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Environmental Noise Assessment

Winu Project, WA

Reference: 24129774-02A

Prepared for:
Rio Tinto Winu Pty Ltd

Reference: 24129774-02A

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Date	Rev	Description	Author	Verified
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1. INTRODUCTION

Lloyd George Acoustics was engaged by Rio Tinto to undertake an assessment of the potential noise and vibration impacts from the proposed Winu Copper-Gold Project (The Proposal) on surrounding noise sensitive fauna receptors (Night Parrot). The Proposal is located approximately 320 km East of Port Hedland in Western Australia. The overall mine layout and locality is presented as *Figure 1-1*.

While not all the details of the mining fleet are finalised, preliminary noise levels are predicted via computer 3D noise modelling techniques and include the following sources and scenarios:

- All mobile mining fleet operating;
- Equipment operating at the ROM and Process Plant;
- Power Generation plant in operation (near process plant);
- Operational Aircraft Noise in accordance with AS2021:2015.

Blasting is proposed as part of mining activities and relevant noise and vibration calculations were undertaken, using input blasting parameters provided by Rio's team.

Additionally, the cumulative noise impacts of the proposed Wind Farm have been considered. A noise assessment by Wood (Ref Rpt02-AU02408-Rev0-17 Feb 2025) has been reviewed and, where applicable, results have been combined with other mining noise to assess cumulative effects.

Appendix A contains a description of the terminology and abbreviations used throughout this report.

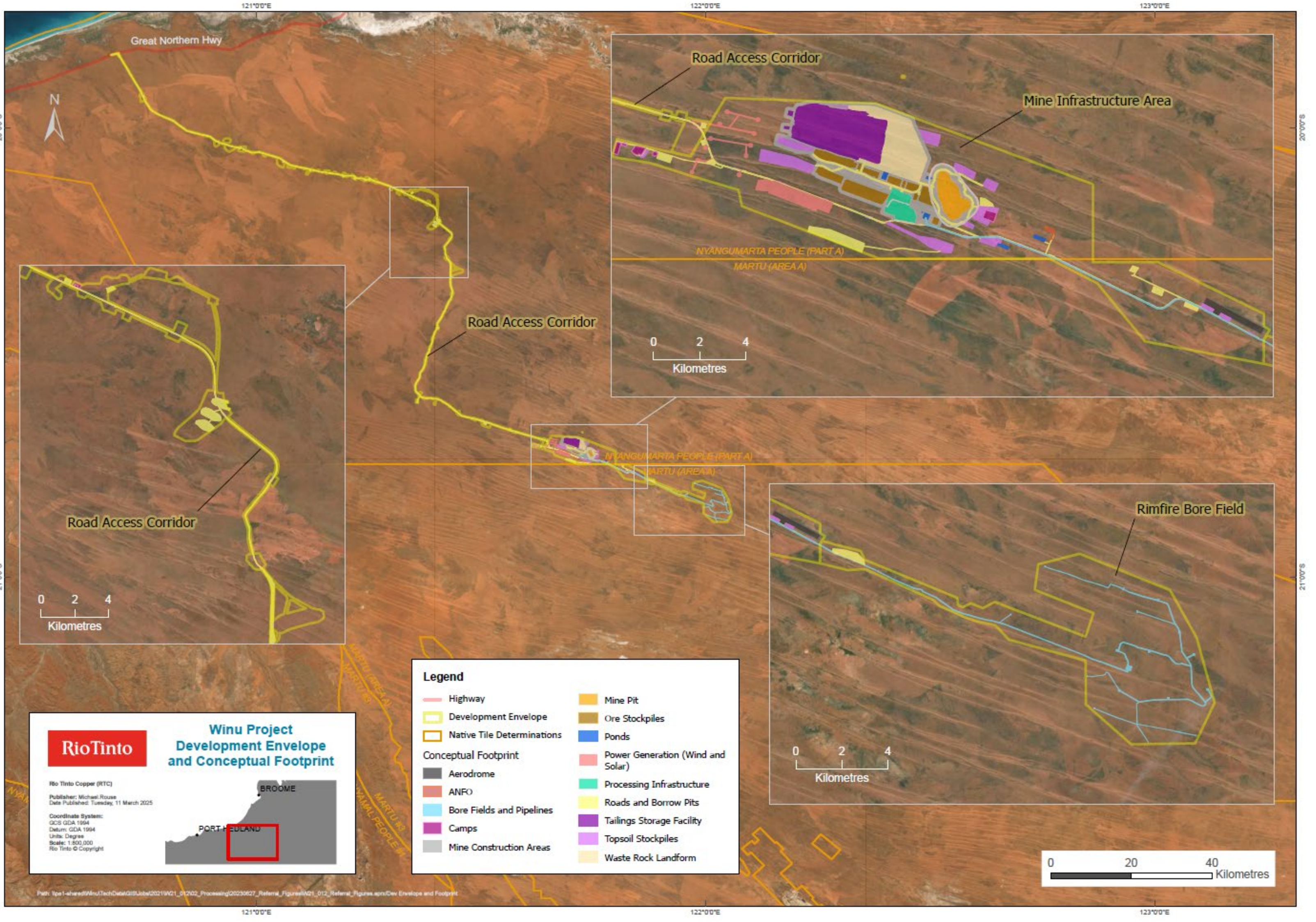


Figure 1-1: Subject Site Location (Source: Rio Tinto)

2. CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations). Noting the prescribed standard for noise emission of the Regulations applies to other receiving premises, it should be noted that there are no nearby noise sensitive premises other than those of the Winu worker camp and the identified fauna sites for the Night Parrots.

2.1. Noise to Worker Village

As the worker village is on the same site as the prescribed activity, the standard assigned noise levels do not apply. In these cases, the *Guideline – Assessment of Environmental Noise Emissions*, produced by Department of Water and Environmental Regulation (DWER), states that at a minimum, accommodation will be designed to achieve a level of L_{Aeq} 40 dB, being indoor levels inside the village sleeping areas. Assuming a 15 dB increase in level when assessing outdoors, this equates to a level of 55 dB L_{Aeq} outside sleeping areas.

2.2. Aircraft Noise

Noise from aircraft is not assessable under The Regulations, per Regulation 3, part (1)(c). However, acceptable noise levels as a result of aircraft movements and methodology for calculating the noise for various aircraft types are provided in Australian Standard *AS2021 Acoustics – Aircraft Noise Intrusion - Building Siting and Construction*. This standard can be used for the assessment of suitability of airport location and orientation. *Table 2-1* sets out the indoor design sound levels from AS2021.

Table 2-1: Indoor Design Sound Levels for Determination of Aircraft Noise Reduction

Building type and Activity	Indoor Design Sound Level, dB L_{Amax}
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60

While the above would apply to any worker camp or community nearby, the receptors nearest to the conceptual footprint are the Night Parrot Habitats and such receptors are not covered in the Standard.

2.3. Noise and Vibration to Fauna

Some project infrastructure is located close to areas where Night Parrot habitats are identified. Lloyd George Acoustics is not aware of legislated noise or vibration criteria related to this particular species and therefore predicted levels are provided for informative purposes to the project team and fauna experts.

2.4. Regulation 11

With regard to airblast level, regulation 11 of the Regulations prescribes that:

(4) Subject to subregulation (5), no airblast level resulting from blasting on any premises or public place, when received at any other premises between 0700 hours and 1800 hours on any day, may exceed —

(a) for an airblast level received at noise sensitive premises —

(i) when received at a sensitive site — 120 dB $L_{Z\,peak}$; or

(ii) when received at a location other than a sensitive site — 125 dB $L_{Z\,peak}$;

or

(b) for an airblast level received at any other premises — 125 dB $L_{Z\,peak}$.

(5) The levels specified in subregulation (4) do not apply in respect of an airblast level when received at premises, or a part of premises, on which the blaster believes on reasonable grounds no person is present at the time of the blast.

(6) Despite subregulation (4), airblast levels for 9 in any 10 consecutive blasts (regardless of the interval between each blast), when received at any other single premises between 0700 hours and 1800 hours on any day, must not exceed —

(a) for airblast levels received at noise sensitive premises —

(i) when received at a sensitive site — 115 dB $L_{Z\,peak}$; or

(ii) when received at a location other than a sensitive site — 120 dB $L_{Z\,peak}$;

or

(b) for airblast levels received at any other premises — 120 dB $L_{Z\,peak}$.

(7) For the purposes of subregulation (6), an airblast level for a blast that would, but for this subregulation, exceed a level specified in subregulation (6)(a)(i) or (ii) or (b) is taken not to exceed that level when received at premises, or a part of premises, on which the blaster believes on reasonable grounds no person is present at the time of the blast.

(8) Subject to subregulation (9), no airblast level resulting from blasting on any premises or public place, when received at other premises outside the periods between 0700 hours and 1800 hours on any day, may exceed 90 dB $L_{Z\,peak}$ except where that blasting is carried out —

(a) as part of surface mining operations for the purposes of removing obstructions in crushers, or making workings safe, or for firing misfired holes; and

(b) with the consent in each case of the mine operator.

(9) The level specified in subregulation (8) does not apply in respect of an airblast level when received at premises, or a part of premises, on which the blaster believes on reasonable grounds no person is present at the time of the blast.

(10) Where blasting is carried out as described in subregulation (8)(a) and (b) outside the periods between 0700 hours and 1800 hours on any day —

(a) the blasting is taken to be carried out between 0700 hours and 1800 hours; and

(b) subregulations (4), (5), (6) and (7) apply accordingly.

(11) For the purposes of this regulation, an airblast level may be determined by —

(a) measurement at its point of reception when, to the extent practicable, other noises that would contribute to the measured airblast level are not present; or

(b) calculation of the airblast level at its point of reception based on measurement of the airblast level at a reference point determined by the inspector or authorised person to be a point where the relationship between the airblast level as measured at the reference point and at the point of reception can be established.

3. METHODOLOGY

Various methodologies are used for the various noise sources associated with the mine operation as described in the following sections.

3.1. Mining Operational Noise Modelling

Computer modelling has been used to predict the noise emissions from the development of the project site to all nearby receivers. The software used was *SoundPLAN 9.0* with the CONCAWE (ISO 17534-3 improved method) selected, as they include the influence of meteorological conditions. Input data utilised in the model of the project are listed below and discussed in *Section 3.1.1* to *Section 3.1.4*:

- Meteorological information;
- Topographical data;
- Ground absorption; and
- Source sound power levels.

3.1.1. Meteorological Conditions

Meteorological information utilised in the software is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-1: Modelling Meteorological Conditions

Parameter	Day (7.00am to 7.00pm)[2]	Night (7.00pm to 7.00am)[2]
Temperature (°C)	20	15
Humidity (%)	50	50
Wind Speed (m/s)	4	3
Wind Direction[1]	All	All
Pasquil Stability Factor	E	F

Notes:
1. The modelling package allows for all wind directions to be modelled simultaneously.
2. The conditions above are as defined in *Guideline: Assessment of Environmental Noise Emissions*; May 2021

Alternatives to the above default conditions can be used where one year of weather data is available and the analysis considers the worst 2% of the day and night for the month of the year in which the worst-case weather conditions prevail (source: *Draft Guideline on Environmental Noise for Prescribed Premises*, May 2016). In most cases, the default conditions occur for more than 2% of the time and therefore must be satisfied.

3.1.2. Topographical Data

Topographical data was adapted from a mixture of publicly available information (e.g. *Google*) and information provided by Rio Tinto for the development in the form of 1-metre contours. Being a conservative preliminary model, mining stage is assumed to be at existing ground level.

Receivers were incorporated into the noise model at 1.4 metres above ground at the location of Winu Camp and the nearest Night Parrot habitats. This height is chosen as it as it aligns with minimum requirements of the noise regulations (at least 1.2m above ground plane) and is at a height equivalent to most standing people.

3.1.3. Ground Absorption

To allow for a combination of low-lying scrub, sand and some cleared areas, a value of 0.4 has been used as an average value to represent the ground cover expected in the project area, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass. Within the pits themselves, the ground absorption has been set to 0.3 assuming both compacted and disturbed ground.

3.1.4. Source Sound Levels

The source sound power levels for mining operations used in the modelling are provided in *Table 3-2*. The table is populated with a mixture of project provided data and Lloyd George Acoustics measured database levels.

Table 3-2: Source Sound Power Levels, dB

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	63	125	250	500	1k	2k	4k	8k	
Front End Loader	102	119	108	109	106	101	95	85	**108**
Komatsu 830E Haul Truck	113	109	115	112	111	107	106	102	**116**
CAT 16M Grader	101	102	111	104	109	110	105	100	**113**
Excavator Cat 6040	97	104	112	111	112	105	99	94	**111**
CAT D10 Tracked Dozer	104	106	111	109	109	107	105	98	**112**
Rock Breaker	111	118	115	110	112	112	108	103	**116**
Primary Crusher	104	104	116	113	111	108	105	99	**113**
Secondary Crusher	101	101	113	110	108	105	102	96	**110**
D65 Drilling Rig	107	106	107	104	106	107	112	112	**116**
SAG & BALL Mill	82	95	100	108	104	103	98	90	**100**
CAT Diesel Genset Enclosure	125	120	115	115	105	105	105	105	**116**

The following is noted in relation to *Table 3-2*:

- All noise sources are assumed to be L_{A10};
- Levels are based on file data retained by Lloyd George Acoustics from similar scale projects and is a mixture of site measured data and manufacturers specifications.
- Sources are generally modelled as point sources at 2.5m above ground level (AGL). All Screening and crushing modules are elevated with assumed acoustic centres of 4.0m AGL. These are considered in line with standard practice and similar previous assessments by Lloyd George Acoustics.
- All sources are modelled as omni-directional point sources.
- 12x Diesel Generator enclosures have been modelled.

3.2. Mine Noise Modelling Scenarios

The mining footprint consists of a single pit location with the worst-case location deemed to be when mobile fleet teams are working in the southernmost areas – being closest to Night Parrot Habitats. This mobile fleet noise is combined with noise from fixed items at the Process Plant and Power station.

3.3. Airblast Assessment

Confined blasting has been considered in the assessment of airblast levels at the nearest fauna receptors and the Winu worker camp. The size of the blast is influenced by many factors including the mass of explosive detonating within a given timeframe (MIC) and a site constant. Noting that some information has been provided by Rio Tinto, the maximum amount of explosive per delay to ensure compliance with the Regulations is determined, assuming a conservative site constant (K_a) of 10. This allows for the determination of a range (tabled data) of vibration and noise outcomes to suit varying structural disturbance outcomes.

For this assessment, airblast is calculated using equations provided in *Australian Standard AS 2187.2-2006 Explosives - Storage and use - Use of explosives* and equations developed by Orica Explosives Australia (Orica).

Confined Charge (AS 2187 Equation)

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

where

P = pressure, in kilopascals

Q = explosives charge mass, in kilograms

R = distance from charge, in metres

K_a = site constant

a = site exponent

Confined Charge (Orica Equation)

$$\text{Airblast Level dB } L_{Linear\,peak} = 20\log\left(\frac{P_B}{P_0}\right)$$

where:

$$P_B = 3.3\left(\frac{R}{W^{\frac{1}{3}}}\right)^{-1.2}$$

$$P_0 = 2x10^{-8}$$

R = *distance from blast*

W = *maximum charge mass per delay*

Unconfined blasting is not proposed except for unusual situations such as large rock removal from machinery or access paths after blasting. It is assumed that these blasts will be managed appropriately.

The maximum charge mass (ANFO) used on the project is 265 kg per hole.

3.4. Ground Vibration Assessment from Blasting

For ground vibration, it is assumed that the blasting conditions are for 'free-face average rock' formation. In the absence of specific blast vibration measurements at this site, the following scaled distance site law is adopted from the AS 2187.2-2006:

$$PPV = 1140\left(\frac{\sqrt{m}}{D}\right)^{1.6}$$

Where:

PPV = Peak particle velocity (mm/s)
m = Charge mass per hole or per delay (kg)
D = Distance from blast (m)

3.5. Aircraft Noise Assessment

*AS2021: Acoustics—Aircraft noise intrusion - Building siting and constructio*n, provides a number of look-up tables for various aircraft types based on a sites' proximity to Airport runway. With reference to *Figure 3-1* and assuming a straight approach, the various distances used in the look-up tables relevant to this site are utilised. The aircraft used at the Mine during full mining operations will likely be Fokker 100.

Noise modelling software, *SoundPlan Noise 9.0* has been utilised to graphically represent the noise levels from worst-case aircraft. The Standard projects noise up to 20km Centreline distance (DT) and 2.6km Sideline Distance (DS) in each direction. Outside of these distances the noise contour maps will appear "cropped" while in reality the noise levels will continue to decay.

Note that the Standard allows for land height corrections however the study, being high level at this stage, assumes a flat terrain model and straight flight paths for all scenarios. Departure (take off) noise is louder than arrival (landing), therefore all modelling has been undertaken assuming departures in either runway directions. Distance DL is not used since this pertains to arrivals/landing noise calculations.

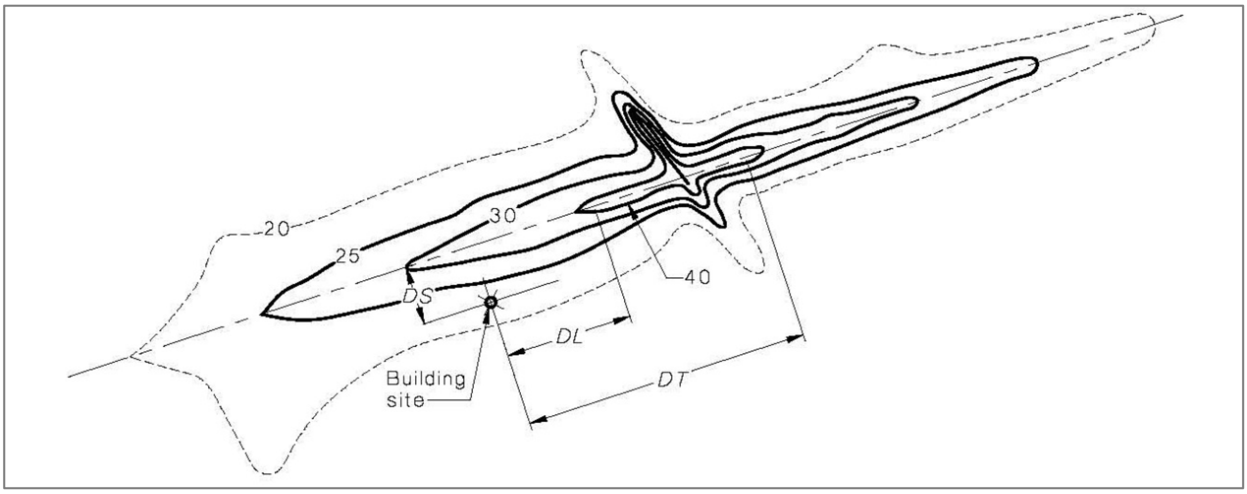


Figure 3-1: Determination of Distance Parameters (Source: AS2021)

4. RESULTS

4.1. Operations Noise Modelling

Mining noise levels were predicted for the worst-case scenario to ensure a conservative approach to modelling. The modelling scenario consisted of:

- Mining Fleet in southern most pit area.
  - Teams of Pit mining fleet: 1x Haul truck, 2x Drill rigs, 1xDozer, 2x Excavators as well as 21x haul trucks in transit between the pit teams and stockpile.
- 12x Diesel Generator enclosures at the Power station (located adjacent the process plant).
- Process Plant – all sources operating simultaneously.
  - The process plant is assumed to have a team of 2x Front-end Loaders, screening and crushing plant and a rock breaker.

Note that while the model includes multiple Night Parrot areas as receiver points, only those nearest to operations are included in the tabulated results, these can be interpreted as the worst-case levels of each grouped set of receptors.

The results for the combined Processing Plant, Power Station and Pit mining operations are provided in *Table 4-1*. A noise contour plot is also provided in *Figure 4-1 and Figure 4-2* showing noise levels at wide extents of the greater area and at close proximity to Winu Camp, respectively.

Table 4-1: Overall Predicted Levels, L_{10} dB(A)

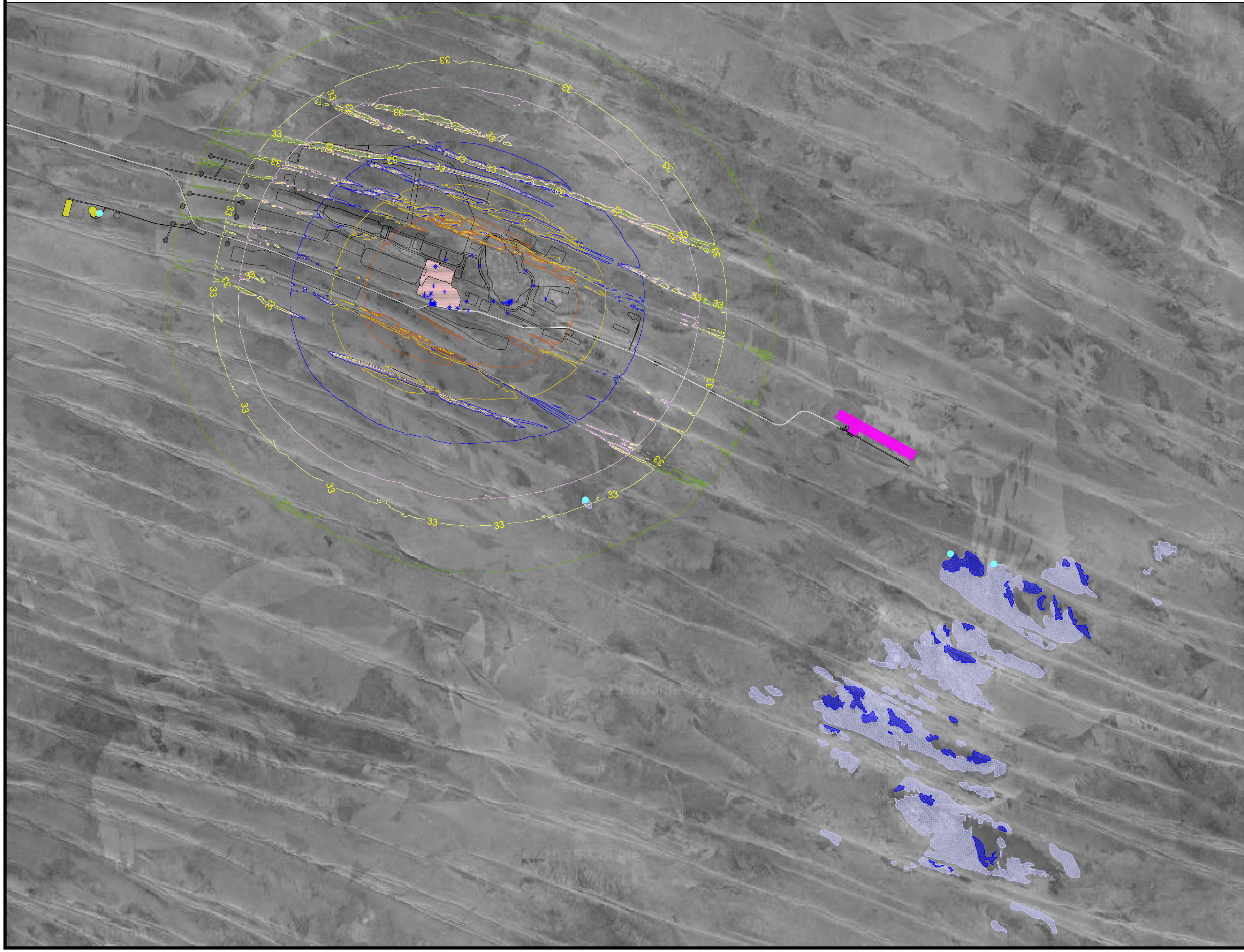
Receiver	Power Station	Haul Trucks	Pit Team	Processing Plant	Overall
Nearest Night Parrot Habitat - Roosting	28	25	30	17	**33**
Nearest Night Parrot Habitat – Foraging	16	14	18	5	**21**
Winu Camp	23	17	21	14	**26**

With regard to the Winu Camp, the highest predicted level is 26 dB L_{A10} which is compliant with the 55 dB L_{A10} outside criteria level by a margin of 29 dB.

Night Parrot Habitats (Roostign) are exposed to a worst-case noise level of 33 dB L_{A10} with mobile fleet working in the southern areas of the pit and the Power station contributing the most to noise levels. The nearest Night Parrot Foraging area is predicted to receive a worst-case noise level of 21 dB L_{A10}.

Figure 4-1: All Mining Operations, dB L_{A10}

Winu Project, Western Australia



Predicted Noise level

=	30
=	35
=	40
=	45
=	50

Legend

- Calculation Receiver
- Plant/Mobile Source
- Access Road
- Infrastructure Areas
- Winu Camp
- ROM/Processing Plant
- Airport
- NIght Parrot - Foraging
- Night Parrot - Roosting

N

0 1000 2000 4000 6000 m

Project No: 24129774
Consultant: MM
Date: 25/03/2025
Algorithm: CONCAWE
SoundPLAN Version: 9.0

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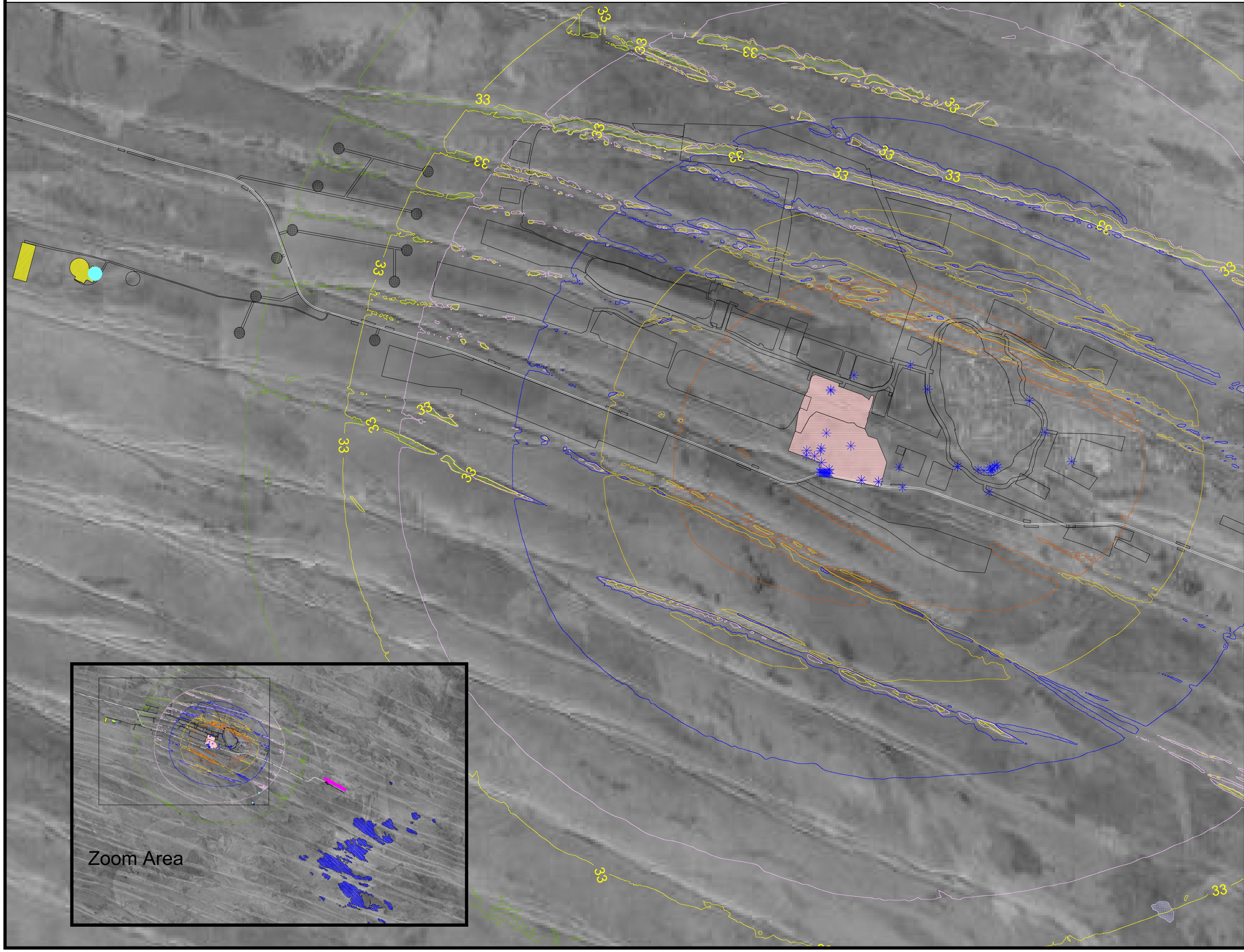
Figure 4-2: All Mining Operations, dB L_{A10}

Winu Project, Western Australia

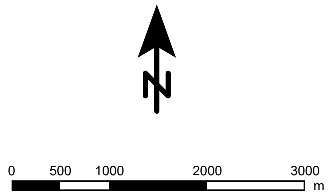


Predicted Noise level

- = 30
- = 35
- = 40
- = 45
- = 50

Legend

- Calculation Receiver
- Plant/Mobile Source
- Access Road
- Developed Areas
- Winu Camp
- ROM/Processing Plant
- Airport
- Night Parrots - Foraging
- Night Parrot - Roosting



Project No: 24129774
Consultant: MM
Date: 24/03/2025
Algorithm: CONCAWE
SoundPLAN Version: 9.0

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4.2. Airblast Noise and Vibration Prediction

Airblast noise and vibration levels have been predicted to the nearest Night Parrot habitat and the Winu Camp, being the closest sensitive receptors. The Winu Worker Camp is 12.5 km from the pit and the nearest Night Parrot (Roosting) site is 5.6 km away from the pit. A blast of 265 kg mass would produce 94 $dB_{Z\ Peak}$ and 0.1 mm/s at the nearest night parrot Roosting habitat and the nearest Foraging habitat a level of 83 dB_{ZPeak} and 0.02mm/s. At the Winu Worker Camp the blast would produce 85 $dB_{Z\ Peak}$ and 0.03mm/s, which is readily below compliance levels.

Table 4-2 presents the charge mass per hole (kg) for a given target peak ground vibration velocity (mm/s). This can be used as guidance when planning blasting near mine structures, noting that the type of rock and/or location influences the outcome considerably.

Advice from Rio Tinto is that blast size may be up to 265 kg in some cases – this value has been highlighted in the table for reference. Based on the 265 kg blast size and using a vibration velocity of 25mm/s as acceptable, a separation distance of 500 metres is appropriate. Generally, outside of 500m no structural damage should be expected, even when blasting heavily confined rock. As always the recommendation is to adopt an iterative strategy combined with vibration monitoring on site.

Table 4-2: Permitted Charge Mass Per Delay (kg) for Various Vibration Velocities

Distance to Receptor	Charge Mass per Hole (kg) to Achieve Peak Ground Vibration Velocity Level (mm/s)					
	Free Face – Average Rock			Heavily Confined		
	25 mm/s	50 mm/s	75 mm/s	25 mm/s	50 mm/s	75 mm/s
250m	530kg	1250kg	2100kg	85kg	200kg	330kg
500m	2100kg	5000kg	8300kg	340kg	800kg	1300kg

Table 4-3 presents the noise levels of an airblast predicted for a given charge mass-per-hole (kg). This can be used as a guideline when planning the blasting at known distances from a nearby structure or sensitive receptor.. The table highlights complying with a 120 $dB_{Z\ Peak}$ criteria level (Human receptors), though this is not necessarily to be taken as a limit for Night Parrots which is as yet unknown.

Table 4-3: Calculated Airblast Noise Levels (Confined blast)

Charge Mass per Hole (kg)	Airblast Level (dB $L_{Z\ peak}$) at Distance (metres)				
	500	1000	2000	5000	10000
50	113	106	99	89	82
100	116	108	101	92	84
200	118	110	104	94	87
250	119	111	104	95	88
265	120	112	105	95	88

4.3. Airport Noise

Modelled results were overlayed with aerial photography and provided drawings of the proposal including key infrastructure such as Camps, Process Plant and the ROM pad. In addition, the calculation plot result also includes the surveyed Night Parrot Habitats layer – refer *Figure 4-3*. Table

Table 4-4: Airport Predicted Levels, L_{Max} dB(A)

Receiver	Maximum Level
Nearest Night Parrot Habitat – Roosting	70
Nearest Night Parrot Habitat – Foraging	70
Winu Camp	<55

The worst-case maximum noise level of a Fokker 100 departure at a Night Parrot Habitat (both roosting and foraging) is up top 70 dB L_{Amax}. Noise to the Winu Camp falls outside of the contour areas, assuming a straight flight path, and therefore impact to the camp is expected to be minimal with a level of < 55 dB L_{Amax}.

4.4. Cumulative Noise with Windfarm

The windfarm modelling prepared by Wood (Reference Rpt02-AU02408-Rev0-12 Feb 2025) was reviewed and the noise levels from the 4m/s wind speed scenario were considered appropriate for assessment in combination with other plant noise. Above this wind speed, the wind noise itself is likely to mask noise from operations.

It should be noted that the Wood noise modelling utilised the ISO9613-2 algorithms in accordance with South Australian Guidelines, while the mining noise has applied the CONCAWE algorithms. Both algorithms are acceptable and in line with guidance from the Department of Water and Environmental Regulation (DWER).

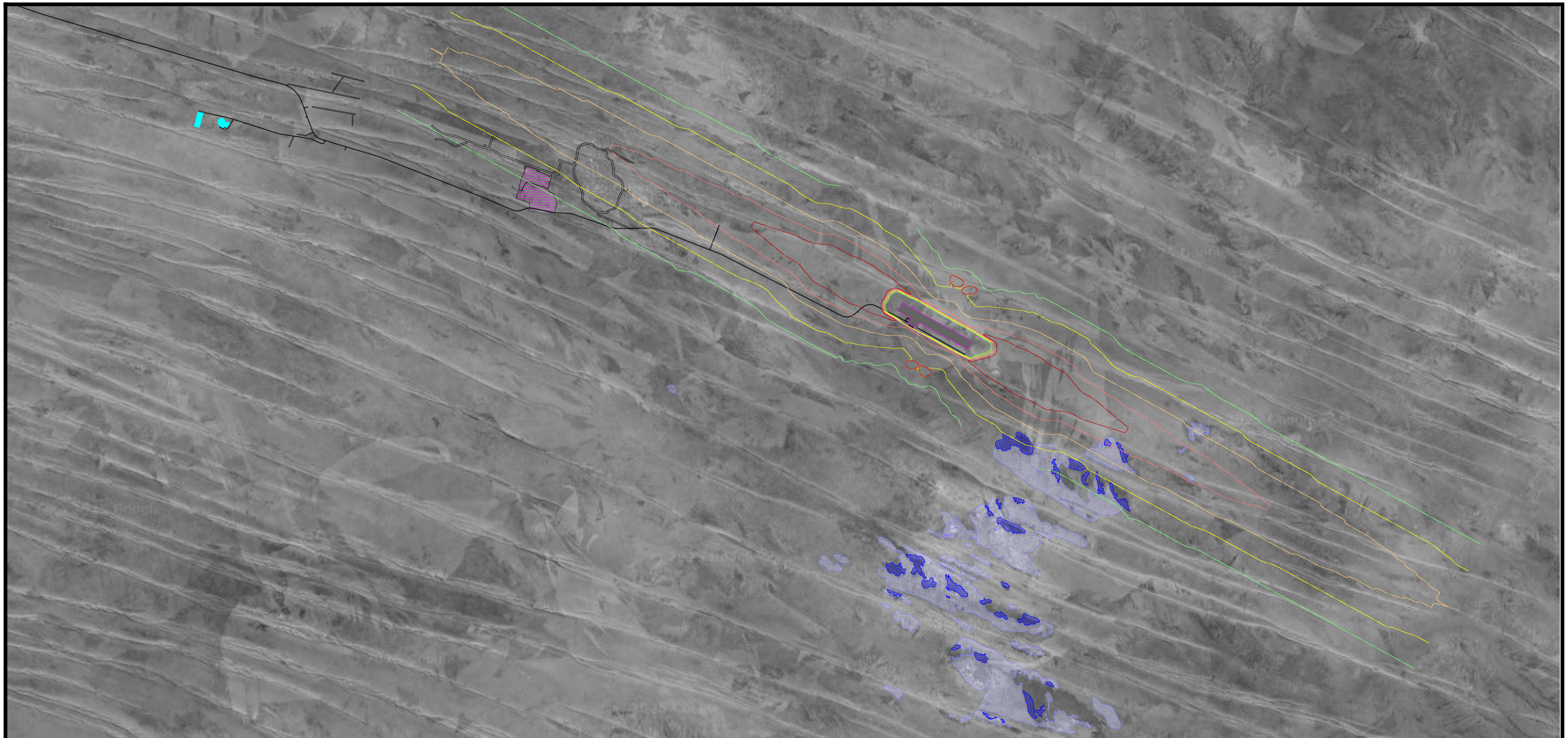
The cumulative scenario results are summarised in *Table 4-5*. A noise contour plot is also provided in *Figure 4-4* showing noise levels in the vicinity of the windfarm and Winu Camp.

Table 4-5: Cumulative Predicted Levels, L_{10} dB(A)

Receiver	Mining Ops	Windfarm Noise at 4/ms	Overall
Nearest Night Parrot Habitat – Roosting	**33**	**<10**	**33**
Nearest Night Parrot Habitat – Foraging	**21**	**<10**	**21**
Winu Camp	**26**	**22**	**27**

The results demonstrate that combined with the Wind Turbine noise, overall levels at the Camp are only likely to increase minimally. According to the Wood report, even at wind speeds of 10 m/s the noise levels at the camp would not exceed 32 dB(A). As such, it is considered that overall noise levels are well within the compliance target of 55 dB L_{A10} for a worker accommodation site.

It should be noted that where a noise level is below 20 dB(A) it is generally considered to be inaudible above background noise level.



Winu Project Air field - Rio Tinto
Scenario 3: Mining Operations - Fokker 100 Aircraft

Noise Level Contours Based on AS2021 Aircraft Departure in both directions

SoundPlan v9.0

21 Mar 2025

Signs and symbols
- Air Strip
- Access Roads
- Worker Camp
- ROM/Process Plant
- Night Parrot - Foraging
- Night Parrot - Roosting

N

Noise levels
L_{max} dB(A)

=	55
=	60
=	65
=	70
=	75

AS 2021:2015

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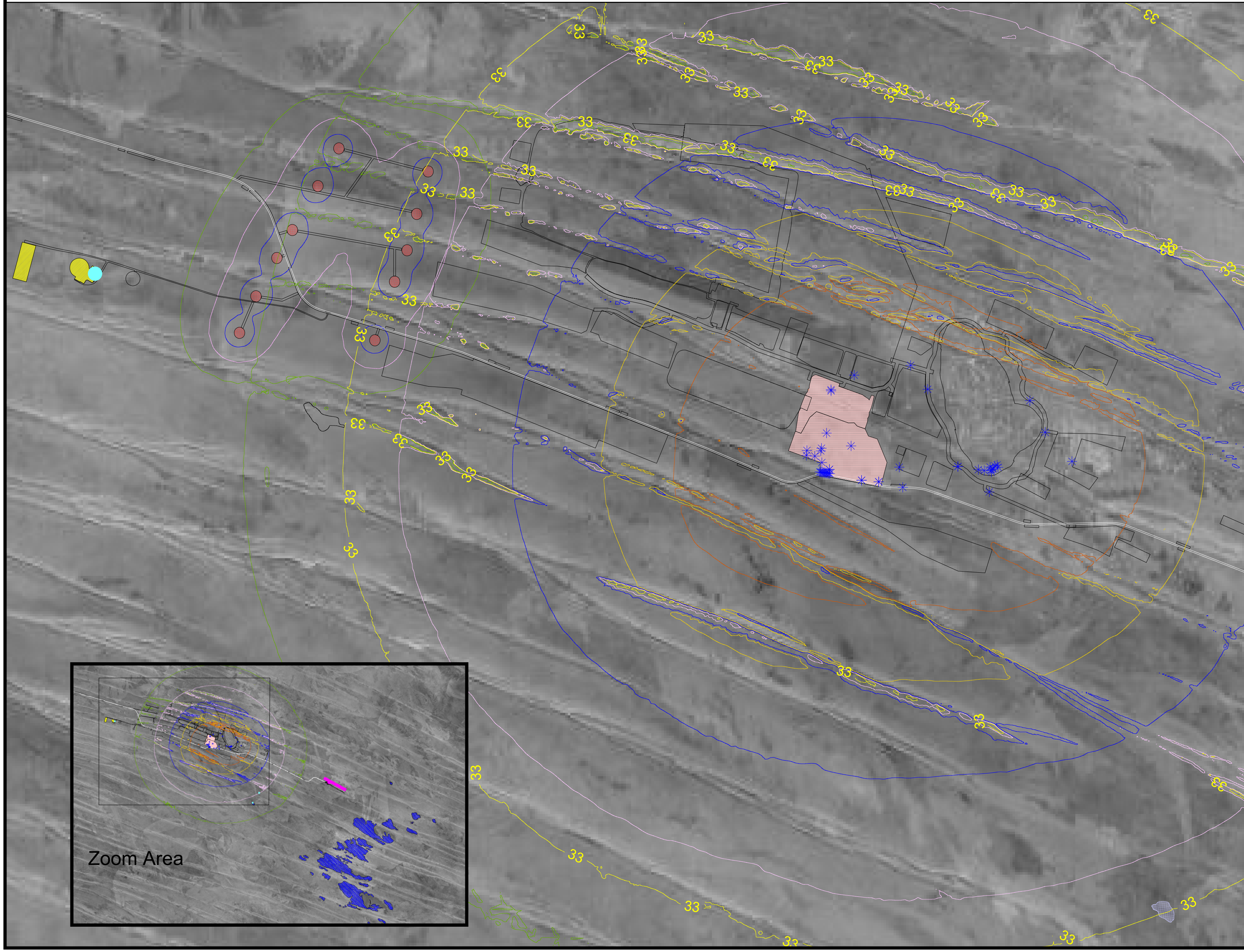
Scale 1: 200000
0 1 2 4 6 8 km

Figure A3

Figure 4-4: All Mining Operations and Windfarm at 4m/s, dB L_{A10}

Winu Project, Western Australia



Predicted Noise level

= 30
= 35
= 40
= 45
= 50

Legend

Calculation Receiver
Plant/Mobile Source
Access Road
Developed Areas
Winu Camp
ROM/Processing Plant
Airport
Wind Turbine
Night Parrot - Foraging
Night Parrot - Roosting

N

0 500 1000 2000 3000 m

Project No: 24129774
Consultant: MM
Date: 24/03/2025
Algorithm: CONCAWE
SoundPLAN Version: 9.0

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5. CONCLUSION

Operational mining noise from the proposed Winu Project was modelled to the Winu Camp and is predicted to comply with the criterion provided in the *Guideline – Assessment of Environmental Noise Emissions* (DWER) at all times and in worst case scenarios.

The operational noise to the nearby Night Parrot Habitats is predicted to not exceed 35 dB_{LA10} with the acceptable criteria unknown for this species, the result is presented for informative purposes.

Guidance on airblast noise and vibration levels was provided to address impacts to the nearest receptors. There is no known airblast criteria for Night Parrots. Therefore, it is recommended that blasting strategies take into account this information, in conjunction with geotechnical surveys and monitoring to minimise impact on the fauna.

Noise impacts from the proposed airport were also calculated in accordance with AS2021:2015, based on departures of Fokker 100 aircraft. The expected maximum noise departure events are 70 dB_{LAMax} at the nearest Night Parrot Habitats – both roosting and foraging areas. Aircraft noise is not expected to impact the Winu Camp significantly being located more than 20km away from the air field.

Wind Farm noise is demonstrated to not contribute to mining noise levels significantly based on the 4 m/s wind speed modelling. Noise levels at the Winu Camp remain under criteria levels even up to 10 m/s.

Appendix A – Terminology & Abbreviations

The following is an explanation of the terminology used throughout this report:

- **Decibel (dB)**

The decibel is the unit that describes the sound pressure levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

- **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A, dB.

- **Sound Power Level (L_w)**

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure level at known distances. Noise modelling incorporates source sound power levels as part of the input data.

- **Sound Pressure Level (L_p)**

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc. and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

- **L_{ASlow}**

This is the noise level in decibels, obtained using the A-frequency weighting and the S (slow) time weighting. Unless assessing modulation, all measurements use the slow time weighting characteristic.

- **L_{AFast}**

This is the noise level in decibels, obtained using the A-frequency weighting and the F (fast) time weighting. This is used when assessing the presence of modulation.

- **L_{APeak}**

This is the greatest absolute instantaneous sound pressure level in decibels using the A-frequency weighting.

- **L_{Amax}**

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

- **L_{A1}**

The L_{A1} level is the A-weighted noise level exceeded for 1 percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

- **L_{A10}**

The L_{A10} level is the A-weighted noise level exceeded for 10 percent of the measurement period and is considered to represent the “intrusive” noise level.

- **L_{A90}**

The L_{A90} level is the A-weighted noise level exceeded for 90 percent of the measurement period and is considered to represent the “background” noise level.

- **L_{Aeq}**

The equivalent steady state A-weighted sound level (“equal energy”) in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the “average” noise level.

- **L_{Zpeak}**

The absolute highest sound pressure level (in Pascals) or the highest noise level in decibels measured over a given period. The level is unweighted denoted by “Z”. Typically used in WA Regulations for blasting criteria.

- **One-Third-Octave Band**

Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20000 Hz inclusive.

- **Representative Assessment Period**

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

- **L_{Amax} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded at any time.

- **L_{A1} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 1 percent of the representative assessment period.

- **L_{A10} assigned level**

Means an assigned level, which, measured as a L_{ASlow} value, is not to be exceeded for more than 10 percent of the representative assessment period.

- **Tonal Noise**

A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

– the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

- **Modulating Noise**

A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

– a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band; and

(b) is present for at least 10% of the representative assessment period; and

(c) is regular, cyclic and audible.

- **Impulsive Noise**

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness means:

– a variation in the emission of a noise where the difference between L_{Apeak} and L_{Amax} is more than 15 dB when determined for a single representative event.

- **Peak Component Particle Velocity (PCPV)**

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x,y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

- **Peak Particle Velocity (PPV)**

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

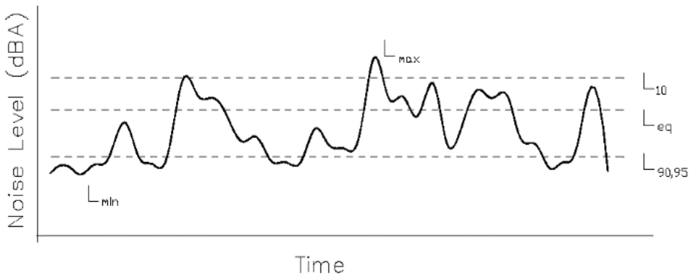
- **RMS Component Particle Velocity (PCPV)**

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

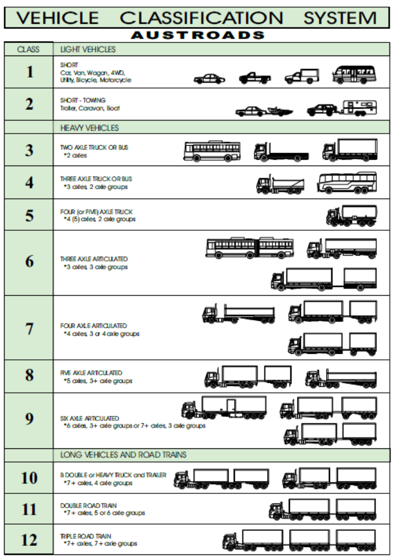
- **RMS Peak Particle Velocity (PPV)**

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

- **Chart of Noise Level Descriptors**



- **Austroads Vehicle Class**



- **Typical Noise Levels**