1.

The project would operate 24 hours a day, 7 days a week, which would involve the presence of staff on-site and would typically see minimal plant and equipment operating on site. During operation, the PV panels would generate electricity which would be transferred into the power grid via the substation. Key noise emissions from the operation of the project are associated with the inverter and transformer components of the substation. It is noted that emissions from these sources are anticipated to be acoustically insignificant compared to ambient background noise levels at assessed receivers.

When required, maintenance activities will be undertaken during standard working hours (except for emergencies) and are expected to include:

- panel cleaning;
- repairs or replacement of infrastructure, as required; and
- land management including mowing to control vegetation as required.

Typical noise sources associated with maintenance activities would include light vehicles movements on site and maintenance of equipment.

2.4 Potentially Sensitive Receivers

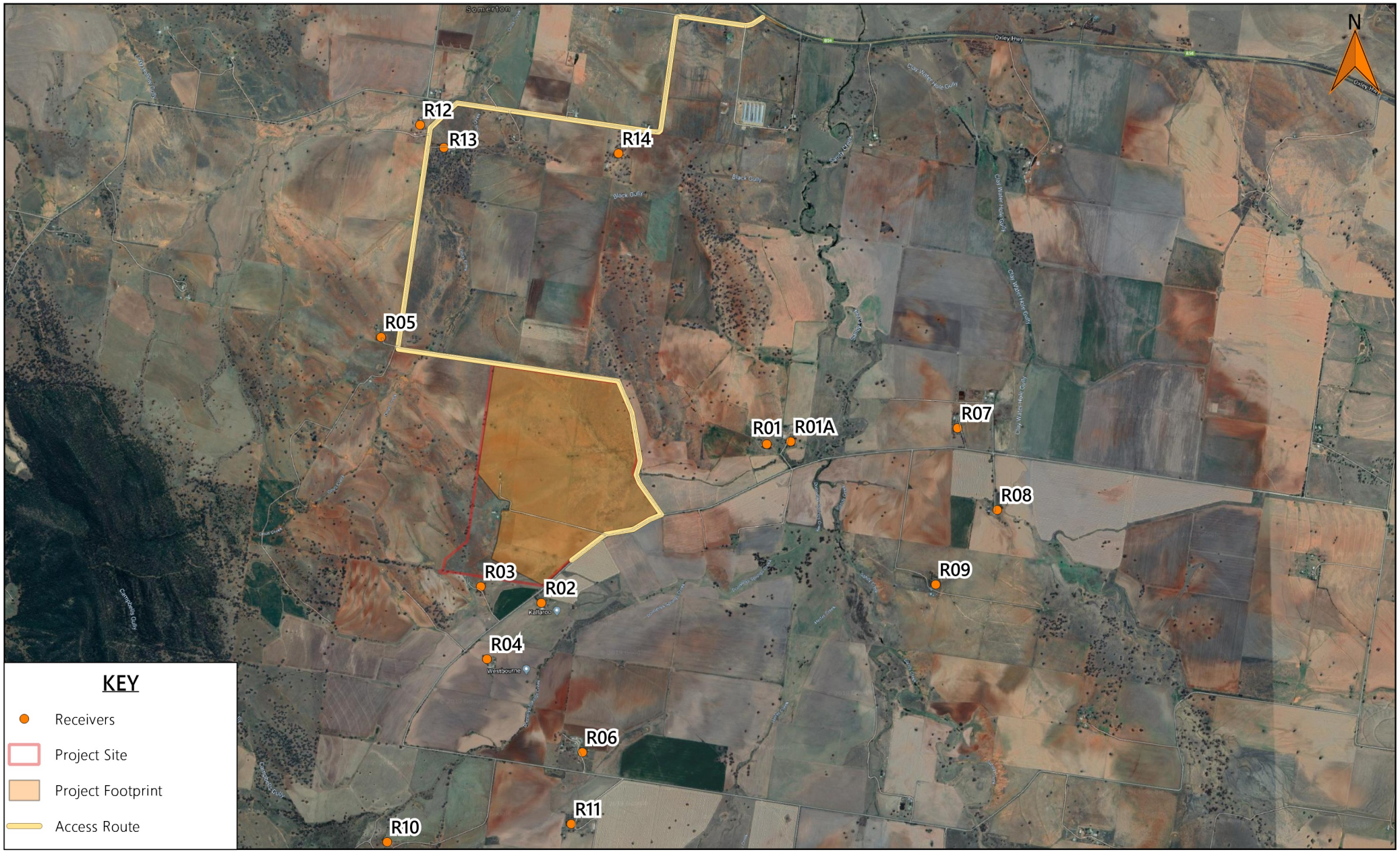
From review of aerial imagery and associated project information, MAC has identified the following potentially sensitive receivers that may be affected by noise from operations, construction activities and related road traffic. **Table 1** presents a summary of receiver identification, address and coordinates are presented in **Figure 1.**

Table 1 Noise Sensitive Receivers

ID	Type	Description/ Address	Coordinates (MGA 55)		Distance (m) from Project
			Easting	Northing	Footprint and Direction
R01	Rural	Lot 176-DP755340	276945	6568046	1100 East
R01A	Rural	Lot 176-DP755340	277152	6568069	1300 East
R02	Rural	2134 Soldiers Settlement Road	274994	6566671	160 South
R03	Rural	Lot 21-DP719649	274470	6566813	260 South
R04	Rural	2050 Soldiers Settlement Road	274524	6566184	780 South
R05	Rural	222 Warminster Road	273607	6568972	1000 West
R06	Rural	Lot 2-DP579848	275349	6565377	1500 South
R07	Rural	390 Prices Road Bective	278595	6568185	2800 East
R08	Rural	367 Prices Road Bective	278939	6567476	2900 East
R09	Rural	Lot 176-DP755319	278407	6566830	2400 East
R10	Rural	1871 Soldiers Settlement Road	273660	6564600	2600 South
R11	Rural	1761 Soldiers Settlement Road	275252	6564757	2000 South
R12	Rural	38 Warminster Road	273945	6570810	2200 North West
R13	Rural	49 Warminster Road	274150	6570613	1900 North West
R14	Rural	27 Babbinboon Road	275661	6570564	1900 North

2.5 Potential Impacts

Potential noise impacts associated with the project relate to construction and operational noise. Road traffic noise associated with the transportation of equipment to site during construction has also been assessed for receivers along the proposed transport/access route.



MAC
Muller Acoustic Consulting

FIGURE 1

PROJECT LAYOUT

REF: MAC180684

3 Noise Policy and Guidelines

This NA has been conducted in accordance with the following key policy and guidelines:

- NSW Department of Environment and Climate Change, NSW Interim Construction Noise Guideline (ICNG), 2009;
- Environment Protection Authority's (EPA's), Noise Policy for Industry (NPI), 2017; and
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), 2011.

The assessment has also considered and applied the following additional policy, guidelines and standards where relevant:

- Australian Standard AS 2436–2010 (R2016) (AS 2436) – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance sites;
- Australian Standard AS 1055:2018 (AS 1055) – Description and Measurement of Environmental Noise;
- Australian Standard AS IEC 61672.1–2019 (AS 61672) – Electro Acoustics - Sound Level Meters Specifications Monitoring; and
- Australian Standard AS IEC 60942-2004 (AS 60942) – Electroacoustics – Sound Calibrators.

3.1 Interim Construction Noise Guideline

The assessment and management of noise from construction work is completed with reference to the Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to assist in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the EPA under the POEO Act (1997), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment.

The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; or
- Qualitative, which is suited to short term infrastructure maintenance (for projects with a typical duration of less than three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise emission predictions from construction activities to the nearest relevant receivers. The qualitative assessment methodology is a more simplified approach that relies more on noise management strategies. This study has adopted a quantitative assessment approach.

The quantitative approach includes identification of potentially affected receivers, description of activities involved in the project, derivation of the construction noise management levels, quantification of potential noise impact at receivers and, provides management and mitigation recommendations. **Table 2** summarises the ICNG recommended standard hours for construction.

Table 2 Recommended Standard Hours for Construction

Period	Preferred Construction Hours
Day (Standard construction hours)	Monday to Friday - 7am to 6pm Saturdays - 8am to 1pm Sundays or Public Holidays - No construction

The recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Work conducted outside of standard hours are considered out of hours work (OOH). OOH periods are divided into two categories representing evening and night periods and cover the hours listed below:

Period 1 (evening/low risk period): Monday to Friday – 6pm to 10pm, Saturdays – 1pm to 6pm, Sundays – 8am to 6pm.

Period 2 (night/medium to high risk period): Monday to Friday – 10pm to 7am, Saturdays/Sundays – 6pm to 7am (8am on Sunday mornings).

There are no out of hours work proposed for this project.

3.1.1 Construction Noise Management Levels

Section 4 of the ICNG details the quantitative assessment method involving predicting noise levels and comparing them with the Noise Management Level (NML) and are key indicators for the potential level of construction noise impacts. **Table 3** provides the ICNG recommended $LA_{eq(15min)}$ NMLs and describes how they are to be applied.

Table 3 Noise Management Levels

Time of Day	Management Level $LA_{eq(15min)}$[1]	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB.	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $LA_{eq(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA.	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB.	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction noise management levels for noise assessment purposes and is the median of the ABL's.

3.1.2 Construction Sleep Disturbance

Section 4.3 of the ICNG (DECC, 2009) states that a sleep disturbance assessment is required where construction activities are planned to occur for more than two consecutive nights.

Given that construction activities are anticipated to occur during standard construction hours, sleep disturbance has not been considered in this assessment.

3.2 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997. The objectives of the NPI are to:

- provide noise criteria that are used to assess the change in both short term and long term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, taking into account the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels, above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured noise level with the PNTLs, assessing impacts and the need for noise mitigation and management measures.

4. Consider residual noise impacts, that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.

5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.

6. Monitor and report environmental noise levels from the development.

3.2.1 Project Noise Trigger Levels

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) value of the **Project Intrusiveness Noise Level** (PINL) and **Project Amenity Noise Level** (PANL) determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Project Intrusiveness Noise Level

The PINL ($LA_{eq(15min)}$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

3.2.3 Project Amenity Noise Level

PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI) and are reproduced in **Table 4**. The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area.

- **Project Amenity Noise Levels (PANL)** – is the recommended levels for a receiver area, specifically focusing the project being assessed.

Furthermore, where the PANL is applicable and can be satisfied, the assessment of cumulative industrial noise is not required.

Table 4 Amenity Criteria

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB L_{Aeq}
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5dBA above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dBA to recommended noise amenity area

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7.

Time of day is defined as follows: (These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.)

- day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays;
- evening – the period from 6pm to 10pm;
- night – the remaining periods.

In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40dB LAeq(1hr).

3.2.4 Maximum Noise Level Assessment

The potential for sleep disturbance from maximum noise level events during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq(15min)}$ 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- L_{Amax} 52dB or the prevailing RBL plus 15dBA, whichever is the greater,

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Department of Environment, Climate Change and Water NSW (DECCW), Road Noise Policy (RNP), 2011. The policy sets out noise criteria applicable to different road classifications for the purpose of quantifying traffic noise impacts. Road noise criteria relevant to this assessment are presented in detail in Section 4.

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4 Assessment Criteria

Background noise monitoring has not been conducted for this project and hence, the minimum applicable Rating Background Levels (RBL) of 35dBA for the daytime and 30dBA for the evening and night time periods have been adopted as per NPI methodology.

4.1 Construction Noise Management Levels

Noise Management Levels (NMLs) for construction activities for all residential receivers are 45dB $LA_{eq(15min)}$ (RBL +10dB). Construction activities are planned for standard hours, however the relevant NML standard construction hours and out of hours periods are summarised in **Table 5**.

Table 5 Construction Noise Management Levels

Location	Assessment Period	RBL, dBA	NML dB $LA_{eq(15min)}$
All Residential Receivers	Day (Standard Hours)	35	45 (RBL+10dBA)
	Evening (OOH Period 1)	30	35 (RBL+5dBA)
	Night (OOH Period 2)	30	35 (RBL+5dBA)

4.2 Operational Noise Criteria

4.2.1 Project Intrusiveness Noise Levels

The Project Intrusiveness Noise Levels (PINLs) for the project are presented in **Table 6** and have been determined based on the RBLs +5dBA.

Table 6 Project Intrusiveness Noise Levels

Receiver	Period[1]	Adopted RBL dB LA_{90}	PINL dB $LA_{eq(15min)}$
All Residential Receivers	Day	35	40
	Evening	30	35
	Night	30	35

4.2.2 Project Amenity Noise Levels

The Project Amenity Noise Levels (PANLs) for residential receivers potentially affected by the project are presented in **Table 7.**

Table 7 Project Amenity Noise Levels

Receiver Type	Noise Amenity Area	Assessment Period[1]	Recommended ANL dB $L_{Aeq(period)}$[2]	PANL dB $L_{Aeq(period)}$[3]	PANL dB $L_{Aeq(15min)}$[4]
Residential	Rural	Day	50	50	53
		Evening	45	45	48
		Night	40	40	43

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Recommended amenity noise levels as per Table 2.2 of the NPI.

Note 3: Project Amenity Noise Level equals the amenity noise level as there is no other industry in the area.

Note 4: Includes a +3dB adjustment to the amenity period level to convert to a fifteen-minute assessment period as per Section 2.2 of the NPI.

4.2.3 Project Noise Trigger Levels

The Project Noise Trigger Levels (PNTLs) are the lower of either the PINLs or the PANLs. **Table 8** presents the derivation of the PNTLs in accordance with the methodologies outlined in the NPI. For this assessment the night time PNTL of 35dB $L_{Aeq(15min)}$ is the limiting criteria.

Table 8 Project Noise Trigger Levels

Catchment	Assessment Period[1]	PINL dB $L_{Aeq(15min)}$	PANL dB $L_{Aeq(15min)}$	PNTL dB $L_{Aeq(15min)}$
Residential Receivers (Rural)	Day	40	53	40
	Evening	35	48	35
	Night	35	43	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2.4 Maximum Noise Level Screening Criterion

The maximum noise level screening criterion shown in **Table 9** is based on night time RBLs and trigger values as per Section 2.5 of the NPI.

Table 9 Maximum Noise Assessment Trigger Levels

Residential Receivers			
$L_{Aeq(15min)}$		L_{Amax}	
40dB $L_{Aeq(15min)}$ or RBL + 5dB		52dB L_{Amax} or RBL + 15dB	
Trigger	40	Trigger	52
RBL +5dB	35	RBL +15dB	45
Highest	**40**	**Highest**	**52**

Note 1: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the screening criteria.

4.3 Road Traffic Noise Criteria

The road traffic noise criteria are provided in the RNP. For this assessment, the 'local road' category, as specified in the RNP, has been adopted for Babbinboon Road and Warminster Road. Road noise criteria relevant to this assessment are presented in **Table 10** for residential receivers.

Table 10 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Road Name	Type of Project/Development	Assessment Criteria - dBA	
			Day (7am to 10pm)	Night (10pm to 7am)
Local Roads	Babbinboon Road Warminster Road	Existing residences affected by additional traffic on existing local roads generated by land use developments	55dBA LAeq(1hr) external	50dBA LAeq(1hr) external

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

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5 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR's iNoise (V2019.1) noise modelling software was used to assess potential noise impacts associated with the project. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. Additionally, the model uses relevant noise source data, ground type, shielding such as barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Plant and equipment were modelled at various locations and heights, representative of realistic construction and operational conditions for assessed scenarios.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'.

5.1 Construction Assessment Methodology

Construction activities are proposed to be progressive (trenching, piling and assembly) and will occur at several locations simultaneously. Noise emissions were modelled for the following three scenarios:

- earthworks involving trenching for cabling;
- piling of panel supports; and
- assembly of the panels.

It is envisaged that all three construction scenarios have the potential to occur simultaneously at up to ten locations across the site. Noise emission data and assumptions used in this assessment are summarised in Table 11. All significant noise generating construction activities will be limited to standard construction hours. Where low intensity construction activities are required to be undertaken outside standard construction hours, such as cabling, minor assembly, use of hand tools etc, they will be managed such that they are not audible at any residential receivers.

Table 11 Construction Equipment Sound Power Levels, Lw dBA re 10^{-12} W				
Noise Source/Item	Utilisation %	Quantity	Lw/ Item	Total Lw
Trenching & Earthworks (per work area)				
Backhoe	100	1	104	104
Light vehicle	50	2	76	76
Total – Trenching & Earthworks				**104**
Piling (per work area)				
Piling Rig (hydraulic)	100	1	113	113
Tele-handler	80	1	106	105
Light vehicle	50	1	76	73
Total – Piling				**114**
Assembly (per work area)				
Mobile Crane/HIAB	100	1	104	104
Tele-handler	100	1	106	106
Light vehicle	50	2	76	76
Hand tools/Power tools	25	1	102	96
Welder	25	1	105	99
Total – Assembly				**109**
Transport (on site)				
Heavy vehicle	100	1	104	104
Tele-handler	100	1	106	106
Total – Transport				**108**

5.2 Operational Assessment Methodology

5.2.1 Operational Noise Modelling Scenarios

For this assessment, noise predictions were modelled for a typical worst case operational scenario over a 15-minute assessment period based on the assumptions, quantities and sound power levels in **Table 12.** Plant noise emission data used in modelling for this assessment were obtained from manufacturers specifications. Where relevant, modifying factors in accordance with Section 3.3 and Fact Sheet D of the NPI have been applied to calculations.

Table 12 Operational Equipment Sound Power Levels, Lw dBA re 10^{-12} W				
Noise Source/Item	Activity	Quantity	Lw/Item	Total Lw
PV Panel Tracking Motor[1,2]	All tracking motors in operation 1 minute per 15-minute period	3400	78	96
Inverter Cabin[2,3]	Constant	10	81	97
Battery Storage System[3]	Constant	1	83	83
Substation	Constant	1	90	90
Light Vehicle	2 vehicles arrive and depart from site (5 minutes duration)	2	76	79

Note 1: Tracking motor is situated underneath the PV panel, -5dB attenuation applied to account for shielding provided by the panel.

Note 2: Modifying factor penalty of +5dB added for low frequency and +5dB added for tonality.

Note 3: -10dB applied to account for enclosure.

5.2.2 Meteorological Analysis

Noise emissions from industry can be significantly influenced by prevailing weather conditions. Wind has the potential to increase noise at a receiver when it is at low velocities and travels from the direction of the noise source.

Meteorological conditions that enhance received noise levels include source to receiver winds and the presence of temperature inversions. To account for the potential for enhancements, the NPI specifies that the source to the receiver wind component speeds up to 3m/s for 30% or more of the time in any seasonal period (i.e. day, evening or night), is a significant meteorological feature and predictions must incorporate these conditions.

To determine the prevailing conditions for the project, weather data from the Bureau of Meteorology's (BOM) Tamworth Airport weather station (2014 to 2016). The data was analysed using the EPA's Noise Enhancement Wind Analysis (NEWA) program to determine the frequency of occurrence of winds speeds up to 3m/s in each seasonal period.

Table 13 summarises the results of the wind analysis and includes the dominant wind direction and percentage occurrence during each season for each assessment period. The results of the detailed analysis of meteorological data is presented in Appendix B.

Table 13 Seasonal Frequency of Occurrence Wind Speed Intervals						
Season	Wind Direction ±(45°)			% Wind Speeds 0.5 to 3 m/s		
	Day	Evening	Night	Day	Evening	Night
Summer	NW	NW	NW	12	11	28
Autumn	SE	NW	NW	17	17	**34**
Winter	ESE	NW	NW	19	21	**32**
Spring	ESE	NW	NW	15	13	**32**

Based on the results of this analysis, the relevant meteorological conditions adopted in the noise modelling assessment are summarised in **Table 14**.

Table 14 Modelled Site Specific Meteorological Parameters		
Assessment Condition	Wind Speed/Direction	Stability Class
Calm (all periods)	N/A	N/A
Prevailing wind (night only)	3m/s NW	N/A
Inversion (night only)	N/A	F

Note: Day period is 7am to 6pm, Evening is 6pm to 10pm, Night period is 10pm to 7am.

5.3 Road Traffic Noise

The United States (US) Environmental Protection Agency's road traffic calculation method was used to predict the L_{Aeq} noise levels from construction vehicles travelling past receivers along public roads. This method is an internationally accepted theoretical traffic noise prediction model and is ideal for calculating road traffic noise where relatively small traffic flows are encountered.

6 Results

6.1 Construction Noise Results

Noise levels were predicted to each assessed receiver assuming receiver heights of 1.5m above ground level for typical construction activities. **Table 15** summarises the maximum predicted noise level from each of the construction scenarios (trenching, piling and assembly) at identified residential receivers.

Table 15 Predicted Construction Noise Levels

Receiver ID	Description/ Address	Highest Predicted Noise Level dB $LA_{eq(15min)}$	NML Standard Hours dB $LA_{eq(15min)}$	Compliance
R01	Lot 176-DP755340	38	45	Yes
R01A	Lot 176-DP755340	37	45	Yes
R02	2134 Soldiers Settlement Road	**50**	45	No
R03	Lot 21-DP719649	44	45	Yes
R04	2050 Soldiers Settlement Road	41	45	Yes
R05	222 Warminster Road	41	45	Yes
R06	Lot 2-DP579848	35	45	Yes
R07	390 Prices Road Bective	<30	45	Yes
R08	367 Prices Road Bective	<30	45	Yes
R09	Lot 176-DP755319	30	45	Yes
R10	1871 Soldiers Settlement Road	<30	45	Yes
R11	1761 Soldiers Settlement Road	32	45	Yes
R12	38 Warminster Road	30	45	Yes
R13	49 Warminster Road	32	45	Yes
R14	27 Babbinboon Road	32	45	Yes

The predicted exceedance of the NML at Receiver R02 on Soldiers Settlement Road is due to piling activities. These levels would be experienced only when these construction activities occur simultaneously along the southern boundary. Scheduling of piling activities to minimise the number of work fronts along the northern boundary would reduce noise levels by approximately 3dB in most situations. The predicted maximum noise levels would be expected when construction work is occurring at the closest point to the receivers, although this is anticipated to be for a limited period.

6.2 Operational Noise Results

Noise levels were predicted at each assessed receiver assuming receiver heights of 1.5m above ground level. **Table 16** summarises the predicted operational noise levels which are demonstrated to comply with the PNTLs at all residential receivers.

Table 16 Predicted Operational Noise Levels

Receiver ID	Description/ Address	Predicted Noise Level dB $LA_{eq(15min)}$			Limiting PNTL dB $LA_{eq(15min)}$	Compliance Achieved
		Calm (All Periods)	NW Wind (Night)	Inversion (Night)		
R01	Lot 176-DP755340	<30	<30	<30	35	Yes
R01A	Lot 176-DP755340	<30	<30	<30	35	Yes
R02	2134 Soldiers Settlement Road	<30	<30	30	35	Yes
R03	Lot 21-DP719649	<30	<30	30	35	Yes
R04	2050 Soldiers Settlement Road	<30	<30	<30	35	Yes
R05	222 Warminster Road	<30	<30	<30	35	Yes
R06	Lot 2-DP579848	<30	<30	<30	35	Yes
R07	390 Prices Road Bective	<30	<30	<30	35	Yes
R08	367 Prices Road Bective	<30	<30	<30	35	Yes
R09	Lot 176-DP755319	<30	<30	<30	35	Yes
R10	1871 Soldiers Settlement Road	<30	<30	<30	35	Yes
R11	1761 Soldiers Settlement Road	<30	<30	<30	35	Yes
R12	38 Warminster Road	<30	<30	<30	35	Yes
R13	49 Warminster Road	<30	<30	<30	35	Yes
R14	27 Babbinboon Road	<30	<30	<30	35	Yes

6.3 Maximum Noise Level Assessment - Operations

A detailed maximum noise level assessment is not required for the project as predicted noise levels for night time operations do not exceed the maximum noise level screening criterion of 40dB $LA_{eq(15min)}$ and/or 52dB LA_{max}.

6.4 Road Traffic Noise Assessment

As described in **Section 2.2**, the route from the Oxley Highway via Babbinboon Road and Warminster Road would be the major transport route for all project vehicles. During construction, traffic generated by the project include employee/subcontractor and delivery vehicles. During construction, the traffic volume over a typical day for standard construction hours is expected to be up to 20 heavy vehicles (semi-trailers) and 70 light vehicles per day (including mini buses for employee transport). Road traffic noise calculations based on the parameters adopted for average and peak flows are presented in **Table 17**.

Table 17 Predicted Construction Road Traffic Noise Levels

Vehicle Type	Vehicles / day[1]	Average / hour	Maximum / hour[2]	Maximum Movements / hour	Speed km/h
B-double or Semi-trailer	40	5	5	10	50
Light Vehicle	10	1	20	40	80

Note 1: Standard construction hours.

Note 2: Assumes that all mini buses and 50% of light vehicles travel to and from site during AM peak and PM peak.

Predicted $LA_{eq(1hr)}$ noise levels from project related construction traffic at the closest receiver on both roads on the route has been completed using the United States (US) Environment Protection Agency's road traffic calculation method and are presented in **Table 18**.

Table 18 Predicted Construction Road Traffic Noise Levels

Road Name	Nearest Offset Distance to Receiver	Predicted Noise Level	RTN Criteria (Day)	Comply
Warminster Road	80m	42dB $LA_{eq(1hr)}$	55dB $LA_{eq(1hr)}$	Yes
Babbinboon Road	25m	48dB $LA_{eq(1hr)}$[1]	55dB $LA_{eq(1hr)}$	Yes

Note 1: Assumes that all worker transportation enters and exits the site in one hour as a worst case assessment.

Results demonstrate that project construction traffic noise levels would satisfy the relevant RNP criteria.

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7 Construction Noise Management

It is noted that construction noise emissions are anticipated to satisfy relevant NMLs, except when piling, trenching or earthworks activities occur in southern panel array of the site (refer **Figure 2**) within 600m of Receiver R02. Therefore, to minimise noise impacts whilst construction activities are occurring within 600m of Receiver R02, the Noise Management Zone (NMZ), calculations show that only one item of significant noise generating equipment (ie piling rig, backhoe or concrete pump) is to operate at any time to remain within 5dB of the NML. Furthermore, the project will notify the potentially affected receiver(s) of the work schedule proposed, the likely duration of any activities.

The project is committed to managing noise emissions within the community. Hence, for construction activities across the remainder of the site, the project will adopt the following procedures where feasible to reduce emissions to the surrounding community:

- scheduling of construction activities to minimise the number of work fronts and simultaneous activities occurring along the eastern boundary to minimise noise levels;
- a construction noise management protocol to minimise noise emissions, manage out of hours (minor) works to be inaudible, and to respond to potential concerns from the community;
- where possible use localised mobile screens or construction hoarding around plant to act as barriers between construction works and receivers, particularly where equipment is near the site boundary and/or a residential receiver including areas in constant or regular use (eg unloading and laydown areas);
- operating plant in a conservative manner (no over-revving), be shutdown when not in use, and be parked/started at farthest point from relevant assessment locations;
- selection of the quietest suitable machinery available for each activity;
- avoidance of noisy plant/machinery working simultaneously where practicable;
- minimise impact noise wherever possible;
- utilise a broadband reverse alarm in lieu of the traditional hi frequency type reverse alarm;
- provide toolbox meetings, training and education to drivers and contractors visiting the site during construction so they are aware of the location of noise sensitive receivers and to be cognisant of any noise generating activities;
- signage is to be placed at the front entrance advising truck drivers of their requirement to minimise noise both on and off-site; and

- utilise project related community consultation forums to notify residences within close proximity of the site with project progress, proposed/upcoming potentially noise generating works, its duration and nature and complaint procedure.

7.1 Operational Noise Recommendations

Operational noise predictions identify that relevant noise criteria would be satisfied at all receivers. Notwithstanding, it is recommended that the proponent actively minimise potential noise emissions from the project. To assist in noise management for the project the following is recommended:

- complete a one-off noise validation monitoring assessment to quantify emissions from site and to confirm emissions meet relevant criteria; and
- prepare an operational noise management protocol to minimise noise emissions and to respond to potential concerns from the community regarding project noise emissions.

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FIGURE 2

Noise Management Zones
REF: MAC180684

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8 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by PROJECTe Pty Ltd (Pe) on behalf of Oriens Energy to complete a Noise Assessment (NA) for the proposed Tamworth Solar Farm near Somerton, NSW (the 'project'). The assessment has quantified potential noise emissions associated with the construction and operation of the project.

The results of the NA demonstrate that construction emissions satisfy relevant NMLs at all assessed receivers, except for one receiver when noise intensive works (piling, trenching) are at their closest proximity in the southern panel array area. It is anticipated that impacts from such activities would be of short duration and of a temporary nature. Notwithstanding, the project has developed specific noise management measures to minimise noise impacts whilst construction activities are occurring in this area.

Operational noise levels are predicted to satisfy the NPI PNTLs at all assessed receivers. However, recommendations to ensure noise levels are minimised and verified have been provided in this report.

Additionally, the NA demonstrates that the road noise criteria as specified in the RNP will be satisfied at all receivers on the proposed transport route.

Based on the NA results, there are no noise related issues which would prevent the approval of the project. The results of the assessment shows compliance with the relevant construction, operational and road noise criteria.

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Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Terms

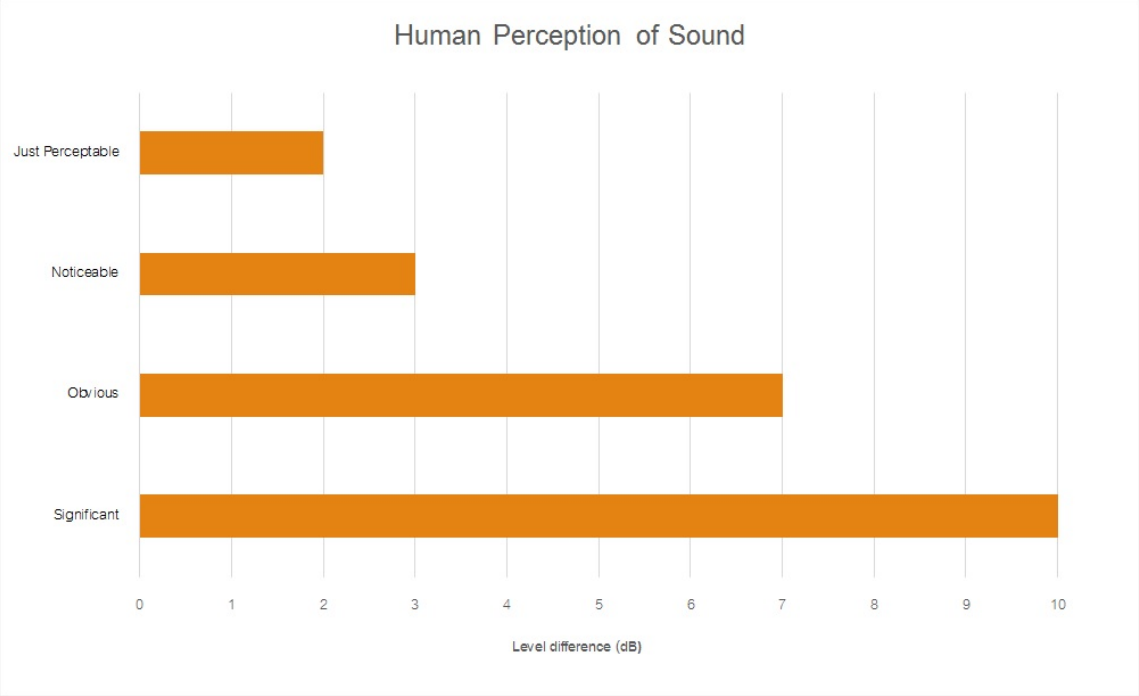
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Appendix B – NEWA Analysed Meteorology

Table B1 NEWA Analysed Meteorological Conditions, Tamworth Airport, NSW									
Direction	Season	Day	Evening	Night	Direction	Season	Day	Evening	Night
		Percentage Occurrence %					Percentage Occurrence %		
0	Summer	8	9	22	180	Summer	9	6	4
0	Autumn	12	14	29	180	Autumn	13	10	7
0	Winter	13	17	27	180	Winter	13	13	10
0	Spring	9	12	27	180	Spring	12	9	7
22.5	Summer	8	8	19	202.5	Summer	9	7	4
22.5	Autumn	12	12	25	202.5	Autumn	11	9	7
22.5	Winter	12	13	20	202.5	Winter	10	12	9
22.5	Spring	10	12	21	202.5	Spring	11	9	7
45	Summer	9	6	7	225	Summer	8	7	6
45	Autumn	13	8	9	225	Autumn	9	8	6
45	Winter	12	11	9	225	Winter	7	9	7
45	Spring	12	11	9	225	Spring	8	9	8
67.5	Summer	10	6	6	247.5	Summer	9	9	9
67.5	Autumn	15	8	6	247.5	Autumn	11	10	8
67.5	Winter	15	11	8	247.5	Winter	8	9	9
67.5	Spring	13	11	8	247.5	Spring	8	9	10
90	Summer	10	5	5	270	Summer	10	9	14
90	Autumn	15	8	5	270	Autumn	12	11	14
90	Winter	16	13	7	270	Winter	11	13	15
90	Spring	14	11	7	270	Spring	8	10	15
112.5	Summer	11	4	5	292.5	Summer	11	10	24
112.5	Autumn	17	9	5	292.5	Autumn	14	16	26
112.5	Winter	19	13	8	292.5	Winter	14	19	26
112.5	Spring	15	11	6	292.5	Spring	9	13	26
135	Summer	12	5	4	315	Summer	11	11	28
135	Autumn	17	9	5	315	Autumn	15	17	34
135	Winter	19	14	9	315	Winter	16	21	32
135	Spring	15	9	6	315	Spring	10	13	32
157.5	Summer	10	6	5	337.5	Summer	7	7	24
157.5	Autumn	14	10	7	337.5	Autumn	11	14	30
157.5	Winter	16	14	10	337.5	Winter	13	17	28
157.5	Spring	14	9	7	337.5	Spring	7	11	28

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