Appendix 62 Noise Impact Assessment – Willowdale Mine Larego Region

Willowdale Mine - Larego Region

Noise Impact Assessment

Alcoa of Australia Limited

23 October 2024

→ **The Power of Commitment**

Project name		Alcoa Larego Region & Myara Region Social Surrounds Assessment					
Document title		Willowdale Mine - Larego Region | Noise Impact Assessment					
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Glossary and abbreviated terms

Term	Description
AS	Australian Standard
Alcoa	Alcoa of Australia Limited
BSEC	Bauxite Strategic Executive Committee
CONCAWE	Conservation of Clean Air and Water in Europe
CEO	Chief Executive Officer
dB	Decibel, unit of sound pressure level
dB(A)	Decibel (A-weighted)
dB(L) $_{\text{Linear peak}}$	Decibel (Linear), peak value of measurement period
EPA	Environmental Protection Authority
GHD	GHD Pty Ltd
ha	Hectare, unit of surface area
IF	Influencing factor
ITAG	Independent Technical Advisory Group
ISO	International Organisation for Standardisation
km	Kilometre, unit of distance
L_{Aeq}	Equivalent continuous sound level over A-weighted spectra
L_{A90}	Noise level exceeded for 90 percent of the measurement period over A-weighted spectra
L_{A10}	Noise level exceeded for 10 percent of the measurement period over A-weighted spectra
L_{A1}	Noise level exceeded for one percent of the measurement period over A-weighted spectra
m	Metre, unit of distance
MMP	Mining Management Program
MMPLG	Mining and Management Program Liaison Group
ms	Millisecond, unit of time
NIA	Noise impact assessment
NMP	Noise Management Plan
NSR	Noise sensitive receptor
ROM	Run of Mine
RFI	Request for information
SPL	Sound pressure level
SWL	Sound power level
SSIA	Social Surrounds Impact Assessment
The Proposal	Construction and operation within Myara Mine Region five-year mine plan (2023-2027)
The Regulations	Western Australia's Environmental Protection (Noise) Regulations 1997

Executive summary

Alcoa of Australia Limited (Alcoa) is operating the Willowdale Mine in the Larego Mine Region in accordance with a Mining Management Program (MMP) assessment under Alcoa's State Agreements. The MMP is subject to progressive update and approval on an annual basis by the Independent Technical Advisory Group (ITAG) and is then endorsed for Ministerial approval with the Bauxite Strategic Executive Committee (BSEC) advising the Minister as part of this process. Alcoa commits to undertake a Social Surroundings Impact Assessment (SSIA) to support this MMP. A Noise Impact Assessment (NIA, this report) is one of the technical studies required as part of the SSIA.

The NIA investigates potential noise impacts that may arise from the construction and operation of mining activities proposed within Larego Mine Region throughout the duration of the 5-year mine plan. Blasting noise and vibration during development and mining operations proposed within Larego Mine Region are expected to be relatively minor compared to the mining operation and therefore a qualitative construction assessment approach was adopted. A quantitative approach utilising noise modelling was adopted to assess the operation of mining activity within Larego Mine Region.

Operational noise modelling for Larego Mine Region predicted noise emissions from 2024 to 2027. Pit clearing, mine development and mining will occur in a phased approach in adjacent zones to start in 2024 and end in 2027. Rehabilitation works will extend from 2027 to 2030.

Because there are Noise Sensitive Receptors (NSR)s in close proximity to the mining operation, for which standard mining operation are not expected to comply, noise sensitivity modelling has been undertaken. This informed the in-principal mitigation to aim for compliance with the assigned levels. The in-principal mitigation includes set-back distances and requirements for noise control of the fleet within the sensitive zones.

It is worth noting that the noise modelling methodology employed is worst-case both from an operational and meteoroidal point of view.

The following worst-case years of operation were selected to be modelled:

- Scenario A (Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits with daytime NSRs and sensitivity zone mitigation included).
- Scenario B (Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits with night-time NSRs and sensitivity zone mitigation included).
- Scenario C (Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits with Bibbulmun Track users during daytime as NSRs and no mitigation included).
- Scenario D (Rehabilitation in 2023 and 2024 pits, Mining in 2025 and 2026 pits, Mine development in 2027 pits with daytime NSRs and sensitivity zone mitigation included.
- Scenario E (Rehabilitation in 2023 and 2024 pits, Mining in 2025 and 2026 pits, Mine development in 2027 pits with night-time NSRs and sensitivity zone mitigation included).

The worst-case condition was qualified by the following:

- Mining activities occur at pit locations closest to the NSR.
- Mining activities occur at the surface and not at lower depths inside pits.
- Full duty cycle and simultaneous operation of all mobile fleet.
- Wind direction is from source to receptor for each NSR.

The findings of the assessment for the Proposal are summarised as follows:

- Some NSRs i.e. NSR1, NSR9 (and NSR15 if it is occupied in near future) have potential for operational noise exceedance under the worst-case conditions. It should be noted that NSR15 is currently unoccupied and unlikely to change in near future (according to the RFI received form Alcoa on 9 August 2024).
- Two NSRs (i.e. NSR2 and NSR9 and NSR13) are also considered non-compliant if tonality is present in the mining noise

– Some NSRs i.e. NSR2, NSR9, NSR13 (and NSR15 if it is occupied in near future) may be subject to audible mining noise under the worst-case conditions during night-time
– Under operational conditions, it is expected that the predicted potential risk of non-compliance is reduced considerably:
    - Mining activities spread out over a larger number of pit locations in comparison with the worst-case scenarios which consider pits that are really close to the NSRs.
    - Mining activities occur at lower elevation than natural ground surface due to pit depths, thus introducing additional noise shielding and reducing projected noise levels.
    - Mobile fleet will not always be simultaneously operating under full load conditions.
    - Wind direction is based on meteorological conditions and varies (instead of defaulting to downwind conditions as have been considered in the worst-case noise modelling presented in this study).
– According to the results of sensitivity modelling, if only 1 working unit is used within 4 km from NSR1, NSR9, and NSR15 (if is the building at NSR15 was to be occupied in the near future), it is expected that predicted noise level will comply with the noise criteria at all NSRs during both night-time and daytime periods.
– Ground borne noise and vibration due to blasting is expected to be insignificant at all of the nearby NSRs except for the mine development pits close to NSR1 and NSR15 (if the building at NSR15 was to be occupied in the near future). Therefore, smaller charge masses (less than 7kg) must be used along with careful Noise Management Plan (NMP) and monitoring.
– Operational NMP and complaint handling practices are also provided in this report to maintain noise compliance under worst-case conditions and to ensure that any issues related to noise and/or vibration are addressed and appropriate corrective actions are identified.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.4 and the assumptions and qualifications contained throughout the report.

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1. Introduction

1.1 Proposal description

Alcoa of Australia Limited (Alcoa) mining operations comprise the Huntly and Willowdale bauxite mines, which are located in Alcoa's Mining Lease 1SA within the Northern Jarrah Forest, interim biogeographical regionalisation for Australia subregion, within south-west Western Australia.

Alcoa's Willowdale Mine supplies bauxite to the Wagerup Alumina Refinery. Alcoa is continuing Willowdale Mine development southwards from the Orion mine region into the new Larego Mine Region (the Proposal). The Willowdale Mine is located within the Northern Jarrah Forest on the Darling Plateau. The Larego Mine Region is located predominantly within the Shire of Harvey, with the northern portion located within the Shire of Waroona, approximately 110 km south-east of Perth.

The NIA considers mining operations within Larego Mine Region under the Mining Management Program (MMP) 2023-2027 (the Proposal) approved under Alcoa's State Agreements. Alcoa has requested a Social Surrounds Impact Assessment (SSIA) which includes Noise Impact assessment (NIA) to support MMP assessment of the Willowdale Mine under Alcoa's State Agreements.

1.2 Purpose of this report

To provide Alcoa with the NIA required to support a SSIA for mining operations under the MMP 2023-2027 for Larego Mine Region, this report has been prepared in accordance with the following guidelines:

– Environmental Factor Guideline: Social Surroundings (EPA 2023)

– Draft Guideline: Assessment of environmental noise emissions (DWER 2021)

– Environmental Protection (Noise) Regulations 1997

– Australian Standard 2187-2:20006 Appendix J-Ground Vibration and Airblast Overpressure.

1.3 Scope of Works

The proposed scope of works for noise modelling and impact assessment for the Proposal are as follows:

- Desktop review of the available preliminary mine plan and nearby noise sensitive receptors (NSR).
- Identify assigned noise levels at selected sensitive receptors and specify relevant airblast criteria and ground vibration criteria.
- Develop acoustic models under the established typical worst-case mining operation scenarios, to generate noise contour plots and predict noise levels at nearby sensitive receptors.
- Undertake modelling predictions for airblast levels and ground vibration levels at nearby sensitive receptors, under the corresponding worst-case scenarios, based on *AS 2187.2-2006 - Appendix J – Ground Vibration and Airblast Overpressure.*
- Assess the predicted noise levels, air-blast levels and ground vibration levels against relevant assessment criteria, as well as against baseline noise environment via audibility assessment.
- Provide practical mitigation and control recommendations if the exceedances are predicted.
- Prepare draft technical report documenting assessment methodology, modelling predictions, assessment results and relevant mitigation and control recommendations.
- Prepare final technical report based on Alcoa comments on draft report.

1.4 Limitations

This report has been prepared by GHD for Alcoa of Australia Limited and may only be used and relied on by Alcoa of Australia Limited for the purpose agreed between GHD and Alcoa of Australia Limited as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Alcoa of Australia Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Proposal background

2.1 Proposal overview

Alcoa operates the Willowdale Mine and is continuing its development southwards from the Orion Mine Region into the new Larego Mine Region (the Proposal). The Proposal includes mining operations proposed within Larego Mine Region five-year mine plan under the MMP 2023-2027.

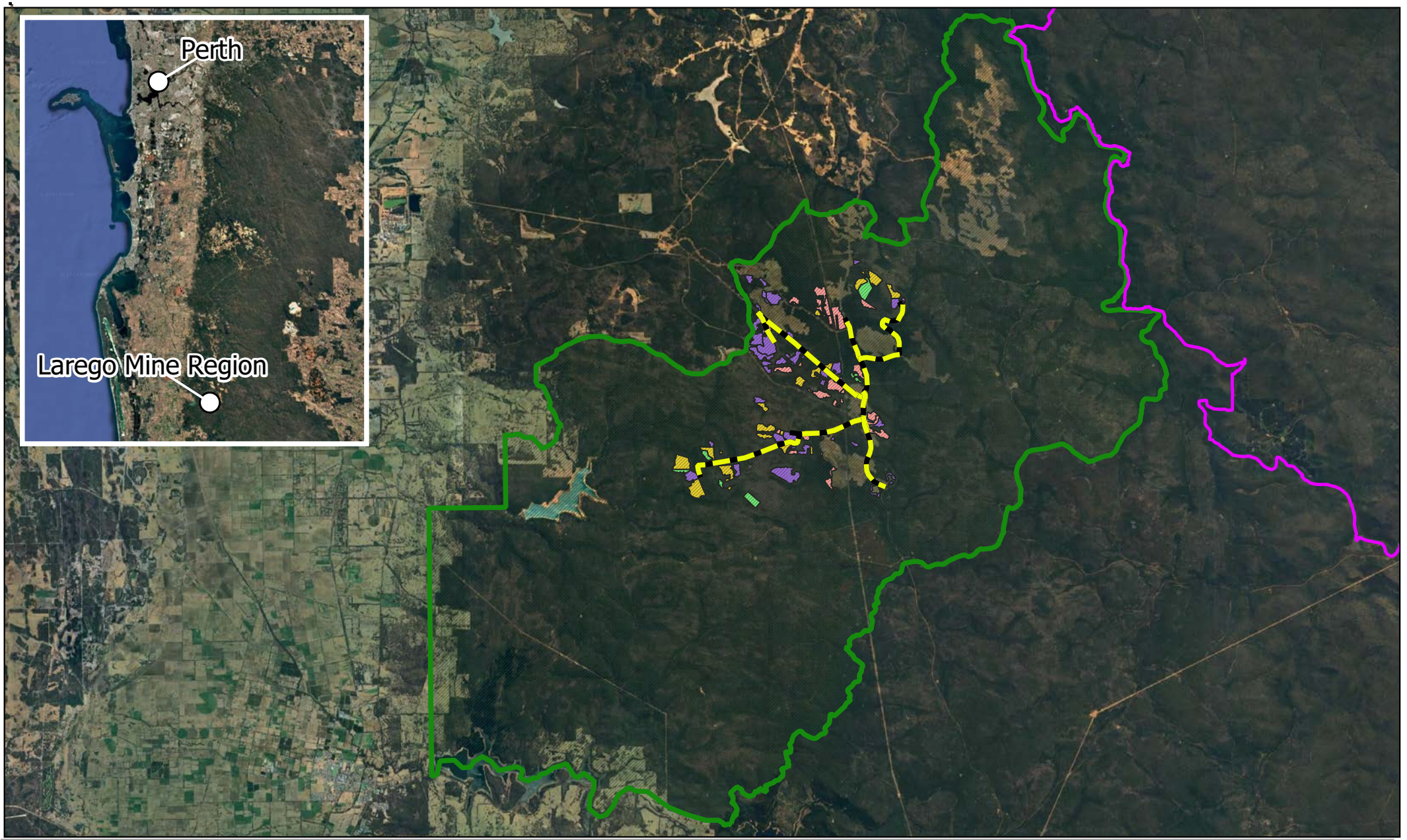
The Larego region is located primarily in the Southwest Region of Western Australia (WA), within the Shire of Harvey, approximately 110 km south-east of Perth and comprises approximately 23,422 ha. The mine region is bounded by the Murray River and Lane Poole Recreation Reserve to the east, the Arundel and Orion mine regions and Lane Poole Conservation Reserve to the north and the ML1SA boundary and private property to the west.

The Larego Mine Region is shown in Figure 2.1.

2.2 Mining operations

The proposed mining operations include the following:

- Development of haul roads.
- Pre-mining (Mine development) activities including drill and blast operations and overburden removal using scrapers and excavators.
- Mine development (Mining) activities including drilling, logging, clearing and disposal of wood waste.
- Load and haul mining of bauxite ore involving a mobile equipment fleet of excavators, loaders, haul trucks and dozers.
- Rehabilitation activities using dozers and scrapers for landscaping, pre-ripping, soil return, contour ripping, followed by planting and fertilising.
- Construction of heavy and light vehicle access roads.



Legend

- Bibbulmun Track
- Haul Road
- Larego Mine Region

Mining Zones

- 2024
- 2025
- 2026
- 2027

Paper Size ISO A4

0 1 2 3 4 km

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

N

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Site Location

Project No.	**12632796**
Revision No.	A
Date.	**23/10/2024**

FIGURE 2.1

Document Path: \\ghdnet\ghd\AU\Melbourne\Projects\61\12632796\04_Tech\Noise\Huntly and Willowdale Mine Plan.qgz
Print Date: 23/10/2024

Data Source:Google Earth Imagery 2024.
Created By: hsatari

3. Assessment methodology

This NIA of the Proposal was undertaken in accordance with EPA and contemporary guidance to predict noise and vibration impact on surrounding noise sensitive receptors (NSRs). The modelling evaluates potential worst-case impacts from the Proposal and outlines how these impacts can be managed. The assessment was undertaken with consideration to the Regulations which is further referenced in Section 4.

3.1 Approach

3.1.1 Blasting methodology

Blasting noise and vibration, is assessed qualitatively as outlined in Section 8 against the vibration noise and blasting criteria outlined in Sections 0 and 4.3.

3.1.2 Operational methodology

The assessment adopted a quantitative approach using noise modelling to assess the operation (which encompasses mine development, mining and rehabilitation) of proposed mining activities within Larego Mine Region at multiple mining zones. Alcoa proposes the operation of mining activities within Larego Mine Region to be staged over several years where selected zones will be mined each year as shown in Figure 2.1. Once mining has concluded in a particular zone, operations will transition into a new zone. The mining location varies from year to year.

For assessment purposes, GHD focused on determining the worst-case noise impact to each of the NSRs for both day and night periods as well as under the worst-case meteorological conditions from a noise propagation perspective. These selections and parameters are outlined in Section 6.

4. Noise and vibration criteria

4.1 Operational noise

In Western Australia noise emissions are assessed on a premises-to-premises basis, where noise emitted by one premises is to be capped so it will not exceed the assigned level (i.e. noise limit) at the nearest premises.

For this purpose, the Regulations specify maximum allowable external noise levels at noise sensitive, commercial and industrial premises. The Regulations (Regulation 7) define prescribed standards for noise emissions as follows:

7. (1) Noise emitted from any premises or public place when received at other premises –

> *1. Must not cause or significantly contribute to a level of noise which exceeds the assigned level in respect of noise received at premises of that kind*
>
> *2. Must be free of –*
>
> > *(i) Tonality (e.g. whining or droning)*
> >
> > *(ii) Impulsiveness (e.g. sirens)*
> >
> > *(iii) Modulation (e.g. banging or thumping)*

Furthermore, a *…noise emission is taken to significantly contribute to a level of noise if the noise emission exceeds a value which is 5 dB below the assigned level…*

The assigned levels (Regulation 8) are shown in Table 4.1.

Table 4.1 Assigned noise levels, dB(A)

Type of premise receiving noise	Time of day	Assigned level, dB(A)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[2]	7.00 am to 7.00 pm Monday to Saturday (Day)	45 + IF	55 + IF	65 + IF
	9.00 am to 7.00 pm Sunday and public holidays (Sunday)	40 + IF	50 + IF	65 + IF
	7.00 pm to 10.00 pm all days (Evening)	40 + IF	50 + IF	55 + IF
	10.00 pm on any day to 7.00 am Monday to Saturday and 9.00 am Sunday and public holidays (Night)	35 + IF	45 + IF	55 + IF
Noise sensitive premises[3]	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours	65	80	90

Notes:

1. IF = influencing factor
2. Noise sensitive areas that are classified as highly sensitive areas include a building, or a part of a building, on the premises that is used for a noise sensitive purpose and any other part of the premises within 15 metres of that building or that part of the building.
3. Any other areas located further than 15 metres from a building and directly associated with a noise sensitive use.

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

> *(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission.*
>
> *(b) The noise emission complies with the standard after the adjustments of* Table 4.2 *are made to the noise emission as measured at the point of reception.*

Table 4.2 Adjustment for intrusive or dominant noise characteristics, dB[1]

Tonality[2]	Impulsiveness[3]	Modulation[3]
+5	+10	+5

Notes:

1. Adjustment applies where noise emission is not music
2. Adjustments are cumulative to a maximum of 15 dB
3. Any area other than highly sensitive area

Assigned noise levels in Table 4.1 have been set differently for noise sensitive, commercial and industrial and utility premises. For noise sensitive premises an influencing factor (IF) is incorporated into the assigned noise levels. IF depends on land-use zonings within circles of 100 m and 450 m radius from the noise receptor, including:

- Proportion of industrial land use zonings
- Proportion of commercial zonings, and
- Presence of major (more than 15,000 vehicles per day) or secondary (6000 to 15,000 vehicles per day) roads.

For this assessment it has been assumed that the IF is zero for all noise sensitive premises surrounding the Larego Mine Region, as they are more than 450 m from any industrial or commercial premises or major road.

For noise sensitive residences, the time of day also affects the assigned levels. The Regulations define three types of assigned noise levels:

- L_{A10} assigned noise level which is not to be exceeded for more than 10 percent of the time
- L_{A1} assigned noise level which is not to be exceeded for more than one percent of the time, and
- L_{Amax} assigned noise level means a noise level which is not to be exceeded at any time.

The L_{A10} noise limit is the most significant for this assessment as this is most representative of continuous noise emissions.

An important impact on Regulation 7 assigned noise levels as per Table 4.1, is that when the noise sensitive receptor location is already affected by industrial noise from outside the Project. There is a requirement for new noise sources that are introduced to the area to comply with a noise limit that is set 5 dB(A) below the assigned noise levels at this noise sensitive receptor (DWER, 2021).

4.2 Blasting noise

The Regulations state that airblast levels resulting from blasting on any premises or public place received at any other premises must not exceed the following limits.

Table 4.3 Blasting noise guide values as per Regulation 11 in the Regulations

Time period	Time	Construction noise requirements
Daytime	7:00 am to 6:00 pm on any day which is not a Sunday or a public holiday	– 125 dB(L) $_{Linear, peak}$ for any blast, and – 120 dB(L) $_{Linear, peak}$ for nine in any ten consecutive blasts, regardless of the interval between blasts.

Time period	Time	Construction noise requirements
Sunday and public holidays	7:00 am to 6:00 pm on Sunday or a public holiday	– 120 dB(L) $_{\text{Linear, peak}}$ for any blast, and – 115 dB(L) $_{\text{Linear, peak}}$ for nine in any ten consecutive blasts, regardless of the interval between blasts.
Out of hours	6:00 pm to 7:00 am on any day which is not a Sunday or a public holiday	– 90 dB(L) $_{\text{Linear, peak}}$ at any other premises, and – The only exception is that explosives which have previously been placed and primed may be fired if necessary to meet a safety requirement of the Department of Minerals and Energy (DME), in which case the levels must meet those given above for daytime and weekend blasting, for the time when the blast was scheduled to be fired.

Furthermore, the Regulations give guidance on peak sound levels dB(L) $_{\text{Linear, peak}}$ for blasting noise, whereby:

- Monday to Friday Daytime level: 125 dB(L) $_{\text{Linear, peak}}$
- Sunday and public holiday Daytime level: 120 dB(L) $_{\text{Linear, peak}}$

4.3 Blasting vibration

For blasting vibration, the following limits minimise risk to any premises nearby.

Table 4.4 Blasting vibration guide values as per AS 2187.2-2006

Time period	Time	Blasting requirements
Daytime	7:00 am to 6:00 pm on any day which is not a Sunday or a public holiday	– No vibration level resulting from blasting on any premises or public place, when received at any other premises, may exceed a peak particle velocity of 10 mm/s. – The vibration levels for 9 in any 10 consecutive blasts (regardless of the interval between blasts) on any premises or public place, when received at any other premises, must not exceed 5.0 mm/s.
Out of hours	6:00 pm and 7:00 am on any day which is not a Sunday or a public holiday	– No vibration level resulting from blasting on any premises or public place, when received at any other premises, may exceed a peak particle velocity of 1.0 mm/s. – The vibration levels for 9 in any 10 consecutive blasts (regardless of the interval between blasts) on any premises or public place, when received at any other premises, must not exceed 0.5 mm/s.

5. Existing environment

5.1 Site description

The Willowdale Mine is located within the Northern Jarrah Forest on the Darling Plateau. The Larego Mine Region is located predominantly within the Shire of Harvey, with the northern portion located within the Shire of Waroona.

The mine region is bounded by the Murray River and Bibbulmun Track to the east, the Arundel and Orion mine regions and Lane Poole Conservation Reserve to the north and the ML1SA boundary and private property to the west.

5.2 Ambient noise environment

GHD reviewed the results of ambient noise monitoring conducted by Wood between 4 July 2020 and 10 September 2020 using eight loggers (Wood, 2023) within the Holyoake region as well as two other loggers with noise data recorded over the second half of 2023. Even though all these loggers were located at least 11 km to the north of the Larego mine regio, the summary of the background noise surveys provides useful information on the ambient noise environment over the Larego Mine Region given. The main outcomes are detailed as follows:

- The ambient noise levels are typical of rural areas and are associated with community activities including dogs, livestock and noise from localised equipment.
- Traffic noise associated with the community activities starts from approximately 4 – 5am and continue to feature prominently throughout the daylight hours.
- Recorded L_{A10} values during night-time periods generally range from 27 to 57 dB(A). Occasionally during quiet periods, faint rumbling and revving characteristics of emissions from mobile equipment can be heard.

The baseline noise survey outcome suggests absence of industrial noise; thus, it is believed there is no requirement to use a noise criterion which is 5 dB below the assigned levels (Table 4.1).

Table 5.1 presents a summary of background noise for the two closest loggers located 11 and 13 km to the north of the Larego Mine Region (Pinzone and Sheltons respectively. Data received from Alcoa on 8 July 2024).

Table 5.1 Overview of relevant background noise levels captured during July-December 2023

Monitoring location Name	Coordinates (Easting, Northing)	Sound pressure level, dB(A)					
		Day L_{A90} Range	Evening L_{A90} Range	Night L_{A90} Range	Day L_{A10} Range	Evening L_{A10} Range	Night L_{A10} Range
Pinzone	407624,6368000	25 - 39	23 - 42	23 - 44	38 - 57	27 - 57	27 - 57
Sheltons	406997,6370366	25 - 43	22 - 45	22 - 46	39 - 53	29 - 54	28 - 23

5.3 Noise sensitive receptors

NSRs have been selected following a desktop review and have been confirmed by Alcoa. As the identified NSRs are remote, with no commercial or industrial zones as well as an absence of any major roads, the IF is equal to nought at all receivers as per the Regulations.

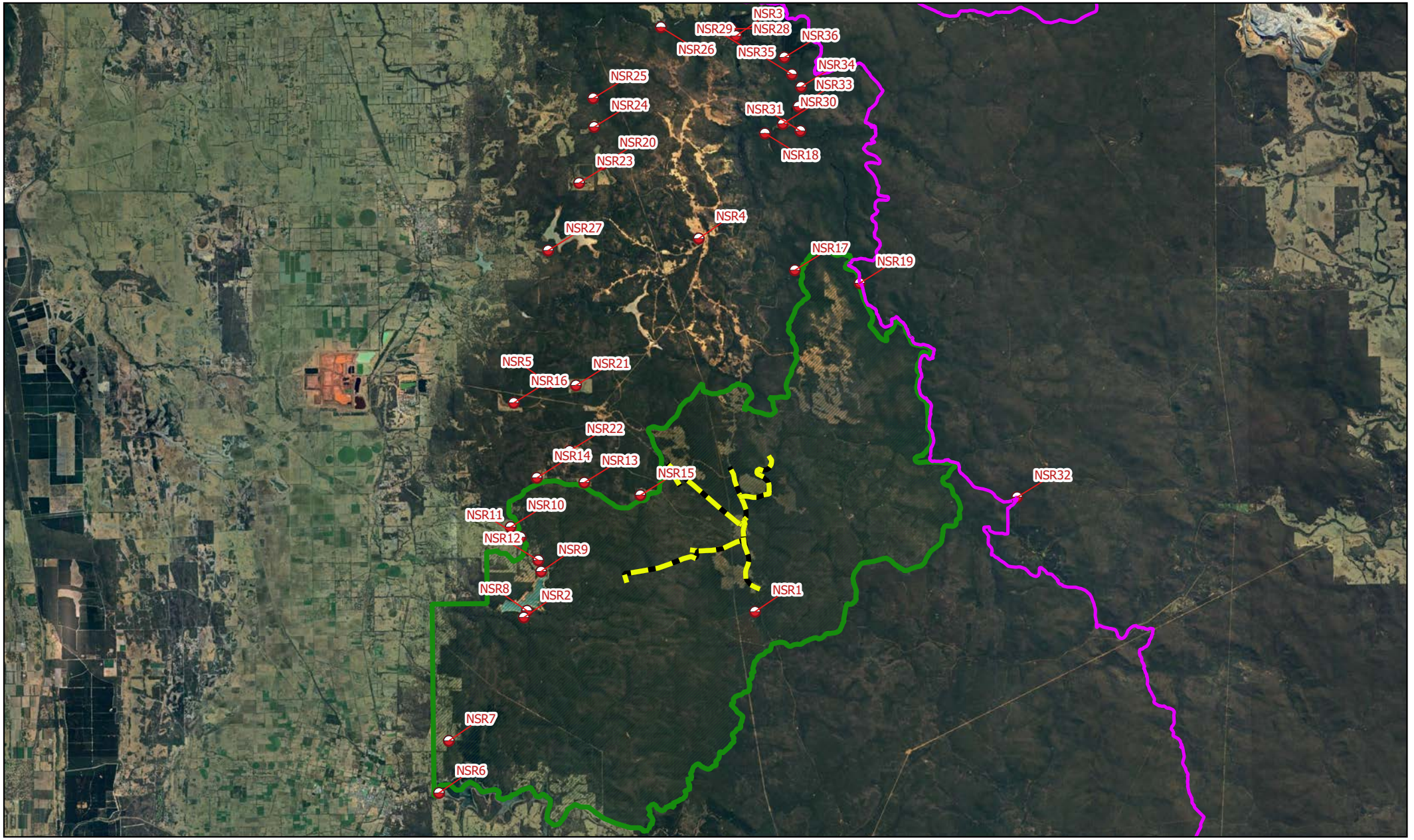
Table 5.2 summarises the details on the NSRs, and Figure 5.1 illustrates their locations.

Table 5.2 Noise sensitive receptors and assigned noise levels

ID	Name	Description	Coordinates		Assigned noise levels L_{A10}		
			Easting	Northing	Day	Out of hours / Sundays and Public Holidays	Night
R1	Hoffman Mill	Campground	414446.4	6347715	45	40	- [1]
R2	Logue Brook Campground	Campground	403783.4	6347451	45	40	35
R3	Nanga Bush Camp	Campground	413571.9	6374278	45	40	35
R4	Willowdale Orion office	Workplace	411851	6364933	45	40	35
R5	Waterous Scout Campsite	Campground	404964.3	6358243	45	40	35
R6	Gibbs Pool Amphitheatre	Recreational	399869.2	6339352	45	40	- [1]
R7	Wildflower Ridge Walk	Recreational	400323.3	6341756	45	40	- [1]
R8	Lake Brockman Tourist Park	Recreational	403928.6	6347760	45	40	35
R9	Lake Brockman Campsite	Campground	404581.9	6349570	45	40	35
R10	431 Black Rock Road, Yarloop	Residential	403174.3	6351619	45	40	35
R11	450 Black Rock Road, Yarloop	Residential	403631.5	6351153	45	40	35
R12	Address not known	Residential	404451.6	6350085	45	40	35
R13	Alcoa owned Residential	Residential	406571.2	6353674	45	40	35
R14	883 Hoffman Road, Hoffman	Residential	404382.1	6353892	45	40	35
R15	Alcoa owned Residential	Residential	409158.5	6353091	45	40	35
R16	1143 Bancell Road, Wagerup	Residential	403318.5	6357352	45	40	35
R17	Bidjar Ngoulin Campsite	Campground	416282.5	6363472	45	40	35
R18	Nanga Townsite	Campground	414900.5	6369782	45	40	35
R19	Bibbulmun Track Murray Campsite	Campground	419274.7	6362872	45	40	35
R20	1078 Nanga Brook Road, Waroona	Residential	407402.5	6368353	45	40	35
R21	268 Bancell Road, Wagerup	Residential	406185.7	6358156	45	40	35
R22	314 Wagerup-Willowdale Road, Wagerup	Residential	405891.3	6355134	45	40	35

ID	Name	Description	Coordinates		Assigned noise levels L_{A10}		
			Easting	Northing	Day	Out of hours / Sundays and Public Holidays	Night
R23	323 Scarp Road, Waroona	Residential	406334.5	6367495	45	40	35
R24	851 Nanga Brook Road, Waroona	Residential	407026	6370081	45	40	35
R25	847A Nanga Brook Road, Waroona	Residential	406980.6	6371404	45	40	35
R26	21 Oro Road, Dwellingup	Residential	410101.4	6374681	45	40	35
R27	24 Prince Road, Waroona	Residential	404905.4	6364382	45	40	35
R28	Lane Pool Reserve	Recreational	413349.3	6374613	45	40	- [1]
R29	Baden Powell Campsite	Campground	414231.5	6373582	45	40	35
R30	Nanga Mill Campground	Campground	415727.2	6370225	45	40	35
R31	Stringers Campground	Campground	416537.5	6369897	45	40	35
R32	Dookanelly Campsite	Campground	426537.8	6353000	45	40	35
R33	Island Pool rest area	Recreational	416450.6	6371024	45	40	- [1]
R34	Chuditch Campground	Campground	416570.7	6371928	45	40	35
R35	Charlies Flat Campground	Campground	416147.6	6372512	45	40	35
R36	Bob's Crossing rest area	Recreational	415798.1	6373291	45	40	- [1]

[1] Receptor not being used overnight, noise level only needs to comply with the assigned noise levels for daytime, Sundays and Public holidays.



Legend

- Bibbulmun Track
- Haul Road
- Larego Mine Region
- Noise Sensitive Receptor

Mining Zones
- 2024
- 2025
- 2026
- 2027

Paper Size ISO A4

0 1 2 3 4 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Noise Sensitive Receptors

Project No. **12632796**
Revision No. A
Date. **23/10/2024**

FIGURE 5.1

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6. Operational noise modelling methodology

6.1 Modelling assumptions

Alcoa utilises operating units which are assigned to the exploitation of a group of pits. Each operating unit comprises of a combination of mobile equipment as described in Table 6.1. For assessment purposes, different mining operations have been assumed to take place at various pits according to the proposed MMP. As a result, mobile equipment (noise sources) were distributed among seven operating units which are summarised in Table 6.1.

There are operating units for mining (A, B and C), mine development (D and E) and rehabilitation operations (F and G) that run concurrently in separate pits (Table 6.1). Also mining operations were assumed to be completed over five years. As a result, for example when mine development is taking place at two separate zones in 2025 (units D and E), mining is occurring in three separate zones that have been developed during 2023 and 2024 (units A, B and C), and rehabilitation is occurring in two separate zones that have been developed in 2021 and 2022 (units F and G).

For conservatism, the following worst-case conditions were assumed:

- All mining operations occur simultaneously at full duty cycle.
- It is assumed that the terrain is on flat and open natural ground contours. Even though it is expected that mining pit depth could have varied average depth, it has been conservatively assumed that mining will occur at the surface level at all years.

Table 6.1 Larego mine operation equipment and locations[1]

Equipment type	Total proposed existing fleet units	Total assumed operational units [2]	Number of equipment						
			Mining			Mine development		Rehabilitation	
Mobile fleet			***Unit A***	***Unit B***	***Unit C***	***Unit D***	***Unit E***	***Unit F***	***Unit G***
Excavators (250T)	3	3	1x in pit	1x in pit	1x in pit	-	-	-	-
Haul trucks moving (190T) [3]	3	3	1 to the crusher	1 to the crusher	1 to the crusher	-	-	-	-
Haul trucks idle (190T)	3	3	1x idle in pit	1x idle in pit	1x idle in pit	-	-	-	-
Blast drills	2	2	-	-	-	1x	1x	-	-
Dozer	11	8	1x in pit	1x in pit	-	1x	2x	1x	2x
Scrapers	5	4	-	-	-	1x	1x	1x	1x
Excavators for soil & overburden removal	3	4[4]	-	-	-	1x	1x	1x	1x
Water carts [3]	1	31	-	1x to the crusher	-	-	-	-	-
Graders [3]	2	1	-	-	1x to the crusher	-	-	-	-
Loader 992	1	1	-	-	-	1x	-	-	-
Loader 993	1	1	-	-	-	-	-	1x	-
Fixed plant									
Crusher 360			1x close to the conveyer						
Diesel generators			6x close to the conveyor						

Notes:
1. Based on RFI-003 received 27 June 2024.
2. Based on an assumed availability of ~75-100% (rounded to the next full unit)
3. Haul trucks, water carts and graders have been modelled as moving sources between the crusher and the tree mining pits where units A, B and C are operating.
4. An additional excavator for soil & overburden removal has been considered for completeness of Rehabilitation Unit G.

Impact of blasting has been taken into account in Section 8. Furthermore, the model does not include noise emissions from any other sources besides source presented in Table 6.1.

6.2 Operational noise sources

The operational noise source details for modelling are shown in Table 6.2.

Table 6.2 Operational noise sources for Larego Mine Region

Equipment type	SWL, dB(A)	Octave band sound power level, (dB)									Height, m	Noise source type
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz		
Excavator (250T)	116	106	115	122	113	114	111	107	100	96	1.5	Point
Blast Drilling	115	108	121	125	115	109	107	106	102	98	1.5	Point
Haul truck (190T) drive-by	120	110	112	119	118	119	115	111	106	99	1.5	Line
Haul truck (190T) idle	107	110	119	104	101	102	103	100	91	82	1.5	Point
Dozer	116	115	120	124	118	115	108	103	96	88	1.5	Point
Scraper	108	108	117	116	112	110	108	102	97	108	1.5	Point
Excavator for soil & overburden removal	115	116	108	117	116	112	110	108	102	97	1.5	Point
Water cart	122	112	118	124	121	121	115	113	106	100	1.5	Line
Grader	111	102	107	113	110	109	105	103	95	93	1.5	Line
Loader 992	113	100	111	122	109	110	108	105	95	90	1.5	Point
Loader 993	116	101	110	121	115	116	110	106	101	94	1.5	Point
Larego crusher (Diesel engine)	110	89	97	104	109	103	105	104	98	91	3	Point
Diesel generator (0.6 MW)	105	-	85		92	96	97	98	98	97	1.5	Point

6.3 Sensitivity modelling

Several modelling scenarios were investigated to determine noise sensitivity zones, due to the proximity of some mining pits to some NSRs. The results of sensitivity modelling are used to estimate the minimum distance (setback distance) and noise level requirement for the mobile equipment fleets to achieve Alcoa's noise objectives as mining activities approach the most affected NSRs. The noise sensitivity zones are defined in Table 6.3.

Table 6.3 Noise sensitivity zone definition

Zone	Sensitivity	Definition
Do Not Mine Zone	Severe	Zones adjacent to receivers. Compliance with Assigned Levels require no mining. Careful management and noise monitoring will be required.
Premium Mining Zone	High	Zones closest, but not necessarily adjacent to receivers. Mining noise emissions controllable through 'optimised mining' with a low noise fleet. Mining activities require evaluation through active modelling and customised noise control strategies.
Attenuated Mining Zone	Medium	Zones further away but still relatively close to receivers. Mining required with noise-controlled fleet. Mining activities require evaluation through active modelling and customised noise control strategies.
Standard Mining Zone	Low	Mining with Alcoa's standard fleet (Table 6.2) without requiring additional noise controls or management.

The fleet types used for the defined sensitivity zone are as follows:

- **Standard fleet:** current Alcoa Larego fleet with the operational noise levels provided in Table 6.2
- **Attenuated fleet:** based on the current Alcoa Larego fleet but incorporating additional noise controls (e.g. engine bay treatments and upgraded exhaust silencers) providing a noise reduction of 5 dB compared to the standard fleet; and
- **Premium fleet:** based on the current Alcoa Larego fleet but assuming a 10 dB reduction compared to the standard fleet. If the 10 dB reduction is not feasible by engineering noise control, smaller/ lower powered equipment models will need to be used.

The following assumptions were adopted for the development of the noise sensitivity zones:

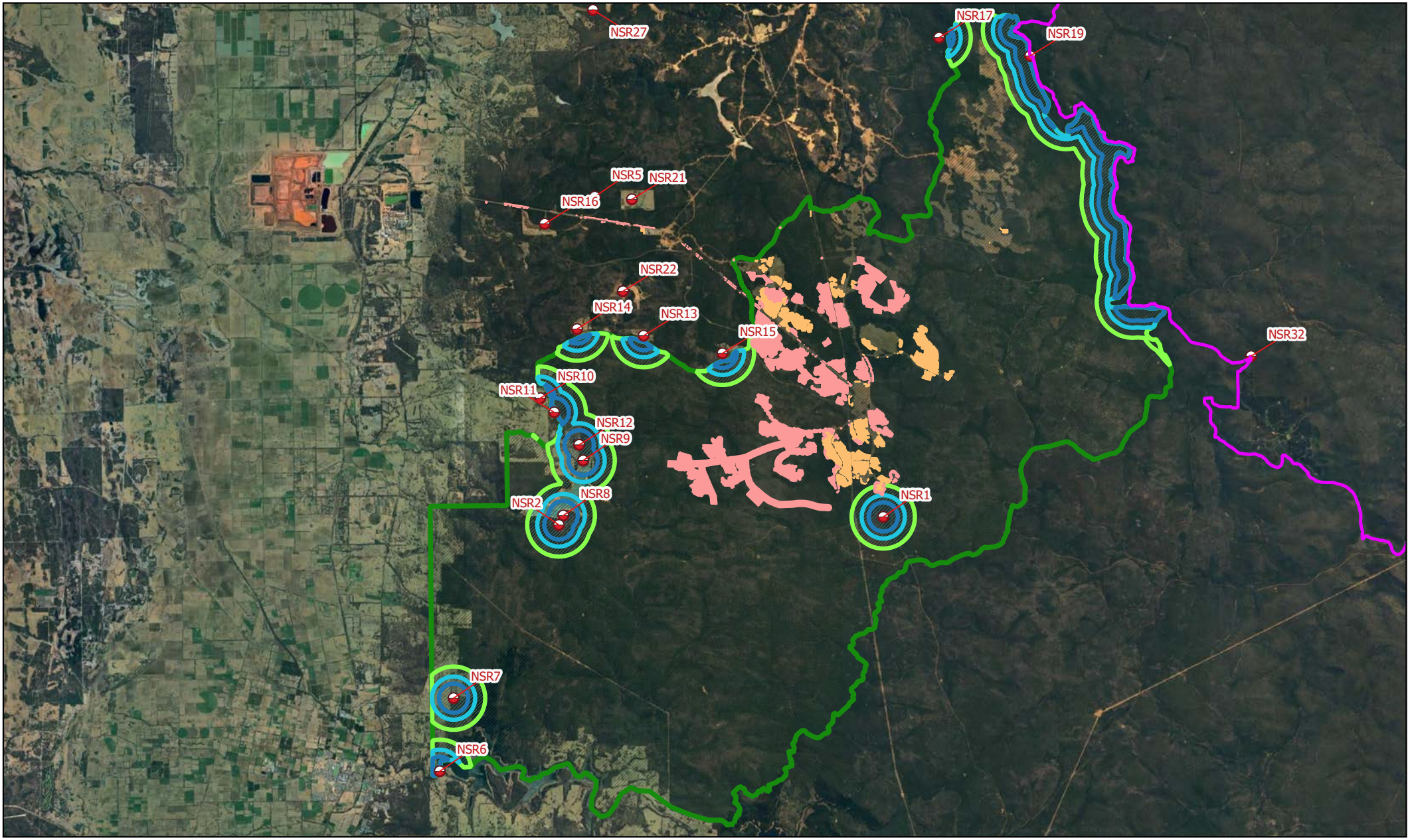
- Noise sensitivity modelling assumed 1 mining work unit composed of:
  - 1 x 250T excavator within the pit
  - 1 x 190T haul truck idling at the excavator location within the pit
  - 1 x dozer operating within the pit
  - 2 x haul trucks within the pit
- Mining operations have been assumed to be undertaken at the surface level.
- Only one work unit operating within a 4 km radius of the nearest NSR at any time. No simultaneous/ multiple operations in proximity have been considered. It is assumed that Alcoa mine planners will be able to simultaneously mine blocks outside of the 4 km radius to achieve Alcoa's mining goals.

6.3.1 Noise sensitivity zones

Figure 6.1 and Figure 6.2 present the noise sensitivity zones for the proposed Larego Mine Region for mining operations respectively during day and night. It should be noted that

- Some operational pits in the proposed 5-year mine plan are located within the "Do not mine zone", "Attenuated mining zone" and "Premium mining zone" during both day and night times.

The sensitivity modelling shown in Figure 6.1 and Figure 6.2 will be used to inform the noise modelling for NIA (Table 6.4). This means that inside sensitive zone, no fleet will be located as a source in the "Do not mine zone" areas, and noise-controlled fleet with 5 dB and 10 dB noise reduction will be used for the mine pits that are located within the "Attenuated" and "Premium" zones, respectively.



Legend

- Noise Sensitive Receptor (Day)
- Bibbulmun Track
- MMP 2024 - 2027
- MMP 2021 - 2023
- Day Do Not Mine Zone
- Day Premium Mining
- Day Attenuated Mining
- Day Standard Mining

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Daytime Mining Noise Sensitivity Zones Larego Region

Project No.	**12632796**
Revision No.	A
Date.	**23/10/2024**

FIGURE 6.1

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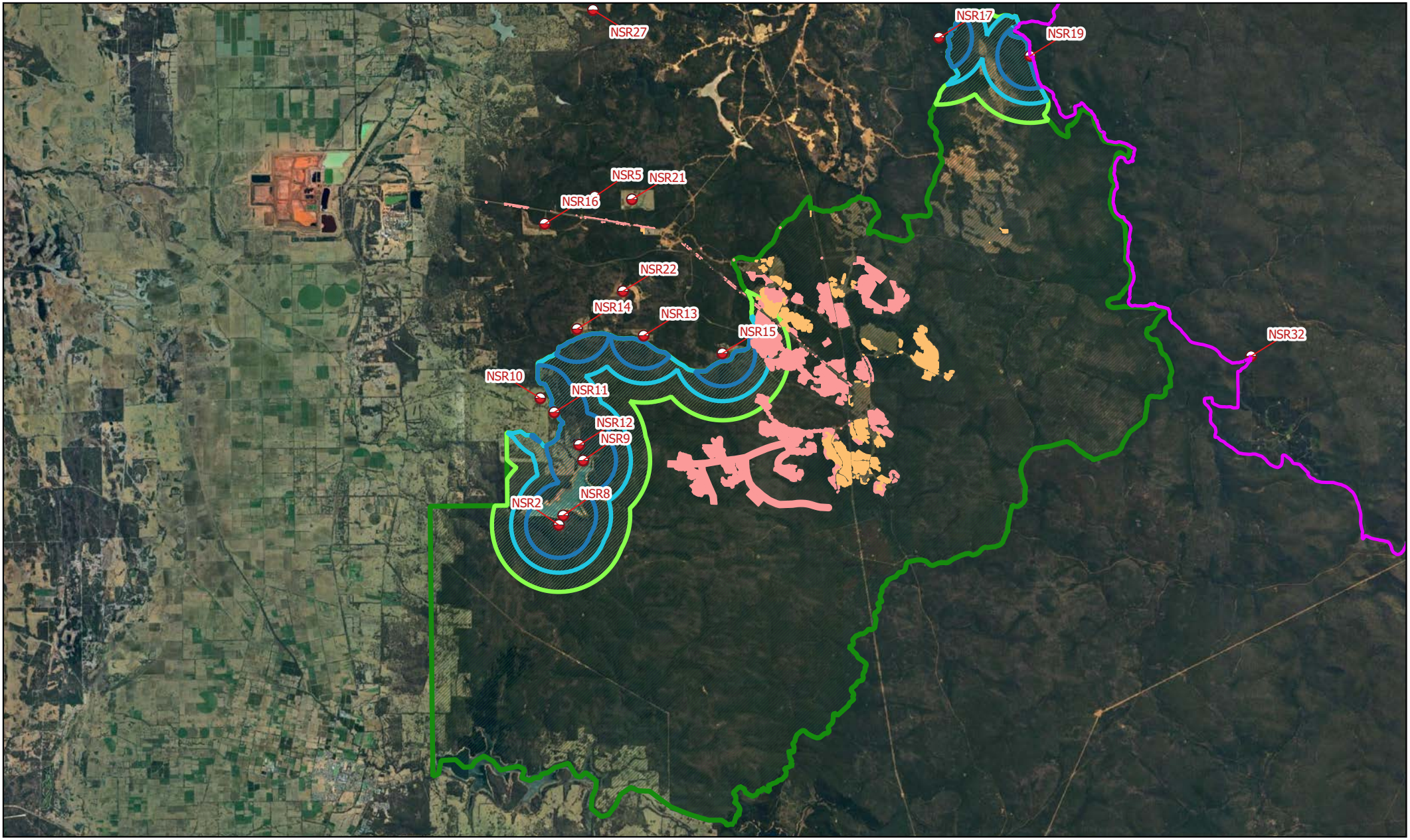

Legend

- Noise Sensitive Receptors (Night)
- Bibbulmun Track
- MMP 2024 - 2027
- MMP 2021 - 2023
- Night Do Not Mine Zone
- Night Premium Mining
- Night Attenuated Mining
- Night Standard Mining

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Nighttime Mining Noise Sensitivity Zones Larego Region

Project No.	**12632796**
Revision No.	A
Date.	**23/10/2024**

FIGURE 6.2

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6.4 Noise modelling scenarios

The noise impact on each NSR depends on the geographic location of the NSR with respect to the mining activities. The worst-case scenarios, in terms of meteorological conditions and schedule of activities, were determined using the Alcoa-provided MMPs shown in Figure 6.1 and Figure 6.2. The results of sensitivity modelling have also been considered in the scenarios with the aim of meeting the noise criteria. This is summarised in Table 6.4.

Table 6.4 Operational modelling noise scenarios

Scenario ID	Representative year	Mining activities	Fixed plant and long haul activities	Most affected receptor(s)	Mitigation required based on sensitivity modelling
1-	2025	Rehabilitation in 2021 and 2022 pits, Mining in 2024 pits Mine development in 2025 pits	Fixed plant, mobile plant, long haul ore trucking activities	-	-
A	2026	Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits		NSR1, NSR2, NSR9, NSR13, NSR15	Set-back distances and attenuated and premium fleet will be used according to the Daytime sensitivity
B	2026	Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits		NSR2, NSR9, NSR13, NSR15	Set-back distances and attenuated and premium fleet will be used according to the Night-time sensitivity
C	2026	Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits		NSR1, NSR15, Bibbulmun Track	No mitigation required as the sources are positioned as close as possible to the Bibbulmun Track, not within the sensitivity zones.
D	2027	Rehabilitation in 2023 and 2024 pits, Mining in 2025 and 2026 pits, Mine development in 2027 pits		NSR1, NSR2, NSR10, NSR14, NSR15, NSR16	Set-back distances and attenuated and premium fleet will be used according to the Daytime sensitivity
E	2027	Rehabilitation in 2023 and 2024 pits Mining in 2025 and 2026 pits, Mine development in 2027 pits		NSR2, NSR10, NSR14, NSR15, NSR16	Set-back distances and attenuated and premium fleet will be used according to the Night-time sensitivity

Notes:
1. Scenario marked with "1-" has been considered but has not been presented in this report as it does not represent worst-case from a noise emissions perspective.

For the noise modelling, there are several acoustic parameters to base the assessment upon, considering the nature, type and duration of noise sources present.

– L_{Amax} is the (A-weighted) maximum root-mean squared (RMS) noise level predicted.
– L_{A1} is the (A-weighted) noise level exceeded for one percent of the operational period.
– L_{A10} is the (A-weighted) noise level exceeded for 10 percent of the operational period.

L_{A10} will be the acoustic parameter chosen for this assessment because complying with L_{A10} implies complying with L_{A1} and L_{Amax} parameters due to it being the most conservative parameter over the range of noise sources present.

6.5 Software package

SoundPLAN 8.2 is a computer program for the calculation, assessment, and prognosis of noise propagation. SoundPLAN calculates environmental noise propagation according to CONCAWE and other algorithms. Propagation calculations consider sound intensity losses due to geometrical spreading, terrain effects, atmospheric absorption and ground absorption. The CONCAWE algorithm also takes into account the presence of wind conditions, such as 'downwind' conditions, which are favourable to sound propagation. As a result, predicted received noise levels are expected to represent a worst-case scenario, due to the distances involved between source and receptors, enhancement of noise due to weather is expected to influence the closest sensitive receptor locations.

The algorithms used in this model account for the following physical features:

- Geometrical divergence
- Atmospheric absorption
- Ground effect
- Screening by obstacles
- Reflections

6.6 Meteorological and geographical conditions

In assessing meteorological conditions, the CONCAWE method has been in accordance with WA DWER Draft Guidelines 2021. Modelling results are based on available information provided and should only be used as a guide for comparative purposes. The noise model inputs and assumptions for the operational assessment of the Project are worst-case default (according to the WA DWER Draft Guidelines 2021) and provided in Table 6.5.

Table 6.5 Noise modelling parameters

Variable	Parameter used	
Prediction algorithm	CONCAWE prediction algorithm	
Ground absorption coefficient – G = 0 is for hard, reflective ground – G = 1 is for soft, porous ground	G = 0.6 (based on vegetated land or sand)	
Receptor heights	1.5 m above ground.	
Terrain	– Three-dimensional terrain has been used in the model. – Ground contours were used based on the dataset provided by Alcoa: – For the remainder of the area 5 m ground contours were sourced from: 5 m data – retrieved from Elvis Elevation.	
Order of reflection	2	
Proposed layout	The noise model developed for this assessment was based on the mine pit shape files provided by Alcoa. 'HUN_36MTHPLAN2024_2027_PIT_HR_INFRA_20240415.shp' (April 2024)	
Meteorological Scenario	Day	Night
Temperature	20°C	15°C
Relative Humidity	50%	50%
Wind Speed [1]	4 m/s	3 m/s
Pascquill Stability	E	F

Notes: The wind direction considered in the noise model is from source to receptor as this constitutes worst-case form a noise emissions perspective.

7. Noise modelling results

For daytime activities, the most stringent assigned level will be 40 dB L_{A10} during Sundays and public holidays. The most stringent criteria overall; however, is the 35 dB L_{A10} night-time assigned level.

The predicted noise levels are presented for the NSRs for daytime and night-time scenarios in Table 7.1, and have been compared with the noise criteria to determine compliance.

As can be seen from Table 7.1, the predicted noise levels are expected to comply with the noise criteria at all receptors except NSR1, and NSR15 during Sunday daytime; and NSR9 and NSR15 during night-time. Compliance is expected on the Bibbulmun Track considering the worst-case scenarios during Sunday daytime including Scenario C which is dedicated to assessing the noise impact on the daytime users of the track. The highest predicted noise level is 46 dB L_{A10} at NSR15 during Sunday daytime and the highest exceedance is +7 dB at the same receptor during night-time. Results in red denote a risk of non-compliance and results in blue present a risk of non-compliance only when tonality is considered (tonality attracts a +5 dB correction as per Regulation 9).

Table 7.1 Noise modelling results

ID	Noise sensitive receptors		Daytime (Sunday and Public Holidays)[1]			Night-time		
		Noise Criteria dB(A)	Predicted noise level, dB L_{A10}			Noise Criteria dB(A)	Predicted noise level, dB L_{A10}	
			A (2026)	C (2026)	D (2027)		B (2026)	E (2027)
NSR1	Hoffman Mill	40	44	35	43	- [2]		
NSR2	Logue Brook Campground	40	31	17	32	35	32	33
NSR3	Nanga Bush Camp	40	4	11	1	35	3	5
NSR4	Willowdale Orion office	40	22	24	20	35	20	21
NSR5	Waterous Scout Campsite	40	24	11	24	35	24	21
NSR6	Gibbs Pool Amphitheatre	40	19	9	20	- [2]		
NSR7	Wildflower Ridge Walk	40	22	13	23	- [2]		
NSR8	Lake Brockman Tourist Park	40	26	14	25	35	25	25
NSR9	Lake Brockman Campsite	40	36	18	35	35	37	36
NSR10	431 Black Rock Road, Yarloop	40	22	5	22	35	22	22
NSR11	450 Black Rock Road, Yarloop	40	21	5	21	35	21	22
NSR12	Address not known	40	23	8	22	35	23	22
NSR13	Alcoa owned Residential	40	35	25	35	35	35	33
NSR14	883 Hoffman Road, Hoffman	40	30	22	30	35	30	29
NSR15	Alcoa owned Residential	40	45	31	46	35	42	40
NSR16	1143 Bancell Road, Wagerup	40	22	20	23	- [2]		

ID	Noise sensitive receptors		Daytime (Sunday and Public Holidays)[1]			Night-time		
		Noise Criteria dB(A)	Predicted noise level, dB L_{A10}			Noise Criteria dB(A)	Predicted noise level, dB L_{A10}	
			A (2026)	C (2026)	D (2027)		B (2026)	E (2027)
NSR17	Bidjar Ngoulin Campsite	40	5	9	4	35	3	4
NSR18	Nanga Townsite	40	1	5	0	35	-1	0
NSR19	Bibbulmun Track Murray Campsite	40	2	7	2	35	1	2
NSR20	1078 Nanga Brook Road, Waroona	40	19	20	18	35	18	18
NSR21	268 Bancell Road, Wagerup	40	25	22	26	- [2]		
NSR22	314 Wagerup-Willowdale Road, Wagerup	40	26	17	26	- [2]		
NSR23	323 Scarp Road, Waroona	40	9	16	9	35	8	10
NSR24	851 Nanga Brook Road, Waroona	40	1	2	1	35	0	0
NSR25	847A Nanga Brook Road, Waroona	40	0	6	-1	35	-2	0
NSR26	21 Oro Road, Dwellingup	40	-3	-2	-4	35	-5	-4
NSR27	24 Prince Road, Waroona	40	19	19	18	35	17	19
NSR28	Lane Pool Reserve	40	1	17	0	- [2]		
NSR29	Baden Powell Campsite	40	-1	1	-2	35	-3	-2
NSR30	Nanga Mill Campground	40	-1	1	-1	35	-2	-2
NSR31	Stringers Campground	40	-1	1	-2	35	-3	-2
NSR32	Dookanelly Campsite	40	15	17	16	35	14	13
NSR33	Island Pool rest area	40	4	11	3	- [1]		
NSR34	Chuditch Campground	40	8	10	8	35	6	7
NSR35	Charlies Flat Campground	40	15	19	14	35	14	15
NSR36	Bob's Crossing rest area	40	-3	-1	-3	- [2]		
- [3]	Closest point on the Bibbulmun Track	40	8	22	8	- [2]		

Notes:

1. Sunday and Public Holiday daytime is used as it is the worst-case condition.
2. The receptors are occupied only during daytime, they are assessed against the daytime criterion only.
3. This is not a specific receptor or dwelling. The closest point on the Bibbulmun Track has been selected to represent the worst-case scenario for daytime users of the Bibbulmun Track.

The modelled noise contours for each scenario are presented in Appendix A:

– Figure A-1: Scenario A $L_{A_{10}}$ daytime noise contours
– Figure A-2: Scenario B $L_{A_{10}}$ night-time noise contours
– Figure A-3: Scenario C $L_{A_{10}}$ daytime noise contours

– Figure A-4: Scenario D $L_{A_{10}}$ night-time noise contours

7.1 Noise impact compliance assessment

The modelling results presented in Table 7.1 show that the predicted noise levels are expected to comply with the noise criteria under worst-case weather conditions during day and night, including during Sundays and public holidays at all NSRs except for NSR1, and NSR15.

The maximum forecast exceedances are +4 dB at NSR9, and +6 dB at NSR15 during Sunday daytime; and with maximum +2 dB at NSR9, and +7 dB at NSR15 during night-time. It should be noted that NSR15 is currently unoccupied and unlikely to be in the near future (according to the information received from Alcoa on 9 August 2024).

There is also a risk of non-compliance for NSR2 (+3 dB) and NSR13 (+5 dB) during night-time should tonality be evident in the received noise (i.e. compliance is expected for this receptor if tonality is not evident).

There is a risk of noncompliance at NSR9 (+1dB) during Sunday daytime should tonality be evident in the received noise (i.e. compliance is expected for this receptor if tonality is not evident).

As can be seen from Figure 6.1 and Figure 6.2, the highlighted receptors for which there is a risk of non-compliance under worst-case considerations are located within the “Do not mine sensitivity zone” and need careful Noise Management Plan (NMP) and noise monitoring which is explained in detail in Section 10. The following sections outline how compliance can be achieved.

7.1.1 Tonality assessment

It is possible that some of the mobile equipment may exhibit tonality at some of the receptors. However, this tonality may not always be evident at the receptor for the following reasons:

- Tonality may not always exceed the ambient noise at the NSRS.
- Overall tonality will be reduced via masking of specific tonal components from one equipment to another.
- The level of noise emissions and tonality from items of mobile equipment will vary depending on their locations (i.e. changing heights, depths and lateral position to NSRs).
- The severity and pitch of the tonality from mobile equipment depend on operating conditions (i.e. heat, operating load, etc.).

Considering the aforementioned reasons, predicting the tonality at the NSRs from the mobile equipment fleet is difficult, especially when the mining operations are several kilometres away from the NSRs.

The predicted noise levels in Table 7.1 show that the potential of non-compliance due to tonality ranges between +2 dB L_{A10} at NSR2 (during night-time for Scenario B) and +12 dB L_{A10} at NSR15 which is the most affected NSR. If NSR15 remains unoccupied, then the maximum potential of non-compliance due to tonality will be +9 dB L_{A10} at NSR1 (during Sunday daytime for Scenario A) that is at risk of non-compliance regardless of tonality (due to worst-case conservatism).

7.1.2 Conservatism of the worst-case noise model

The worst-case modelling considerations in terms of weather conditions and mining and mine development activities are expected to provide a significant conservative margin (cumulatively could be up to 6 – 10 dB based on Wood, 2023) for predicted noise levels at adjacent NSRs.

7.1.2.1 Weather conditions

The worst-case weather conditions are the default meteorological conditions stipulated in the WA DWER Draft Guidelines 2021. It is expected that the most frequent occurrence of default weather conditions will occur in the cooler periods of the year.

7.1.2.2 Mining activities

The worst-case considerations in terms of schedule of activities (RFI-002 received 15 April 2024) requires modelling simultaneous working units in the vicinity of some NSRs. The results of sensitivity modelling were used in the modelling of the worst-case scenarios by indicating locations of noise-controlled fleet within the sensitive zones. However, the worst-case consideration of the schedule of activities is against the sensitivity modelling assumption which is to use only one working unit within 4 kms radius form the NSRs. This is the main reason for the non-compliance at NSR1, NSR9, and NSR15 (if it is occupied in near future) because they are inside the “Do Not Mine” sensitivity zones and receive noise simultaneously from more than one working unit withn 4 km from the NSRs (refer to noise contours in Appendix A).

It should also be considered that, the modelling scenarios assessed assume that all noise-generating activities occur simultaneously at full duty cycle, and that all mining activities occur at the pit surface. Hence, it is expected that these worst-case assumptions have additional significant margins of conservatism in terms of noise modelling predictions compared with realistic activities within the pit areas.

7.1.2.3 Impact of conservatism on the predicted results

Table 7.1 presents the predicted noise levels incorporating the following worst-case conditions:

- For each scenario, noise sources were located at the pit closest to the nearest NSR for each mining area under consideration, which is a very conservative approach from a noise propagation perspective.
- There are simultaneous working units within 4 kms radius form the NSRs which is very conservative approach from noise propagation perspective and disregards the assumption made for the sensitivity modelling.
- Full duty cycle and simultaneous operation of all mobile fleet. In reality, the equipment load will fluctuate through the day and instances of all equipment being under full load simultaneously are highly unlikely.
- Mining activities occur at the surface and not at lower depths inside pits. This is quite conservative, because mining equipment, relative position to nearby ground contours, will fluctuate throughout the day with equipment being shielded at times and exposed at other times.
- Wind direction from source to receptor for each NSR (i.e. downwind conditions). This constitutes worst-case from a noise propagation point of view. In reality, there will be times when the wind conditions are not downwind, and there could be significant period of times when downwind conditions are not present.

Under operational conditions which constitute more realistic conditions, it is predicted that:

- If simultaneous working units are not used within 4 km radius from the relevant NSRs, the predicted noise are expected to reduce by about 5 dB or more for both day and night scenarios.
- Outside of downwind conditions, modelling shows a 2 dB or more reduction in noise levels for both day and night scenarios.

Hence, for realistic operational conditions, it is expected that predicted noise level will comply with the noise criteria at all NSRs at all times.

At times when worst-case conditions may be present, it is expected that with the implementation of the operational NMP discussed in Section 10), noise compliance can be achieved at all NSRs at all periods of the day even where mining activity may occur closest to the pit edges of NSRs.

7.1.3 Audibility assessment

The audibility of mining noise at the NSRs depends on the ambient baseline levels, the weather conditions and the tonal content of the noise. These are factors that are difficult to predict given the range of distances involved.

A conservative and simplified approach to assess the audibility is proposed based on 30 dB(A) (i.e. 5 dB below night-time noise criteria). The audibility contour lines have been illustrated in Figure A-2 and Figure A-5.

Based on the worst-case noise modelling results presented in Table 7.1, NSR2, NSR9, NSR13 and NSR15 (if it is occupied in near future) are predicted to have the potential to be audible under the worst-case conditions at night-time (Scenarios B and D).

However, audibility is reduced when weather conditions are expected to be less conducive for noise propagation (i.e. other than worst-case weather conditions). Furthermore, mining noise is assessed as audible if the predicted noise level values protrude above the ambient monitoring data by more than 3 dB as a person typically does not detect a change in noise levels below 2 to 3 dB (David Bies, 2018). Recorded L_{A10} values during night-time periods generally range from 27 to 57 dB(A) in the area (Table 5.1). This suggests that the audibility of mining noise is likely to be masked by typical ambient noise levels, so even under the worst-case condition, audibility will not always be a potential risk.

8. Blasting noise and vibration assessment

8.1 Blasting noise

Blast noise data from Alcoa's existing mine operations in the Mayara North Mine Region was collected by Wood in a previous assessment (Wood, 2023) to derive an empirical assessment criterion based on current operational practices. Table 8.1 summarises the blast methodology and the incurred noise emission that is assumed to be practiced in Larego Mine Region based on Alcoa's existing mine operations.

Table 8.1 Blast noise at distances from Alcoa's existing mine operations in Larego North Mine Region (Wood, 2023)

Monitor	Distance from blast centre, m	Maximum instantaneous charge mass, kg	Measured peak noise level dB(L)$_{Linear, peak}$
Blast 1			
1	1390	9 kg per hole, 762 holes	117
2	2780		107
3	5560		92
Blast 2			
1	1090	7 kg per hole, 40 holes	116
2	2180		107
3	4360		99

Based on this data, the noise criteria of 120 dB(L)$_{Linear, peak}$ is expected to be at approximately 1,200 m from the blast centre. Except for NSR1 and NSR15 (if it is occupied in near future) which are close to the mine development pits (from about 850m to 1100m within the sensitivity zones), it is not expected that there will be any exceedances at other NSR locations due to their large distances from the mine development pits (>2000 m). This has been visualised in Figure 8.1 by calculating the buffer distance for blasts taking place at mine development pits with respect to the location of the NSRs. The daytime sensitivity zones have been overlaid for comparison purposes only. It can be seen from the figure that, NSR1 and NSR15 (if it is occupied in near future) require careful noise control for the air-blast noise. Other NSRs will not be impacted by blasting noise even when three simultaneous blasts take place at different mine development sites.

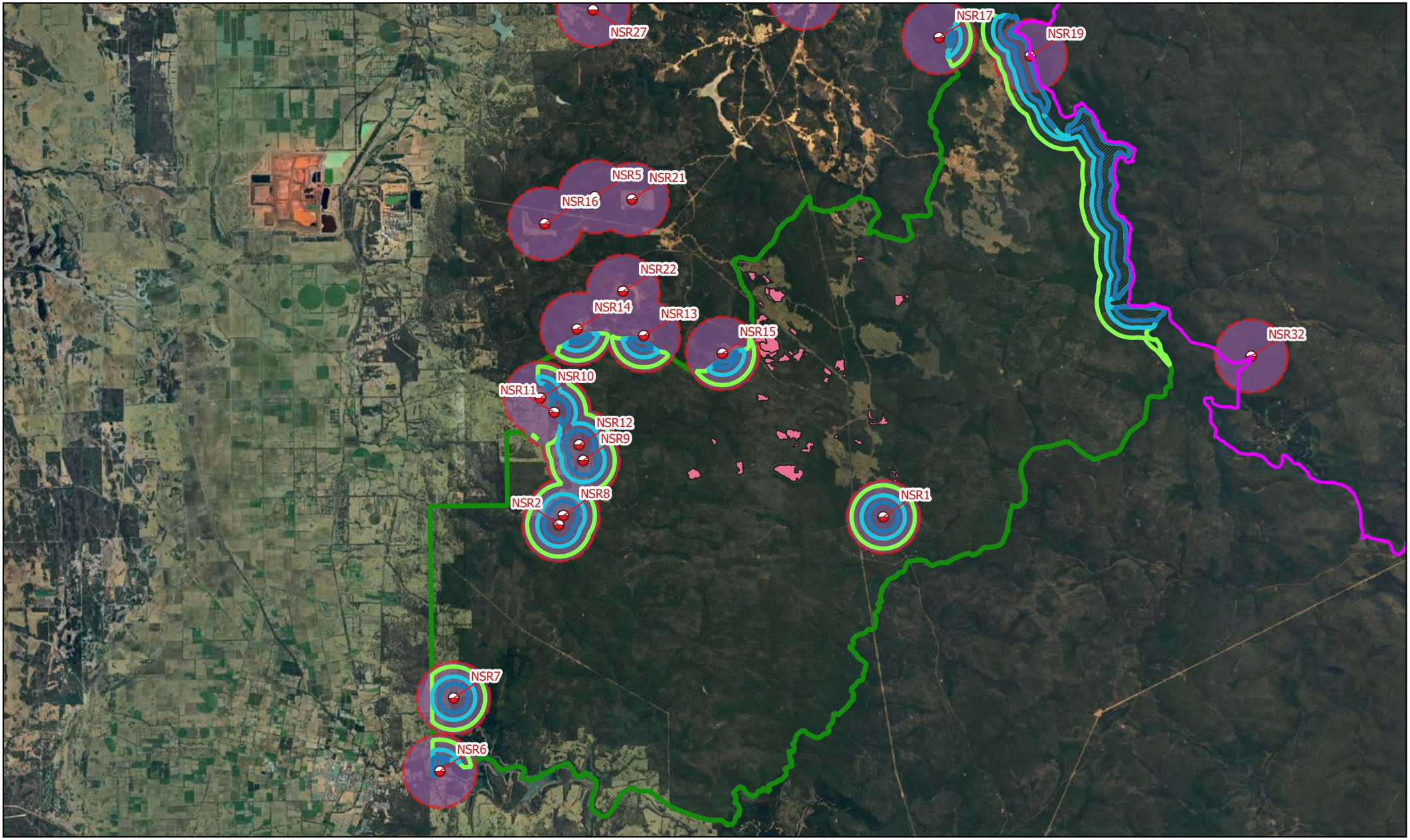
As a result, for the mine development pits close to NSR1 and NSR15 (i.e. within the sensitivity zones), smaller charge masses must be used along with careful noise management plan and monitoring.

8.2 Blasting vibration

The calculated distances for ground-borne vibration levels to attenuate to below 5 mm/s are 212 m and 188 m for a 9 kg and 7 kg charge masses, respectively. It is not likely the safety exclusion zone for a blasting event will exceed these distances from the blast centre. Therefore, ground borne vibration is expected to be insignificant at all the nearby NSRs for the proposed region.

Table 8.2 Calculated distance for ground vibration to attenuate levels below 5 mm/s criteria.

Blast ID	Maximum instantaneous charge mass (8 ms detonation window)	Distance to attenuate below 5 mm/s (Safety exclusion zone)
Blast 1	9 kg	212 m
Blast 2	7 kg	188 m



Legend

- Noise Sensitive Receptor (Day)
- Bibbulmun Track
- Mine Development 2025 - 2027
- 1200m Blasting Noise Radius
- Day Do Not Mine Zone
- Day Premium Mining
- Day Attenuated Mining
- Larego Mine Region

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Blast Zones Peak Noise Level Assessment

Project No. **12609060**
Revision No. A
Date. **23/10/2024**

FIGURE 8.1

Document Path: \\ghdnet\ghd\AU\Melbourne\Projects\61\12632796\04_Tech\Noise\Huntly and Willowdale Mine Plan.qgz
Print Date: 23/10/2024

Data Source:Google Earth Imagery 2024.
Created By: hsatari

9. Construction noise management

Construction activities should be performed in accordance with the Regulations. Under the Regulations, various construction noise requirements apply for daytime construction and out of hours construction as outlined in the table below.

Table 9.1 Construction noise criteria

Time period	Time	Construction noise requirements
Daytime construction	7:00 am and 7:00 pm on any day which is not a Sunday or a public holiday	No specific construction noise criteria. However, construction noise should be kept as low as practicable. This is provided that: – The construction work is carried out with respect to control of noise as outlined in Section 6 of AS 2436-1981 “Guide to Noise Control on Construction, Maintenance and Demolition Sites”. – The equipment used for the construction works is the quietest that is reasonably available. – The CEO may request a construction noise management plan to be submitted for the construction work at any point of time.
Out of hours construction	7:00 pm and 7:00 am on any day which is not a Sunday or a public holiday	Construction noise should, as far as practicable, meet the assigned noise levels outlined in Regulation 8 in the Regulations. This is provided that: – The construction work is carried out with respect to control of noise as outlined in Section 6 of AS 2436-1981 “Guide to Noise Control on Construction, Maintenance and Demolition Sites”. – The equipment used for the construction works is the quietest that is reasonably available. Furthermore, out of hours construction works may require the following are undertaken if excessive noise is expected: – The contractor must advise all nearby occupants of the work to be done at least 24 hours before it commences. – The contractor must show that it was reasonably necessary for the work to be done out of hours. – The contractor must submit to the CEO a noise management plan at least seven days before the work starts, and the plan must be approved by the CEO. – The noise management plan must include details of: • Need for the work to be done out of hours • Types of activity which could be noisy • Predictions of noise levels • Control measures for noise and vibration • Monitoring of noise and vibration • Complaint response

10. Operational noise management plan

Worst-case operational conditions may be present due to the factors below, which are further elaborated in Section 7.1.2.3.

- Mining activities occur simultaneously at pit locations closest to the NSRs.
- Mining activities occur at the surface and not at lower depths inside pits.
- Full duty cycle and simultaneous operation of all mobile fleet.
- Wind direction from source to receptor for each NSR (i.e. downwind conditions).

Whilst these conditions are unlikely to occur simultaneously, it is still a possibility. Hence, operational noise management strategies should be in place to achieve compliance of noise level at all receptors. This is especially true for NSR1, NSR2, NSR9, NSR13 and NSR15 (if it is occupied in near future), where both the wors-case operational conditions mentioned above, and presence of tonality will cause risk of non-compliance.

The noise mitigation and management measures outlined in Table 10.1 will be implemented to reduce the disturbance to the nearby receivers and the likelihood of non-compliance during mining activities within the noise sensitivity zones where non compliances have been predicted in the noise impact assessment (Table 7.1).

Table 10.1 Operational Noise Management Plan (NMP)

Action required	Noise or vibration?	Details
Mining operation management	Noise	– No simultaneous working group should be operating within 4 km radius from NSR1, NSR2, NSR9 and NSR13. This should be the case for NSR15 were it to become occupied. – Attenuated and Premium fleet should be used within the relevant sensitivity zones as outlined in Figure 6.1 and Figure 6.2. – For the mine development pits close to NSR1, NSR2, NSR9 and NSR13. smaller charge masses must be used for blasting. This should be the case for NSR15 were it to become occupied.
Implement community consultation measures (refer to Section 9 for further details of each measure).	Noise and vibration	Letter box drop to potentially affected receivers located within sensitivity zone by Alcoa to indicate days / nights and expected hours of mining activities that have the potential to exceed assigned noise levels (i.e. NSR1, NSR2, NSR9 and NSR13, and NSR15 (were it to become occupied) – Alcoa has a blast notification list whereby elected community members can be part of the text/ email communications – If our system is demonstrating a potential exceedance in an area on a given day, we would look to move the blast and or operations to another day to minimise impacts. – If our system is demonstrating coming close to the assigned limits, Alcoa places an officer with a handheld noise device at the sensitive receptor to understand impacts and manage as required.
Site inductions	Noise and vibration	– All employees, contractors and subcontractors expected to work within the sensitivity zones that are forecast to exceed assigned levels (i.e. NSR1, NSR2, NSR9 and NSR13, and NSR15 should it become occupied) are to receive a noise specific induction as part of their site induction. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures. • Permissible hours of work. • Any limitations on high noise generating activities. • Location of nearest sensitive receivers.
Monitoring	Noise and vibration	Noise monitoring at the boundary of the noise sensitive receivers where assigned noise levels are predicted to be exceeded (i.e. NSR1, NSR2, NSR9 and NSR13, and NSR15 (in case it is occupied)) is to be carried out for the duration of the works within the noise sensitivity zone.

Action required	Noise or vibration?	Details
Complaint handling	Noise and vibration	A complaint handling procedure as specified in Section 10.1 is to be carried out.

10.1 Complaint handling

Alcoa will adopt the following protocol for handling complaints. This protocol is intended to ensure that the issues are addressed and that appropriate corrective actions are identified and implemented as necessary:

– Alcoa will record all verbal and telephone complaints in writing within a noise complaint register and will forward all complaints to the Superintendent, together with details of the circumstance leading to the complaint and all subsequent actions. Details to be recorded should include:
  - Time of the event.
  - Location of the event.
  - What was felt / heard (can they identify the plant or process).
  - If it was felt / heard outside or inside.
  - If inside, were windows / doors open.
  - Impact of the event on person affected (e.g. awakening etc.).
  - Weather conditions at time (if known).
– Complaints received will, as an initial step, be referred to Alcoa. Alcoa will respond as described above.
– Alcoa environmental advisors, assigned to the site, will investigate the complaint to determine whether noise has occurred unnecessarily.
– If excessive or unnecessary noise has been caused, corrective action will be planned and implemented by Alcoa.
– Complainants will be informed by the Community Relations Officer that their complaints are being addressed, and (if appropriate) that corrective action is being taken.
– Follow up monitoring or other investigations will be carried out by Alcoa to confirm the effectiveness of the corrective action.
– Complainants will be informed of the implementation of the corrective action that has been taken to mitigate the adverse effects.
– The notification letter will advise the residents of the appointed person and their contact details for any queries or complaints.
– Alcoa's complaint response line will be attended at all times during out of hours works.

10.2 Community consultation

Community consultation will be undertaken via Alcoa, including:

– Community Members with noise monitoring equipment on their property
  - Agreements are in place outlining the purpose of hosting noise monitoring equipment on the property, access requirements, payments, and so on. This is signed and agreed by Alcoa and the property owner.
  - Are contacted via phone and/or email if unplanned or planned maintenance on the equipment is required and agree on a suitable time for all party for works to take place.
  - In some instances, neighbours have advised of noise impacts from the residential location and investigation has resulted in noise monitor recording noise levels well below assigned levels. In this instance, Alcoa has taken proactive measures to place a temporary monitor on an alternative location on the property as a study to compare and understand noise in other areas.
– General community

- Given the opportunity to receive blast notifications via text and email as an informing communication when and where blasting plans to take place. This includes Karnet Prison Farm.
- Consultation around potential noise impacts with neighbouring property owners is ongoing.
- Recording, managing, and investigating complaints as per procedure explained in section 10.1.

11. Conclusion

The NIA provided in in this report summarised the results of investigating potential noise impacts from the construction and operation of the proposed expansion of the Willowdale Mine within the Larego Mine Region as stipulated in the 5-year mine plan (2023-2027) under the MMP. Construction noise, including blasting noise and vibration, was deemed minor compared to operational noise, leading to a qualitative assessment approach for construction and a quantitative noise modelling approach for operation.

Preliminary noise modelling was undertaken based on the mining plans assuming use of Alcoa's standard mining fleet. Assuming worst-case operational conditions, the following five scenarios have been considered:

– Scenario A (Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits with daytime NSRs and sensitivity zone mitigation considered.
– Scenario B (Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits with night-time NSRs and sensitivity zone mitigation considered).
– Scenario C (Rehabilitation in 2022 and 2023 pits, Mining in 2024 and 2025 pits, Mine development in 2026 pits with Bibbulmun Track users during daytime as NSRs and no mitigation considered).
– Scenario d (Rehabilitation in 2023 and 2024 pits, Mining in 2025 and 2026 pits, Mine development in 2027 pits with daytime NSRs and sensitivity zone mitigation considered.
– Scenario e (Rehabilitation in 2023 and 2024 pits, Mining in 2025 and 2026 pits, Mine development in 2027 pits with night-time NSRs and sensitivity zone mitigation considered).

Because there are NSRs extremely close to the mining operation, for which standard mining operation are not expected to comply, noise sensitivity modelling has been undertaken. This informed the in-principal mitigation to achieve compliance with the assigned levels. The in-principle mitigation include set-back distances and requirements for noise control of the fleet within the sensitive zones.

The NIA modelling results indicate potential risk of operational noise exceedance at NSR1 (up to +4 dB during Sunday daytime), NSR9 (up to +2 dB during night-time) and NSR15 (up to +7 dB during night-time, should it become occupied in near future) under worse-case consideration for scenarios A, B, D and E. No risk of non-compliance is expected on the Bibbulmun Track considering the worst-case scenarios during Sunday daytime including Scenario C which is dedicated to assessing the noise impact on the daytime users of the track. The results also show a risk of non-compliance for NSR2 (by +3 dB during Night), NSR9 (by +1 dB during Sunday daytime) and NSR13 (by +5 dB during Night) if tonality is present in the mining noise.

Notwithstanding the above, under realistic operational conditions, all NSRs are expected to comply with noise criteria at all periods of the day. With operational noise management planning practices such as those detailed in Section 10 of this report, noise compliance can be achieved.

The modelling results and contour maps show a potential risk of audibility for NSR2, NSR13, NSR14, and NSR15 (if it is occupied in near future) under worst-case considerations. However, mining noise is unlikely to be audible if it is lower than 3 dB below the existing levels of ambient noise in the area.

Ground borne blast noise and vibration are expected to be insignificant at all nearby NSRs for the proposed Larego Mine Region except for NSR1 and NSR15 (if it is occupied in near future). Therefore, smaller charge masses (compared to 7 and 9 kg currently used by Alcoa at Myara North) must be used along with careful noise management plan and monitoring such as those detailed in Section 10 of this report.

12. References

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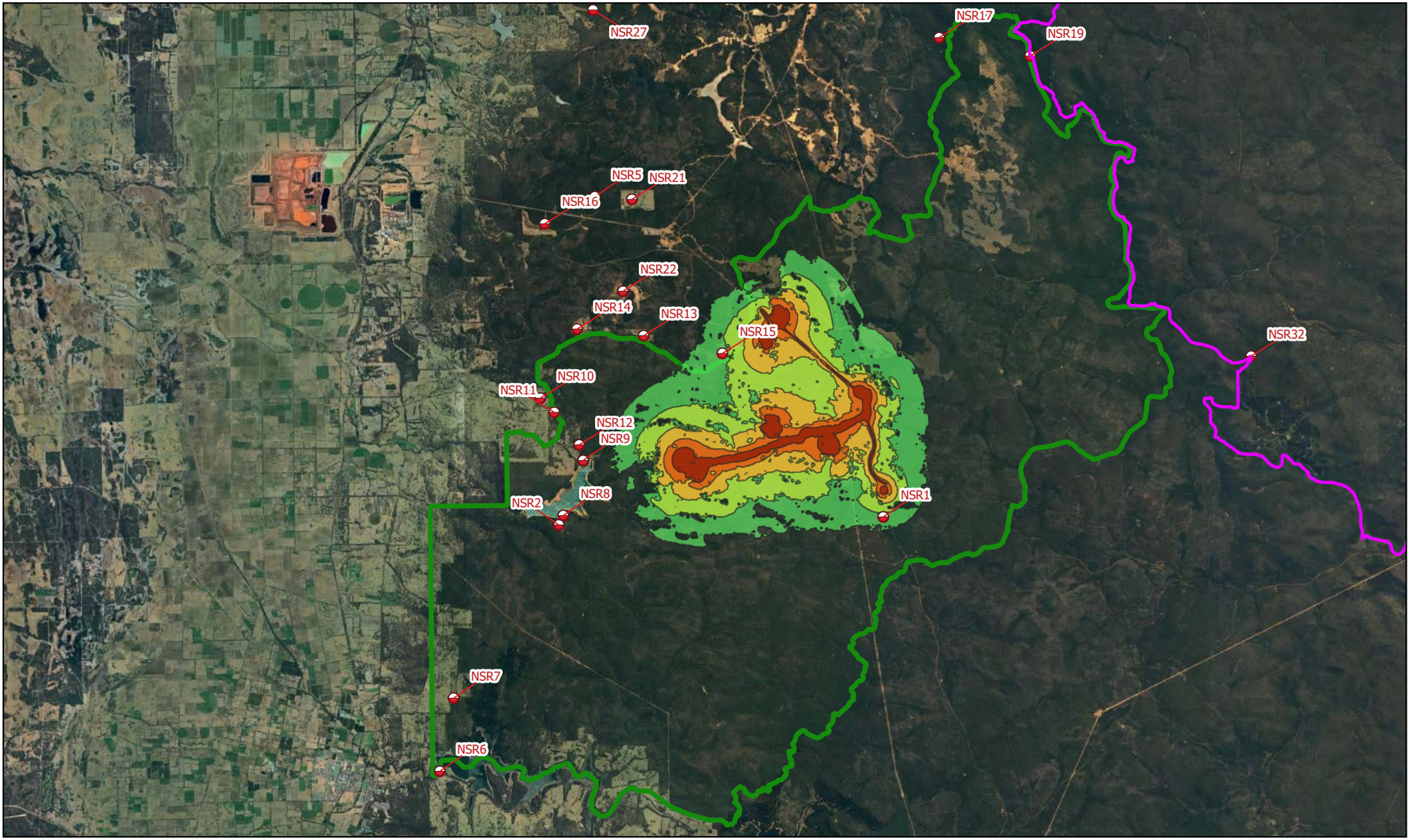
Appendix A

Noise contour maps



Legend

Predicted Noise Level dB(A)
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65

- Noise Sensitive Receptor
- Bibbulmun Track
- Larego Mine Region

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Scenario A (2026), LA_{10}
Daytime Noise Contours

Project No.	**12632796**
Revision No.	A
Date.	**23/10/2024**

FIGURE A.1

Document Path: \\ghdnet\ghd\AU\Melbourne\Projects\61\12632796\04_Tech\Noise\Huntly and Willowdale Mine Plan.qgz
Print Date: 23/10/2024

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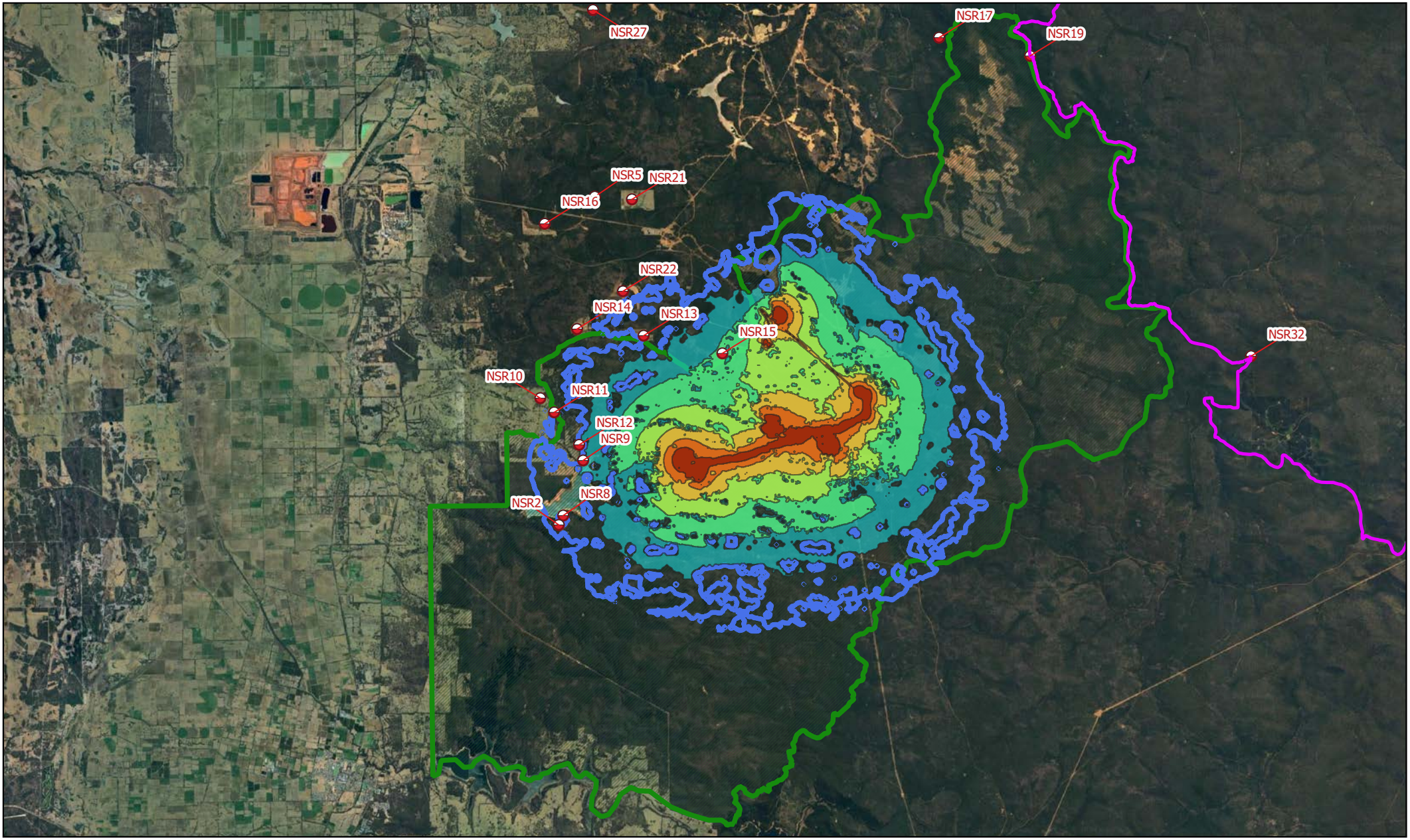

Legend

Predicted Noise Level dB(A)
- 30 (Audibility contour line)
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65

- Noise Sensitive Receptor
- Bibbulmun Track
- Larego Mine Region

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Scenario B (2026), LA_{10} Nighttime Noise Contours

Project No.	**12632796**
Revision No.	A
Date.	**23/10/2024**

FIGURE A.2

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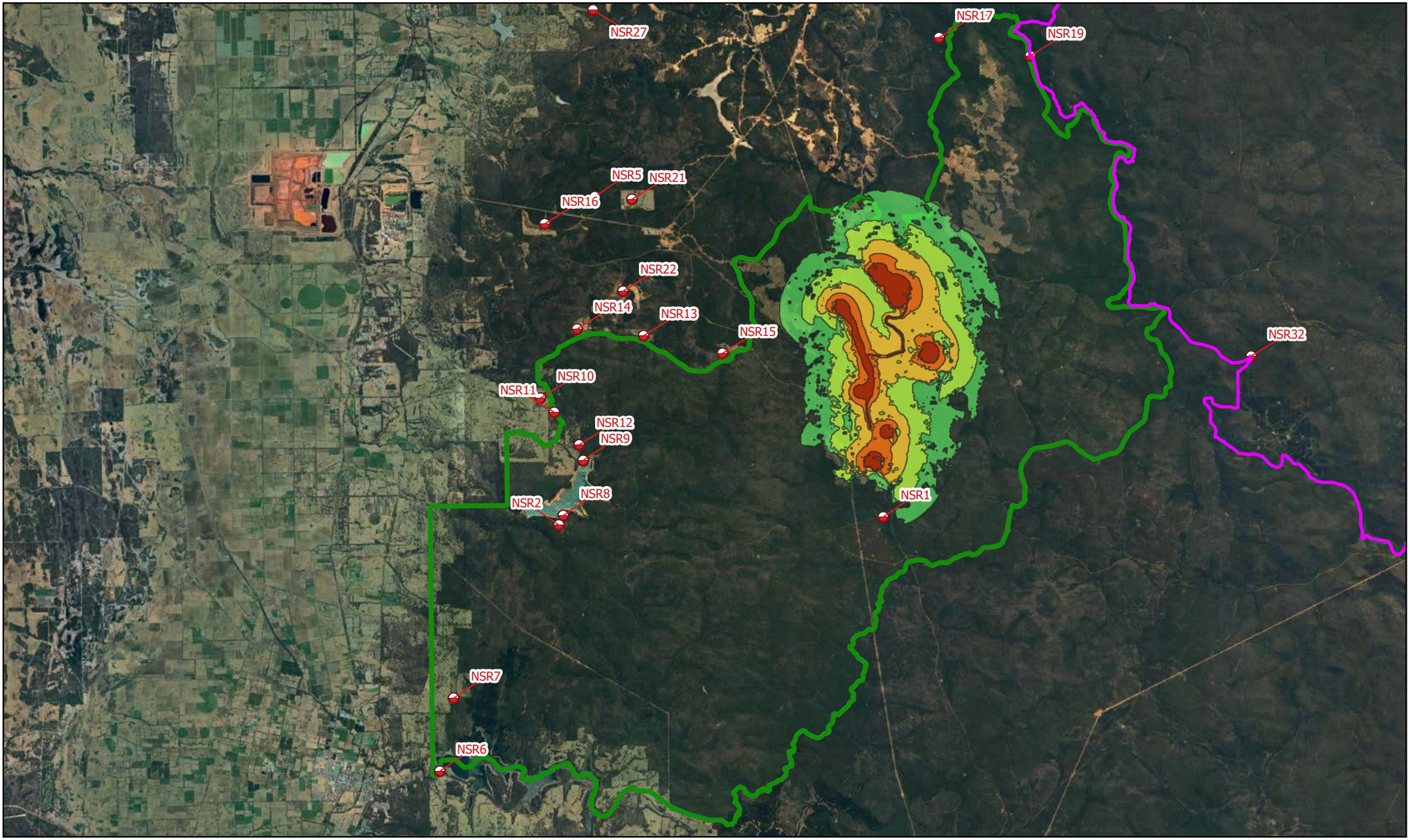

Legend

Predicted Noise Level dB(A)
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65

- Noise Sensitive Receptor
- Bibbulmun Track
- Larego Mine Region

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Scenario C (2026), LA_{10}
Daytime Noise Contours

Project No.	**12632796**
Revision No.	A
Date.	**23/10/2024**

FIGURE A.3

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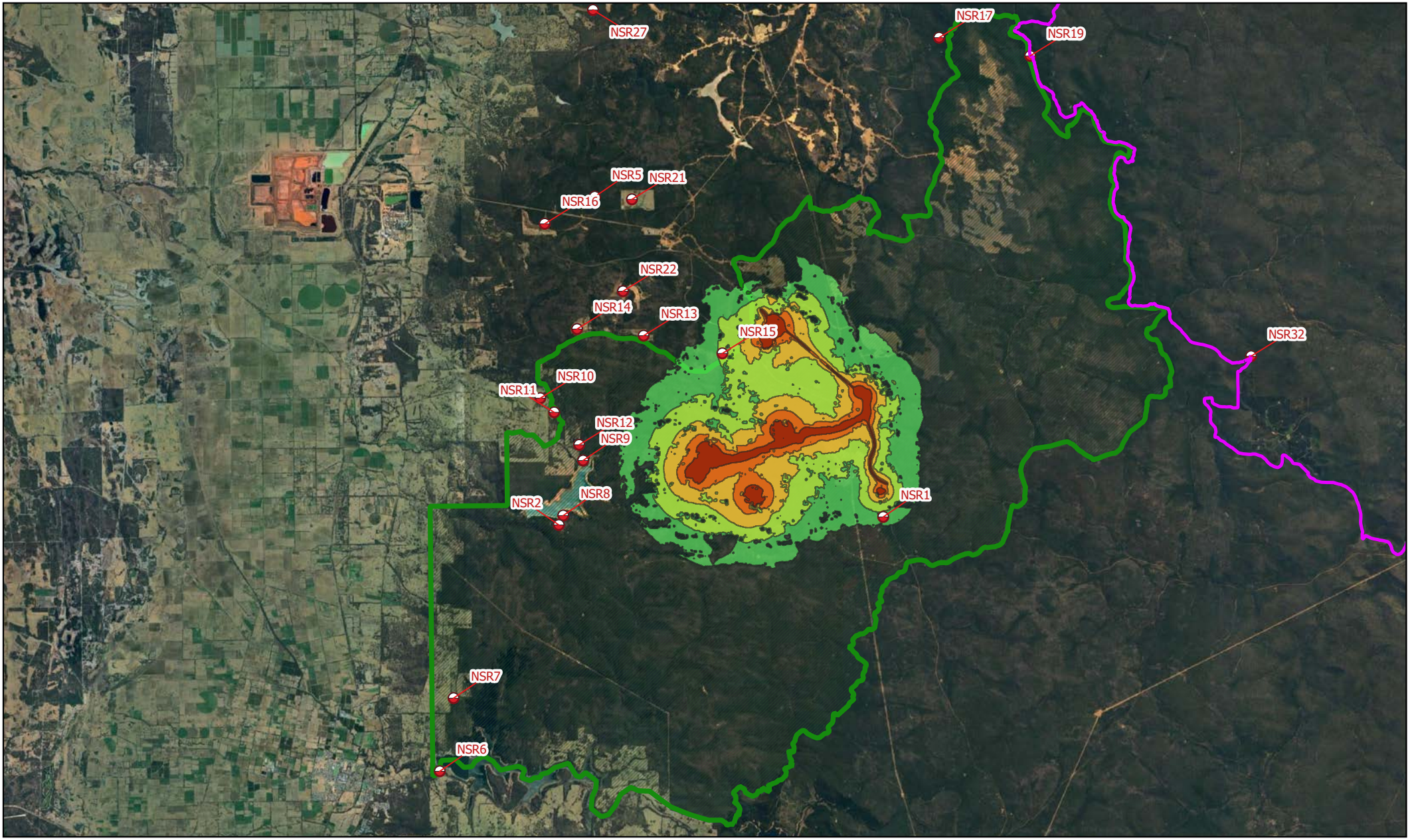

Legend

Predicted Noise Level dB(A)
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65

- Noise Sensitive Receptor
- Bibbulmun Track
- Larego Mine Region

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

Alcoa Larego Region Noise Impact Assessment
Alcoa of Australia Limited

Scenario D (2027), LA_{10}
Daytime Noise Contours

Project No.	**12632796**
Revision No.	A
Date.	**23/10/2024**

FIGURE A.4

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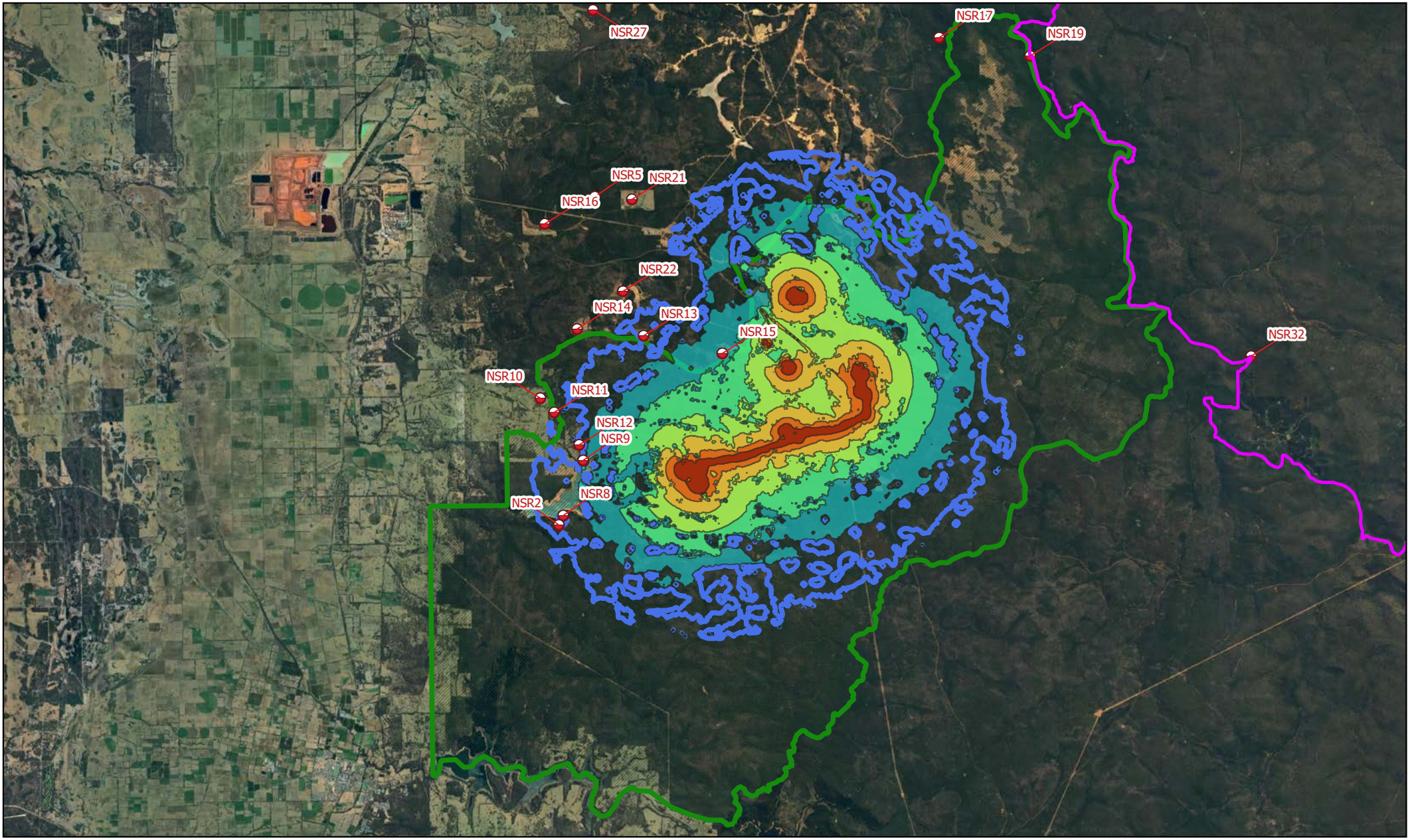

Legend

Predicted Noise Level dB(A)
- 30 (Audibility contour line)
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65

- Noise Sensitive Receptor
- Bibbulmun Track
- Larego Mine Region

Paper Size ISO A4

0 1 2 3 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA94
Grid: GDA94 / MGA zone 50

GHD

Alcoa Larego Region Noise Impact Assessment
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Scenario E (2027), LA_{10}
Nighttime Noise Contours

Project No.	**12632796**
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Date.	**23/10/2024**

FIGURE A.5

Document Path: \\ghdnet\ghd\AU\Melbourne\Projects\61\12632796\04_Tech\Noise\Huntly and Willowdale Mine Plan.qgz
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The Power of Commitment