Noise & Vibration Impact Assessment

Bangus Quarry Landfill Development

Tumblong Reserve Road, Tumblong, NSW

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Tumblong Reserve Road, Tumblong, NSW

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TABLE OF CONTENTS

APPENDIX A: Noise Contour Maps

1 Introduction

1.1 Background

The Bangus Quarry located at Tumblong Reserve Road, Tumblong was reserved as a quarry in 1975. Since then the quarry has been utiised as a source of gravel to service regional needs. After the proposed final excavation to design levels, the quarry will reach the end of its productive life and will require remediation in accordance with the quarry licence requirements and with the duty of care to the community.

The proposed development involves remediation of the quarry by utilising it for general solid waste (non-putrescible) landfill purposes after which the quarry will be capped and returned to a state consistent with the surrounding landscape and local biodiversity considerations.

The landfill will fulfill a local regional need servicing a single manufacturing facility operating in the resource recovery and recycling industry. Visy Pulp and Paper, located at Tumut, NSW is a producer of kraft linerboard utilising plantation grown radiata pine and recycled waste paper. Due to anomalies and imperfections in the recycling industry, materials such as glass, metal and plastics are generated in the process and these elements are required to be sent to landfill in the absence of other resource recovery options. The landfill is proposed to accept up to 60,000 tonnes per annum of general solid waste (non-putrescible) from Visy.

The Secretary's Environmental Assessment Requirements (SEARs) have been provided for the development. The SEARs (No. 1321) identifies the following requirements for noise and vibration:

- Background noise assessment at all nearby noise sensitive receivers.
- Operational noise modelling and assessment in accordance with the NSW Noise Policy for Industry (NPI) to include noise modification factors and weather impacts on noise propagation.
- Operational traffic noise analysis in accordance with the NSW Road Noise Policy (RNP).
- Operational vibration modelling and analysis in accordance with the EPAs NSW Assessing Vibration: A Technical Guidelines (2006).
- Construction Noise and Vibration Assessment in accordance with the Interim Construction Noise Guideline (ICNG).

Waves Acoustic Consulting Pty Ltd (Waves Consulting) has been engaged by MH Earthmoving Pty Ltd (through InSitu Advisory Pty Ltd) to prepare a Noise and Vibration Impact Assessment (NVIA) to demonstrate the noise and vibration impacts associated with the project. This report presents the results of the assessment and forms part of the Environmental Impact Statement (EIS) for the proposal.

This report has been prepared to inform the EPA, the DoPE, Gundagai Council and all relevant stakeholders. The aim of the report is to assess the potential noise and vibration impacts of the proposed development on any nearby sensitive receivers and has been prepared in accordance with the guidelines outlined in Section 1.2.

1.2 Relevant Guidelines

Noise from the operation of the proposal has been assessed in accordance with the NSW Noise Policy for Industry (NPI) 2017.

Noise from additional traffic movements on the local road network has been assessed in accordance with the NSW Road Noise Policy (RNP), NSW EPA 2011.

Vibration from the operation and construction of the proposal has been assessed in accordance with Assessing Vibration: a technical guideline (DEC 2006).

Construction Noise Impacts have been assessed in accordance with the NSW Interim Construction Noise Guideline (ICNG).

2 Development Description

2.1 Overview of the Development and Potential for Impacts

The site covers an area of approximately 4.5 hectares and is located approximately 3.5 km from the community of Tumblong and 18.7 km from the Gundagai township. An adjacent lot will be used for the temporary storage of excavated fill and aggregate which will be removed by the cessation of landfilling and rehabilitation operations.

The proposed site is identified as Lot 7004 of Deposited Plan 1028797 and Lot 7300 of Deposited Plan 1149008 and was designated as a quarry (Reserve 89508) in 1975. The site is located on the unsealed Tumblong Reserve Road, approximately 1.2 km from the intersection with the Old Hume Highway.

The proposed development will involve the disposal of up to 60,000 tonnesper annum of General Solid Waste (Non-Putrescible) material principally derived from the Visy Pulp and Paper production facility located at Tumut. The development and operation of the facility is to be conducted in a sustainable and responsible manner, whilst ensuring that all potential impacts to the surrounding environment are managed appropriately and mitigated or minimised where necessary. The operation is to be maintained, monitored and reported in accordance with the statutory approval and licensing arrangements from the appropriate authorities.

The proposed operational hours for the site are as follows:

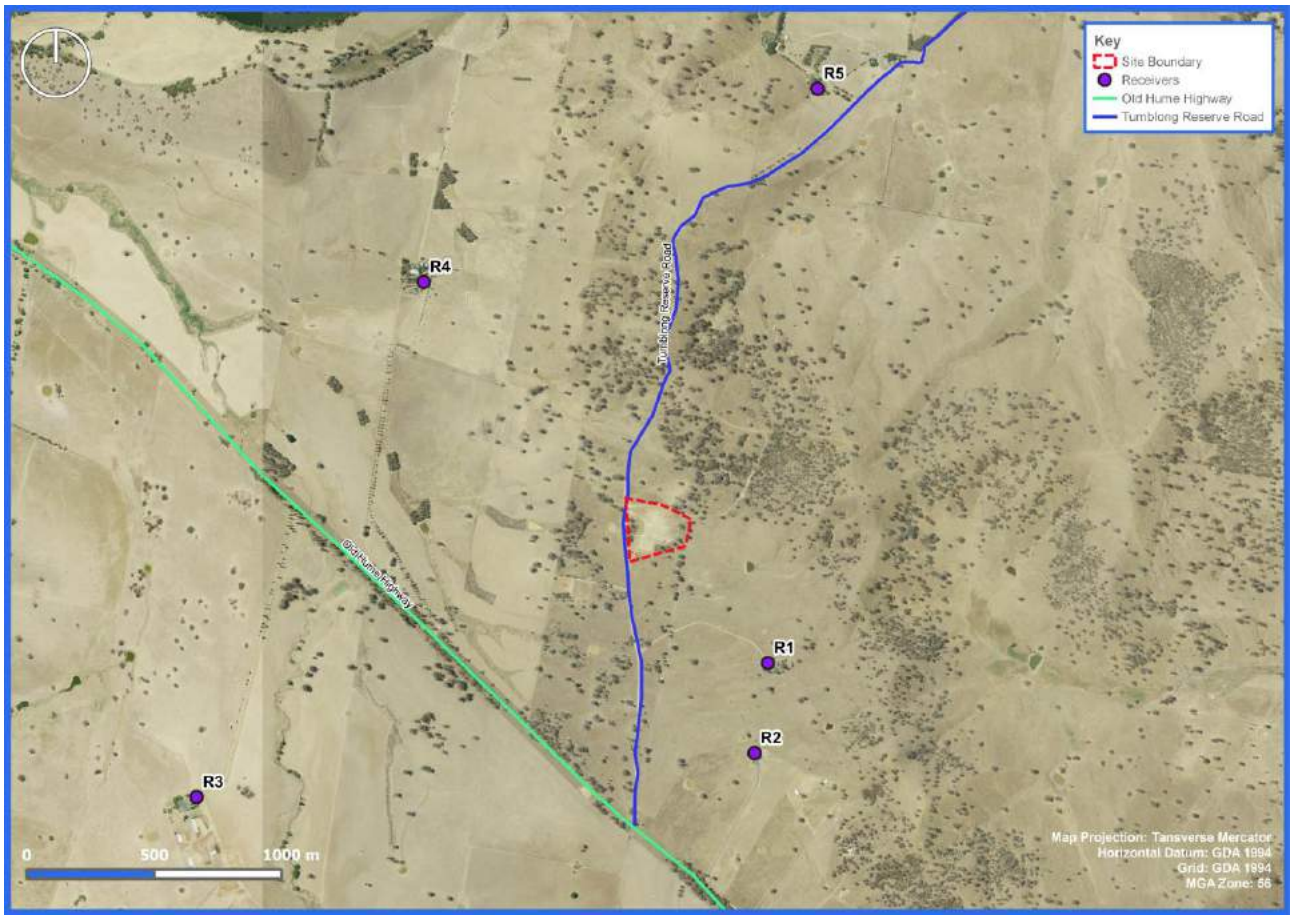
- Opening hours (staffed): 7:00am to 5:00pm Monday to Friday and Saturday 7:00am to 1:00pm
- Closed at all other times.

The main noise and vibration sources from the proposed facility will include:

- Offsite vehicle movements on the nearby road network.
- Onsite vehicle movements - mainly an excavator, loader, watercart, truck and dog (deliveries).

Figure 1 below illustrates the proposed development site and the proximity of the residential receivers in the surrounding area.

Figure 1. Site Location & Surrounding Area



Aerial photography courtesy of NSW Imagery

The site is situated in an area surrounded by rural residential dwellings, which are the only noise sensitive receivers in the area. Table 1 below summarises the distance between the site boundary and the nearest residential dwellings.

Table 1. Nearest Noise Sensitive Receiver Summary

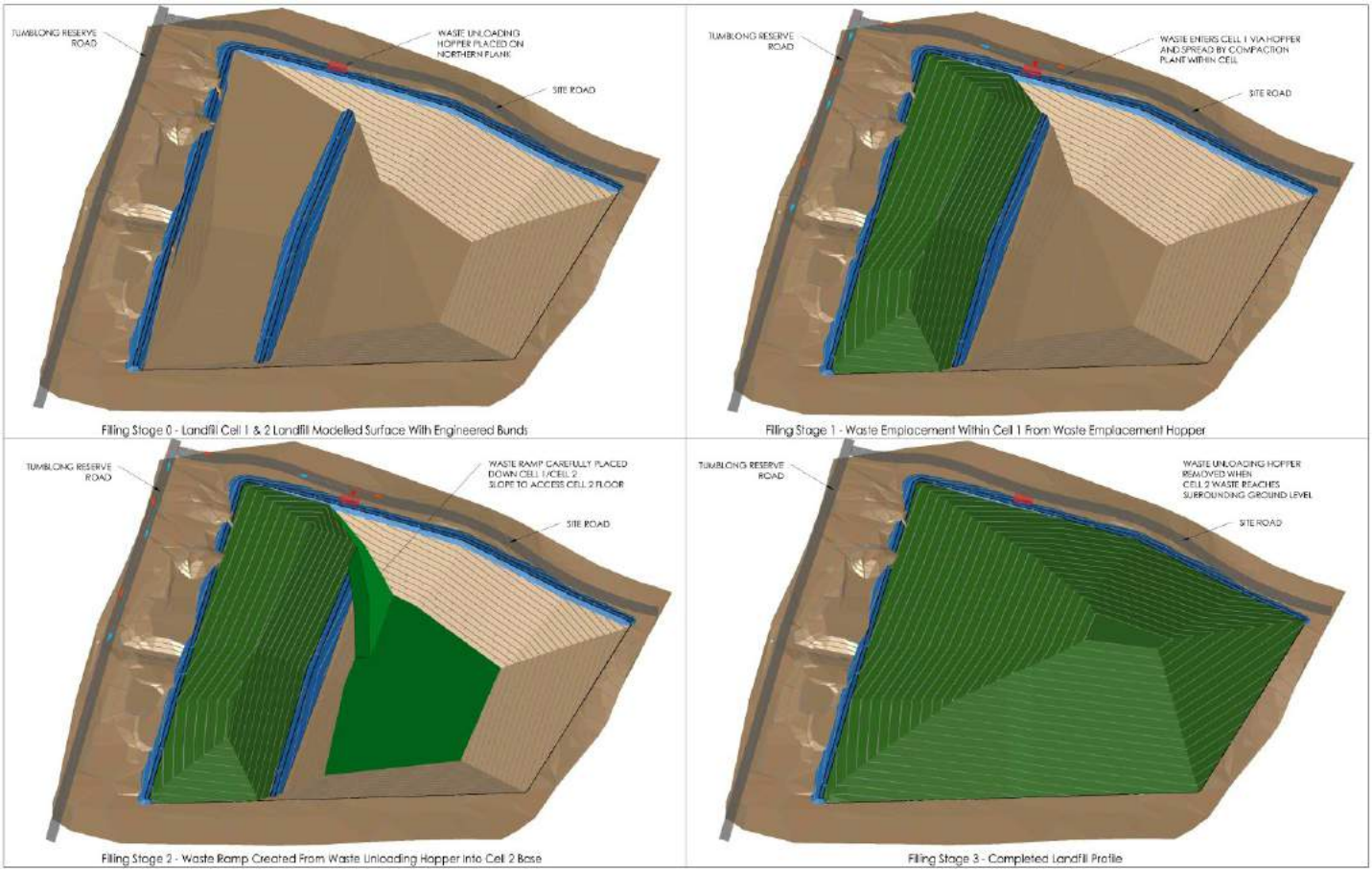
Residential Receiver	Distance to Site (m)	Direction
R1	580	South East
R2	840	South South East
R3	1900	South West
R4	1100	North West
R5	1750	North North East

Adjacent to the site is Tumblong Reserve Road (a local road), which provides the main access for road traffic to the site. The next nearest road (local road) is The OId Hume Highway which is located approximately 1 km directly south of the site.

2.2 Proposed Filling Plan

Figures 2 illustrates the proposed filling plan for the development. The main noise sources associated with the operation of the facility will be the outdoor movement of vehicles to deliver, handle and manoeuvre waste material around the site.

Figure 2. General Filling Plan



As the site develops over time the mobile noise sources will progress from operating below the surrounding ground level (ie in the quarry hole), to level with the surrounding ground, to finally above the surrounding ground level (ie a small hill).

This assessment report will determine the worst-case noise impacts throughout the lifetime of the development ie as the noise sources change locations horizontally and vertically (below ground level, level and above ground level) across the site.

2.3 Potential Operational Noise Impacts

Potential noise impacts from operation of the proposed development which will be assessed in this report include:

- Noise emission from vehicle and plant movements on site to any nearby sensitive receivers ie delivery truck, excavator and loader movements.
- Additional noise emission from vehicle movements on the adjacent roads to any nearby sensitive receivers.

2.4 Potential Construction Noise Impacts

Potential noise impacts from construction of the proposed development which will be assessed in this report include:

- Noise emission from vehicle movements on the site to any nearby sensitive receivers. Typical vehicle movements will include delivery trucks, bulldozers, loaders and excavators. These vehicles will also haul excess fill material to the adjacent lot during construction.
- Additional noise emission from construction vehicle movements on the surrounding roads to any nearby sensitive receivers.

2.5 Potential Vibration Impacts

The offset distances (in all directions) between the vibrationally intensive equipment and any sensitive receivers is large (> 500 m). The potential for vibration impacts due to the construction or operation of the development are effectively nil. All vibration criteria with respect to cosmetic damage to buildings and human comfort impacts will be satisfied as a result.

No further consideration of vibration impacts is given in this assessment as a result.

2.6 Operational Noise Levels

Table 2 provides the overall Sound Power Level for the proposed outdoor equipment / activities which have been used in this assessment. These levels have been based on recent site measurements for the plant and equipment at a similar site (as per Gundagai Landfill: Equipment SWL Testing – Advitech Environmental 21 July 2017).

Table 2. Worst-Case Sound Power Level of the Proposed Outdoor Plant

Description	Overall L_{WA} (dB re 1pW)
Volvo L120 front end loader	107
Volvo 360 excavator	107
Hino watercart (10,000 L capacity)	106
Truck & Dog	106

2.7 Operational Hours

The proposed operational hours were provided by MH Earthmoving Pty Ltd and are summarised in Table 3.

Table 3. Summary of Operational Hours

Operational Activity	Hours
Landfill Activities – deliveries, front loader & excavator movements	0700 to 1700 hrs Monday to Friday. 0700 to 1300 hrs on Saturday. No evening, night-time or weekend activities.

2.8 Operational Traffic Generation

The proposed traffic movements for receival of material at the site were taken from the traffic report prepared by SECA Solution (September 2019). At full development the site will be capable of receiving, processing and storing up to 60,000 tonnes per annum.

This level of operation is estimated to generate up to 20 vehicle trips per day (10 inbound and 10 outbound) comprising 30 tonne truck and dog or semi-trailers. These vehicles will travel to and from the site via the Old Hume Highway and the Hume Highway.

In addition to the heavy vehicles, the site is predicted to generate up to ten (10) light vehicle trips per day due to staff attending the site.

3 Environmental Background Noise

The environmental background noise levels around the site and the nearest noise sensitive receivers will be low as the rural area is sparsely populated. For this assessment background noise levels were not measured. Instead background noise levels have been derived from two (2) industry recognised sources:

- Australian Standard AS 1055-2. 1997. Acoustics – Description and measurement of environmental noise. Part 2: Application to specific situations.
- NSW EPA Noise Policy for Industry 2017 (NPI).

Table 4 below summarises the recommended background noise levels derived from these sources during daytime, evening and night-time assessment periods.

Table 4. Measured Noise Levels Corresponding to NSW NPI Assessment Periods

Source of Background Noise Levels	L_{AF90} Background Noise Levels					
	Monday to Saturday			Sundays & Public Holidays		
	Day	Evening	Night	Day	Evening	Night
AS 1055-2 1997 Appendix A Noise Category Area R1 (ie rural with little transportation noise)	40	35	30	40	35	30
Noise Policy for Industry (NPI) Minimum RBLs	35	30	30	35	30	30

Note 1. For Monday to Saturday, Daytime 0700 to 1800 hrs, Evening 1800 to 2200 hrs, Night-time 2200 to 0700 hrs.
For Sundays and Public Holidays, Daytime 0800 to 1800 hrs, Evening 1800 to 2200 hrs, Night-time 2200 to 0800 hrs.
Note 2. The RBL noise level is representative of the *median background sound level* (in the absence of the source under consideration), or simply the background level.

To define the applicable environmental criteria at nearby noise sensitive receivers the background noise levels from the EPA NSW Noise Policy for Industry (NPI) will be used. These represent the minimum RBLs levels that can used in any NPI assessment, so will generate the most conservative noise criteria possible under this legislation.

4 Operational Noise Assessment Guidelines

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the NSW Environment Protection Authority (EPA).

The EPA oversees the NSW Noise Policy for Industry (NPI) 2017 which provides a framework and process for deriving noise trigger levels. The NPI replaced the Industrial Noise Policy (INP) at the end of October 2017.

The NPI sets out the procedure to determine the *project noise trigger levels* relevant to a particular industrial development. The project noise trigger level applies to existing noise-sensitive receivers; however, it may also be used in strategic planning processes for proposed land uses.

If it is predicted that the development is likely to cause the project noise trigger level to be exceeded at existing noise-sensitive receivers, management measures are required to reduce the predicted noise level.

4.1 Project Noise Trigger Level - Introduction

The project noise trigger level provides a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so *trigger* a management response; for example, further investigation of mitigation measures.

The project noise trigger level, feasible and reasonable mitigation, and consideration of residual noise impacts are used together to assess noise impact and manage the noise from a proposal or site. It is the combination of these elements that is designed to ensure that acceptable noise outcomes are determined by decision makers.

The trigger level is tailored for each specific circumstance to take into account a range of factors that may affect the level of impact, including:

- Background noise environment.
- Time of day of the activity.
- Character of the noise.
- Type of receiver and nature of the area.

The scientific literature indicates that both the increase in noise level above background levels (that is, intrusiveness of a source), as well as the absolute level of noise are important factors in how a community will respond to noise from industrial sources. The project noise trigger level established in the NPI addresses each of these components of noise impact.

The project noise trigger level is the lower (that is, the more stringent) value of the *project intrusiveness noise level* and the *project amenity noise level*. The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses.

Applying the most stringent requirement as the project noise trigger level ensures that both intrusive noise is limited and amenity is protected and that no single industry can unacceptably change the noise level of an area. Typically, the intrusiveness level will inform the project noise trigger level in areas with little industry (and/or ambient noise levels), whereas the amenity level will inform the project noise trigger level in areas with higher existing background noise levels. Intrusive noise levels are only applied to residential receivers (residences). For other receiver types only the amenity levels apply.

4.2 Project Intrusiveness Noise Level

The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.

The project intrusiveness noise level is determined as follows:

$L_{Aeq,15min}$ = rating background noise level + 5 dB

where:

- $L_{Aeq,15m}$ - represents the equivalent continuous (energy average) A-weighted sound pressure level of the source over 15 minutes.
- Rating Background Noise Level (RBL) - represents the background level to be used for assessment purposes, as determined by the methodology in Factsheets A & B of the NPI.

Intrusiveness noise levels are not used directly as regulatory limits. They are used in combination with the amenity noise level to assess the potential impact of noise, assess reasonable and feasible mitigation options and subsequently determine achievable noise requirements.

4.2.1 Minimum Project Intrusiveness Noise Levels

The NPI applies minimum RBLs to any project. These result in minimum intrusiveness noise levels as follows:

Table 5. Minimum RBLs and Project Intrusiveness Noise Levels

Time of Day	Minimum RBL (dB)	Minimum Project Intrusiveness Noise Level $L_{Aeq,15min}$ (dB)
Day	35	40
Evening	30	35
Night	30	35

4.3 Project Amenity Noise Level

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 6 where feasible and reasonable.

The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The *recommended amenity noise levels* represent the objective for total industrial noise at a receiver location, whereas the *project amenity noise level* represents the objective for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level = recommended amenity noise level (from Table 6) minus 5 dB

Table 6. Recommended Amenity Noise Level as per Table 2.2 of the NPI

Receiver Type	Noise Amenity Area	Time of Day	Recommended Amenity Noise Level $L_{Aeq,period}$ (dB)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5 dB above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom – internal	All	Noisiest 1-hour period when in use	35
Hospital ward internal external	 All All	 Noisiest 1-hour Noisiest 1-hour	 35 50
Place of worship – internal	All	When in use	40
Area specifically reserved for passive recreation (eg national park)	All	When in use	50
Active recreation area (eg school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5 dB to recommended noise amenity area

4.4 Recommended Amenity Noise Level – Residential Receiver Classification

Residential receivers must have the area type defined in order to select the applicable recommended amenity noise level. Table 7 below illustrates how the NPI classifies the rural, suburban and urban noise amenity area categories.

Table 7. Residential Receiver Category as per Table 2.3 of the NPI

Receiver Category	Typical Planning Zone	Typical Background Noise Levels (RBL)			Description
		Day	Eve	Night	
Rural residential	RU1, RU2, RU4, R5, E4	<40	<35	<30	**Rural** – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented in column 3 due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5, RU6, R2, R3, E2, E3	<45	<40	<35	**Suburban** – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.
Urban residential	R1, R4, B1, B3, B4	>45	>40	>35	**Urban** – an area with an acoustical environment that: ▪ is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources ▪ has through-traffic with characteristically heavy and ▪ continuous traffic flows during peak periods ▪ is near commercial districts o**r** industrial districts ▪ has any combination of the above

For this development the *rural* classification will apply to the residential receivers when defining the recommended amenity noise level.

4.5 Recommended Amenity Noise Level – Existing Background Noise Corrections

The recommended amenity noise level applicable to residential receivers can be changed in the following circumstances:

- When existing traffic noise levels are dominant, are 10 dB above the recommended noise amenity level and are unlikely to decrease, then the project amenity noise levels become the $L_{Aeq,period(traffic)}$ – 15 dB.
- At industrial / residential interfaces where a project seeks to make minor changes to an existing development. In this case, the recommended amenity noise levels can be increased by 5 dB in the region that is in close proximity to existing industrial premises and that extends out to a point where the existing industrial noise from the source has fallen by 5 dB or an area defined in a planning instrument.
- As per the information given in Table 7 for residential receivers in the rural category.

For this development, none of the circumstances described above are present so background noise level corrections will not be applied.

4.6 Recommended Amenity Noise Level - Time Period Correction

The L_{Aeq} is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardise the time periods for the intrusiveness and amenity noise levels, the NPI assumes the following conversion:

$L_{Aeq,15min} = L_{Aeq,period} + 3$ dB

(unless robust evidence is provided for an alternative approach for the particular project being considered)

4.7 Maximum Noise Level Assessment - Sleep Disturbance

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

Where the subject development / premises night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40 dB or the prevailing RBL plus 5 dB, whichever is the greater.

and/or

- L_{AFmax} 52 dB or the prevailing RBL plus 15 dB, whichever is the greater.

a detailed maximum noise level event assessment should be undertaken.

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

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

- How often high noise events will occur.
- The distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development.
- Whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods).
- Current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

Maximum noise level event assessments should be based on the L_{AFmax} descriptor on an event basis under *fast* time response. The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

4.8 NPI Project Noise Trigger Levels (PNTL)

Having defined the area type, the processed results of the unattended noise monitoring have been used to determine project noise trigger levels. The intrusive and amenity noise levels for nearby noise-sensitive receivers are presented in Table 8. These criteria are nominated for the purpose of assessing potential noise impacts from the onsite sources of noise associated with the proposed development.

For each assessment period, the lower (ie the more stringent) of the amenity or intrusive trigger levels are adopted (if applicable), as marked in **bold**, as the project noise trigger levels (PNTL).

Table 8. NPI Project Noise Trigger Levels

Receiver	Time of Day	RANL[1] $L_{Aeq,period}$	RBL[2] $L_{AF90,15min}$	Project Noise Trigger Levels		
				Intrusive $L_{Aeq,15min}$	Amenity $L_{Aeq,15min}$	Sleep Disturbance $L_{Aeq,15min}$
Rural Residential	Day	50	35	**40**	48	-
	Evening	45	30	**35**	43	-
	Night	40	30	**35**	38	**40**

Note 1. RANL = Recommended Amenity Noise Level for residences in Rural areas.
Note 2. RBL = Rating Background Level taken from the minimum allowable RBL levels in the NPI as discussed in Section 4.2.1.

However, we note that the site only operates during normal daytime hours. Therefore, the evening, night-time and sleep disturbance noise impacts will be nil and considered no further in this assessment.

4.9 NSW Road Noise Policy (RNP)

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the NSW Environment Protection Authority (EPA). The EPA oversees the Road Noise Policy (RNP, January 2011) which provides a framework and process for deriving traffic noise criteria. The RNP criteria applicable to this development are given in Table 9 below.

Where the existing noise levels due to traffic already exceed the assessment criteria given in Table 9 then the RNP requires that the total traffic noise level increase should be limited to 2 dB for situations where additional traffic is generated on existing roads by changes to land use developments.

Table 9. RNP Road Traffic Noise Criteria for Residential Land Uses.

Road Category	Type of Project / Land Use	External Assessment Criteria (dB re 20 µPa)	
		$L_{Aeq,15hr}$ (Day)	$L_{Aeq,9hr}$ (Night)
Freeway / arterial / sub-arterial roads	Existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use developments	55 $L_{Aeq,15hr}$ (Day)	50 $L_{Aeq,9hr}$ (Night)
Local roads		55 $L_{Aeq,1hr}$ (Day)	50 $L_{Aeq,1hr}$ (Night)

5 Operational Noise Modelling

Noise modelling of the site was undertaken using SoundPLAN v7.4 modelling software.

The noise model was constructed from a combination of aerial photography, existing ground topography and design masterplans for the development. The local terrain, design of the development, receiver buildings and structures have been digitised in the noise model to develop a three-dimensional representation of the operations of the development and surrounding environment.

5.1 Noise Model Parameters

The parameters in Table 10 were defined in the noise model to calculate noise levels at sensitive receivers.

Table 10. Noise Model Parameters

Variable	Parameter
Calculation Standard	CONCAWE
Topography	Surrounding Area – 5m resolution
Ground Absorption	0.75 (manly soft vegetation)
Receiver Height	1.5 m (mainly first storey receivers)

5.2 Noise Enhancing Meteorological Conditions

Noise model predictions were performed using noise enhancing meteorological conditions given in the NSW Noise Policy for Industry (NPI).

The noise enhancing meteorological conditions used in this assessment are given in Table 11 below. For all conditions the worst-case wind direction (source to receiver) for each receiver was assessed.

Table 11. Noise Enhancing Meteorological Conditions Used in the Noise Assessment

Period	Meteorological Parameters
Day / Evening	Stability categories A-D with light winds up to 3 m/s at 10 m AGL
Night	Stability category F with winds up to 2 m/s at 10 m AGL

Note 1. AGL = Above Ground Level.
Note 2. Stability categories are based on the Pasquill–Gifford stability classification scheme.
Note 3. Worst-case stability category D taken for Day / Evening periods.

This provides a conservative prediction of the potential noise impacts from the development at the surrounding sensitive receivers.

5.3 Operational Scenarios

With reference to Section 2 the proposed operational scenarios can be summarised as per Table 12 below.

Table 12. Proposed Operational Scenarios

Time of Day	Description of Operational Noise Sources in Worst-Case 15-minute Period
Monday to Friday (0700 to 1700 hrs) Saturday (0700 to 1300 hrs)	**Materials Handling / Stockpiling** – Front end loader and excavator full load (ie max engine revs) operation for 100% of the time. Watercart at full load operating for 50% of the time. All vehicles assumed to move throughout the site **Deliveries / Truck Movements** – Up to two (2) truck and dogs moving throughout the site. Full load (ie max engine revs) operation for 50% of the time
Evening (1800 to 2200 hrs)	**No Operational Activities –** no assessment required.
Night-time (2200 to 0700 hrs)	

5.4 Mobile Operational Noise Source Levels

Mobile operational noise sources include:

- Delivery vehicles were modelled entering the site from Tumblong Reserve Road and then moving around the site. For a worst-case noise assessment, the loudest vehicle has been assessed which is a 30 tonnes truck & dog combination with a typical Sound Power Level of 106 dB L_{WA}. Delivery trucks were assumed to operate at full load (ie max engine revs) for 50% of the time while manoeuvring around the site.
- Permanent onsite vehicles which can move anywhere around the site and have noise levels as given in Table 2. The vehicles were assumed to operate at full load (ie max engine revs) for the percentage of time as indicated below:
  a. Volvo L120 front end loader 100% of the time in any 15-minute period.
  b. Volvo 360 excavator 100% of the time in any 15-minute period.
  c. Hino watercart (10,000 L capacity) 50% of the time in any 15-minute period.

5.5 Corrections for Annoying Noise Characteristics

Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration.

The NPI identifies correction factors for annoying noise characteristics which must be applied to the predicted noise levels before assessing against the PNTLs. All of the noise sources in this report have been assessed, based on the noise data available, for annoying noise characteristics. The proposed operational noise sources are generally broadband in nature and have not demonstrated any annoying characteristics as per the definitions in Fact Sheet C of the NPI.

6 Predicted Operational Noise Impacts

6.1 Predicted Operational Noise Impacts - NPI

Noise modelling of the onsite noise sources has been used to predict the noise emissions from the typical operation of the facility to the surrounding sensitive receivers.

A selection of the predicted worst-case operational noise levels due to onsite noise sources are summarised and compared against the NPI project noise trigger levels in Table 13. These predictions include the worst-case noise levels throughout the lifetime of the development.

In addition, a noise contour map for the daytime period is provided in Appendix A. The noise contours presented are taken at 1.5 m elevation to simulate first storey receivers (ie typical residential receivers in the area). The noise contours show how the noise emission from the proposed development propagates into the surrounding environment.

Table 13. Predicted Operational Noise Levels Compared to PNTLs

Location	Worst-Case $L_{Aeq,15m}$			PNTLs Exceedance $L_{Aeq,15m}$			$L_{Aeq,15m}$ Sleep Disturbance
	Day	Eve	Night	Day	Eve	Night	
Residential				**40**	**35**	**35**	**45**
R1	40	-	-	0	-	-	-
R2	37	-	-	0	-	-	-
R3	28	-	-	0	-	-	-
R4	33	-	-	0	-	-	-
R5	≤20	-	-	0	-	-	-

The results from Table 13 and Appendix A demonstrate that the noise emissions from the site to the surrounding environment are low. The proposed development satisfies the PNTLs at all nearby residential receivers during all time periods.

6.2 Predicted Operational Noise Impacts – RNP

Table 14 summarises the existing traffic volumes and noise characteristics of the roads potentially impacted by operation of the proposed development (ie the surrounding roads used by vehicles accessing and exiting the site).

Table 14. Summary of Existing Traffic Volumes on the Surrounding Roads

Road	Existing Traffic		Road Type	RNP Assessment Criteria	Estimated Existing Noise Levels
	Volume per Day	Percentage Heavy Vehicles %			
Tumblong Reserve Road	< 20[1]	10%	Local	55 $L_{Aeq,1hr}$ (Day)	< 20 $L_{Aeq,1hr}$ (Day)[3]
Old Hume Highway	< 100[2]	10%	Local	55 $L_{Aeq,1hr}$ (Day)	< 35 $L_{Aeq,1hr}$ (Day)[3]
Hume Highway	10,877[2]	34%	Arterial	55 $L_{Aeq,15hr}$ (Day)	> 55 $L_{Aeq,15hr}$ (Day)

Note: 1. Estimated by Waves Consulting.
2. Taken from Seca Solution Traffic Report (September 2019)
3. Estimated using CoRTN traffic model (with Australian conditions corrections) to the nearest residential receiver (R2).

Tumblong Reserve Road and the Old Hume Highway have estimated existing noise levels which are below the RNP assessment criteria. For these roads the combined existing traffic volumes and future predicted volumes (due to the proposed development) need to be assessed against the RNP assessment criteria.

However, for the Hume Highway we find that the RNP criteria are already likely to be exceeded. Based on this, the allowable increase in noise due to traffic from the proposed site must not exceed 2 dB as per the RNP requirements.

Table 15 summarises the predicted in noise levels on the nearest affected roads due to the traffic generated by operation of the development site. These predictions use the future traffic volumes as described in Section 2.8 above.

Table 15. Summary of Operational Traffic Noise on Surrounding Roads (from available traffic data)

Road	Future Traffic		Road Type	RNP Assessment Criteria	Estimated Future Noise Levels	Increase in Noise Levels (dB)
	Volume per Day	Percentage Heavy Vehicles %				
Tumblong Reserve Road	< 50	44%	Local	55 $L_{Aeq,1hr}$ (Day)	< 20 $L_{Aeq,1hr}$ (Day)[1]	NA
Old Hume Highway	< 130[2]	23%	Local	55 $L_{Aeq,1hr}$ (Day)	< 35 $L_{Aeq,1hr}$ (Day)[1]	NA
Hume Highway	10,907[2]	34%	Arterial	55 $L_{Aeq,15hr}$ (Day)	> 55 $L_{Aeq,15hr}$ (Day)	< 0.5

Note: 1. Estimated using CoRTN traffic model (with Australian conditions corrections) to the nearest residential receiver (R2).

The predicted operational traffic noise levels on Tumblong Reserve Road and the Old Hume Highway are significantly below the RNP assessment criteria for local roads. Therefore, the RNP criteria for these roads are satisfied as a result.

Since the existing traffic noise levels on the Hume Highway (arterial road) likely exceed the RNP assessment criteria, all new traffic noise increases must satisfy the 2 dB increase criteria. Table 15 shows that the proposed development generates negligible additional traffic noise on this road. The RNP criteria are satisfied as a result.

The site will not operate during the night-time, which means all traffic noise impacts during the night will be nil.

7 Construction Noise & Vibration Assessment Guidelines

People are typically more tolerant to noise and vibration during the construction phase of proposals than during normal operation. This response results from recognition that the construction emissions are of a temporary nature – especially if the most noise-intensive construction impacts occur during the less sensitive daytime period. For these reasons, acceptable noise and vibration levels are normally higher during construction than during operations.

Construction often requires the use of heavy machinery which can generate high noise and vibration levels at nearby buildings and receivers. For some equipment, there is limited opportunity to mitigate the noise and vibration levels in a cost-effective manner and hence the potential impacts should be minimised by using feasible and reasonable management techniques.

At any particular location, the potential impacts can vary greatly depending on factors such as the relative proximity of sensitive receivers, the overall duration of the construction works, the intensity of the noise and vibration levels, the time at which the construction works are undertaken, and the character of the noise or vibration emissions.

7.1 Construction Hours

For this project the construction works would be undertaken in accordance with the Interim Construction Noise Guideline (DECCW 2009) and would typically occur during the standard working hours between:

- 0700 to 1800 hrs Monday to Friday.
- 0800 to 1200 hrs on Saturdays.

There will be no construction works on Sundays or public holidays.

Where Out-of-Hours Works (OOHWs) are required (for emergency works, oversized equipment delivery, etc) they would be subject to separate approval on a case-by-case basis.

7.2 Noise Management Levels for Construction Activities

The ICNG requires proposal specific Noise Management Levels (NMLs) to be established for noise affected receivers. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices are investigated to minimise noise emissions.

Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts would be managed via site specific construction noise management plans, to be prepared in the detailed design phase.

The ICNG provides an approach for determining $L_{Aeq,15min}$ NMLs at residential receivers by applying the measured $L_{AF90,15min}$ rating background noise levels (RBL), as described in Table 16.

Table 16. Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq,15min}$	Time of Day
Standard hours Monday to Friday 0700 to 1800 hrs Saturday 0800 to 1300 hrs No work on Sundays or public holidays	RBL + 10 dB	The **noise affected level** represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	≥ 75 dB (Highly Noise Affected)	The **highly noise affected level** represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: ▪ Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences. ▪ If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended hours	RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Note 2: The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Noise Policy for Industry (NPI).

Adopting the measured background noise levels in Table 4 the NMLs derived for the proposal are detailed in Table 17.

Table 17. Construction NMLs for Residential Receivers

Receiver	Time of Day	Construction NMLs $L_{Aeq,15min}$ (dB)		
		Standard Hours	Out-of-Hours	Highly Noise Affected
Residential				
All Residential	Day	50	45	75
	Evening	N/A	40	75
	Night-time	N/A	40	75

Where construction would be undertaken during the night-time period the potential for sleep disturbance should be assessed. However, this project will not conduct any construction works during the night-time period. Therefore, construction related sleep disturbance impacts will be nil and considered no further in this assessment.

7.3 Construction Traffic Noise

When trucks and other vehicles are operating within the boundaries of the various construction sites, road vehicle noise contributions are included in the overall predicted $L_{Aeq,15min}$ construction site noise emissions and then compared against the NMLs. When construction related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site.

The ICNG does not provide specific guidance in relation to acceptable noise levels associated with construction traffic. For assessment purposes, guidance is taken from the RNP; however, it is noted that these are taken as noise goals only and are not mandatory.

One of the objectives of the RNP is to apply relevant permissible noise criteria to protect sensitive receivers against excessive decreases in amenity as the result of a proposal. For this development site the RNP assessment criteria will be applied to all potentially affected roads. These criteria are summarised in Table 9 (Section 4.9) above. However, where the existing traffic noise levels already exceed the assessment criteria given in Table 9 (Section 4.9) then the RNP requires that the total traffic noise level increase should be limited to 2 dB. When assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

On this basis, construction traffic NMLs will be set at the RNP assessment criteria except where these criteria are already exceeded by existing traffic noise. In this case, the NMLs will be set at 2 dB above the existing road traffic noise levels. The levels are considered appropriate to identify the onset of potential noise impacts. Consideration should be given to applying feasible and reasonable noise mitigation measures to reduce the noise impacts and preserve acoustic amenity where the NMLs for construction traffic are exceeded.

7.4 Construction Vibration

An example of the recommended safe working distances for vibrationally intensive plant is provided in Table 18.

Table 18. Recommended Safe Working Distances for Vibration Intensive Plant

Plant Item	Rating / Description	Safe Working Distance	
		Cosmetic Damage[1]	Human Response[2]
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 50 kN (Typically 2-4 tonnes)	6 m	20 m
	< 50 kN (Typically 4-6 tonnes)	12 m	40 m
	< 50 kN (Typically 7-13 tonnes)	15 m	100 m
	< 50 kN (Typically 13-18 tonnes)	20 m	100 m
	< 50 kN (Typically > 18 tonnes)	25 m	100 m
Large Hydraulic Hammer	1600 kg – 18 to 34t excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Note 1: Referenced from British Standard BS 7385 Part 2-1993.
Note 2: Referenced from Assessing Vibration: A Technical Guideline.

The typical offset distance between any vibrationally intensive construction plant and the nearest residential receivers is > 500 m. Comparing the residential offset distance to the safe working distances shows that all residential receivers are located much further away than the safe working distances. Therefore, the potential for vibration impacts due to the construction of the development is effectively nil. All vibration criteria with respect to cosmetic damage to buildings and human comfort impacts will be satisfied. No further consideration of vibration impacts is given in this assessment as a result.

8 Construction Noise Modelling

The same noise model as described in Section 5 (operational noise model) was used as the basis of the construction noise model with the necessary modifications to the noise sources (ie construction activities) and construction scenarios.

8.1 Construction Scenarios & Noise Sources

Table 19 summarises the proposed construction equipment for the site. In general, the majority of the construction phase will focus on earth works to prepare the site for future operations.

Table 19. Proposed Construction Plant Information and Sound Power Levels L_{WA}

Construction Item	Make / Model	Capacity	Estimated Sound Power Level L_{WA}
Excavator	EC360B	~40 tonnes	107
Bull dozer	CAT D10	~40 tonnes	112
Bull dozer	CAT D7	~35 tonnes	112
Dump truck	Moxy	~25 tonnes	106
Water cart	Rhino	~15 tonnes	106
Vibrating foot pad roller	CAT	18 tonnes	111

The proposed timeframes and construction scenarios are summarised below.

CELL 1

- Cell 1 excavation to take two (2) weeks to complete.
- Excavation to commence approximately January 2020 onwards using all equipment except the vibrating roller.
- Excavated materials used to construct the perimeter bunds and basal sub-base layer; the remainder stored in Cell 2
- After bulk excavation stage, cell construction stage should take a further two (2) weeks placing the clay sub-base layer.

CELL 2

- Cell 2 excavation to take approximately nine (9) weeks to complete with a further four (4) weeks to undertake the clay sub-base layer. This is anticipated to take place from January 2021 onwards.
- Bulk excavated materials to be used partially for the clay sub-base layer, partial capping to the western lower flank facing the road with the balance carted to adjacent for temporary stockpiling.

REHABILIATION

- Rehabilitation of the landfill, this will involve carting from the adjacent Lot back onto the landfill. With the landfill capacity at approximately 485,000 m^3 and the annual filling rate of 60,000 T/pa (assuming 1 T/m^3), it is estimated that the site will be rehabilitated in approximately eight (8) years from commencement. Rehabilitation is anticipated to take four (4) months to complete.

The ICNG recommends that the realistic worst-case or conservative noise levels from the source should be predicted for assessment locations representing the most noise-exposed residences or other sensitive land uses. For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted as the intensity of use and location of the construction equipment will vary throughout the site and throughout the day.

To simulate a worst-case construction scenario the model will assume that all equipment is present on site and that each piece of equipment is operating at full load for 50% of the time.

8.2 Construction Traffic Volumes

The proposed construction traffic movements were provided by MH Earthmoving Pty Ltd and are summarised in Table 20.

Table 20. Summary of Construction Traffic Volumes

Type of Vehicle	Total Vehicles per Day (inbound & outbound)
Truck & Dog	5

9 Predicted Construction Noise Impacts

The following section details the assessment of potential airborne noise impacts associated with the construction of the proposal. Construction noise goals have been determined based on the relevant government guidelines and industry standards. Potential noise levels have been predicted at sensitive receivers for the proposed construction activities and where levels are above the goals, feasible and reasonable impact mitigation measures are considered.

9.1 Construction Noise Impacts from Onsite Noise Sources

The typical $L_{Aeq,15m}$ noise levels at the surrounding noise sensitive receivers are provided in Table 21 and are representative of the 'noisiest' construction periods allowing for the simultaneous operation of noise intensive construction equipment in close proximity.

Table 21. Predicted Construction Noise Levels

Location	Worst-Case $L_{Aeq,15m}$			NML Exceedance $L_{Aeq,15m}$		
	Day	Eve	Night	Day	Eve	Night
Residential				**45**	**40**	**40**
R1	48	-	-	3	-	-
R2	44	-	-	0	-	-
R3	35	-	-	0	-	-
R4	41	-	-	0	-	-
R5	< 20	-	-	0	-	-

During standard construction hours, exceedances of the NMLs of up to 3 dB are predicted at the closest residential receiver R1. This assessment has only considered construction activities inside standard construction hours. Where this is not possible then any OOHWs would be subject to separate approval on a case-by-case basis.

The NMLs are satisfied at all other noise sensitive receivers surrounding the site.

Noise levels are not predicted to exceed 75 dB $L_{Aeq,15m}$ at any receivers. Therefore, no receivers are found to be 'highly noise affected' as per the ICNG.

9.1.1 Standard Mitigation Measures

When construction noise levels are predicted to exceed the NMLs the ICNG recommends that construction noise mitigation measures should be considered, where reasonable and feasible. Standard construction noise mitigation measures include the following:

- Avoiding the coincidence of noisy plant working simultaneously close together would result in reduced noise emissions.
- Equipment which is used intermittently is to be shut down when not in use.
- Where possible, equipment with directional noise emissions should be oriented away from sensitive receivers.
- Regular compliance checks on the noise emissions of all plant and machinery used for the proposal would indicate whether noise emissions from plant items were higher than predicted. This also identifies defective silencing equipment on the items of plant.
- Non-tonal reversing alarms should be used on all items of plants and heavy vehicles used for construction.

9.1.2 Additional Mitigation Measures

Since no receivers are considered to be 'highly noise affected' as per the ICNG, this assessment finds that additional mitigation measures (ie non-standard measures) are not necessary.

9.2 Noise Impacts from Construction Traffic

Table 22 summarises the existing traffic volumes and noise characteristics of the roads potentially impacted by construction at the development (ie the surrounding roads used by vehicles accessing and exiting the site).

Table 22. Summary of Traffic Volumes on the Surrounding Roads

Road	Existing Traffic		Road Type	RNP Assessment Criteria	Estimated Existing Noise Levels
	Volume per Day	Percentage Heavy Vehicles %			
Tumblong Reserve Road	< 20[1]	10%	Local	55 $L_{Aeq,1hr}$ (Day)	< 20 $L_{Aeq,1hr}$ (Day)[3]
Old Hume Highway	< 100[2]	10%	Local	55 $L_{Aeq,1hr}$ (Day)	< 35 $L_{Aeq,1hr}$ (Day)[3]
Hume Highway	10,877[2]	34%	Arterial	55 $L_{Aeq,15hr}$ (Day)	> 55 $L_{Aeq,15hr}$ (Day)

Note: 1. Estimated by Waves Consulting.
2. Taken from Sec Solution Traffic Report (September 2019)
3. Estimated using CoRTN traffic model (with Australian conditions corrections) to the nearest residential receiver (R2).

Tumblong Reserve Road and the Old Hume Highway have estimated existing noise levels which are below the RNP assessment criteria. For these roads the combined existing traffic volumes and future predicted volumes (due to construction) need to be assessed against the RNP assessment criteria.

However, for the Hume Highway we find that the RNP criteria are already likely to be exceeded. Based on this, the allowable increase in noise due to traffic from the proposed site must not exceed 2 dB as per the RNP requirements.

Table 23 summarises the predicted noise levels on the nearest affected roads due to the traffic generated by construction at the site. These predictions use the construction traffic volumes as described in Section 7.3 above.

Table 23. Summary of Construction Traffic Noise on Surrounding Roads (from available traffic data)

Road	Future Traffic		Road Type	RNP Assessment Criteria	Estimated Future Noise Levels	Increase in Noise Levels (dB)
	Volume per Day	Percentage Heavy Vehicles %				
Tumblong Reserve Road	< 30	40%	Local	55 $L_{Aeq,1hr}$ (Day)	< 20 $L_{Aeq,1hr}$ (Day)[1]	NA
Old Hume Highway	< 110	18%	Local	55 $L_{Aeq,1hr}$ (Day)	< 35 $L_{Aeq,1hr}$ (Day)[1]	NA
Hume Highway	10,887	34%	Arterial	55 $L_{Aeq,15hr}$ (Day)	> 55 $L_{Aeq,15hr}$ (Day)	< 0.5

Note: 1. Estimated using CoRTN traffic model (with Australian condition corrections) to the nearest residential receiver (R2).

The predicted construction traffic noise levels on Tumblong Reserve Road and the Old Hume Highway are significantly below the RNP assessment criteria for local roads. Therefore, the RNP criteria for these roads are satisfied as result.

Since the existing traffic noise levels on the Hume Highway (arterial road) likely exceed the RNP assessment criteria, all new traffic noise increases must satisfy the 2 dB increase criteria. Table 15 shows that the proposed development generates negligible additional construction traffic noise on this road. The RNP criteria are satisfied as a result.

The site will not operate during the night-time, which means all construction traffic noise impacts during the night will be nil.

10 Conclusion

Waves Consulting has conducted a noise and vibration impact assessment of the proposed landfill development at Tumblong Reserve Road, Tumblong NSW. The proposed development involves remediation of the Bangus quarry by utilising it for landfill purposes after which the quarry will be capped and returned to a state consistent with the surrounding landscape and local biodiversity considerations. This assessment has investigated the worst-case noise emissions associated with the construction and operation of the proposed development.

This assessment has demonstrated that the predicted noise emissions from the site to the surrounding environment are low. The proposed development satisfies the Project Noise Trigger Levels (PNTLs) of the NSW Noise Policy for Industry (NPI) during all time periods.

The operational traffic noise levels on the nearby affected roads have been assessed. Table 15 of this assessment shows that the proposed development generates negligible operational traffic noise. The NSW Road Noise Policy (RNP) criteria are satisfied as a result.

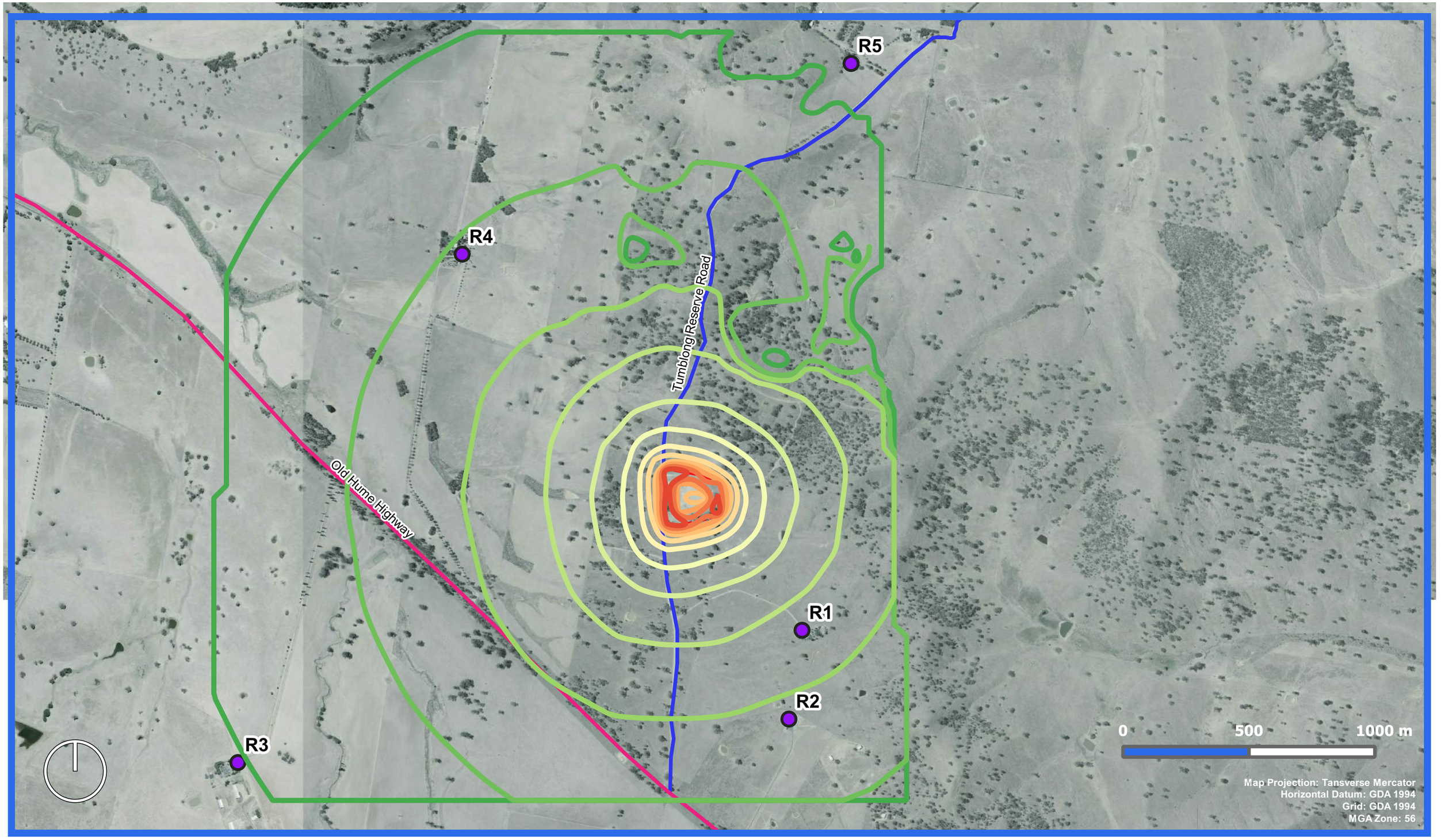
The construction noise impacts have been assessed in accordance with the NSW Interim Construction Noise Guidelines (ICNG). During standard construction hours, exceedances of the NMLs of up to 3 dB are predicted at the closest residential receiver R1. No receivers were found to be 'highly noise affected' as per the ICNG. Standard noise mitigation measures have been recommended for the construction phase. Additional (non-standard) mitigation measures were not found to be necessary.

The construction traffic noise levels on the nearby affected roads have been assessed. Table 23 of this assessment shows that the proposed development generates negligible construction traffic noise. The NSW Road Noise Policy (RNP) criteria are satisfied as a result.

The offset distances (in all directions) between the vibrationally intensive equipment and any sensitive receivers is large (> 500 m). The potential for vibration impacts due to the construction or operation of the development are effectively nil. All vibration criteria with respect to cosmetic damage to buildings and human comfort impacts will be satisfied as a result.

It is concluded that the proposed project is a complying development with respect to noise and vibration impacts and is therefore suitable for construction and operation.

APPENDIX A:
NOISE CONTOUR MAPS



Key

- Site Boundary
- Receivers
- Old Hume Highway
- Tumblong Reserve Road

LAeq (dB) - Daytime

35	60
40	65
45	70
50	75
55	80

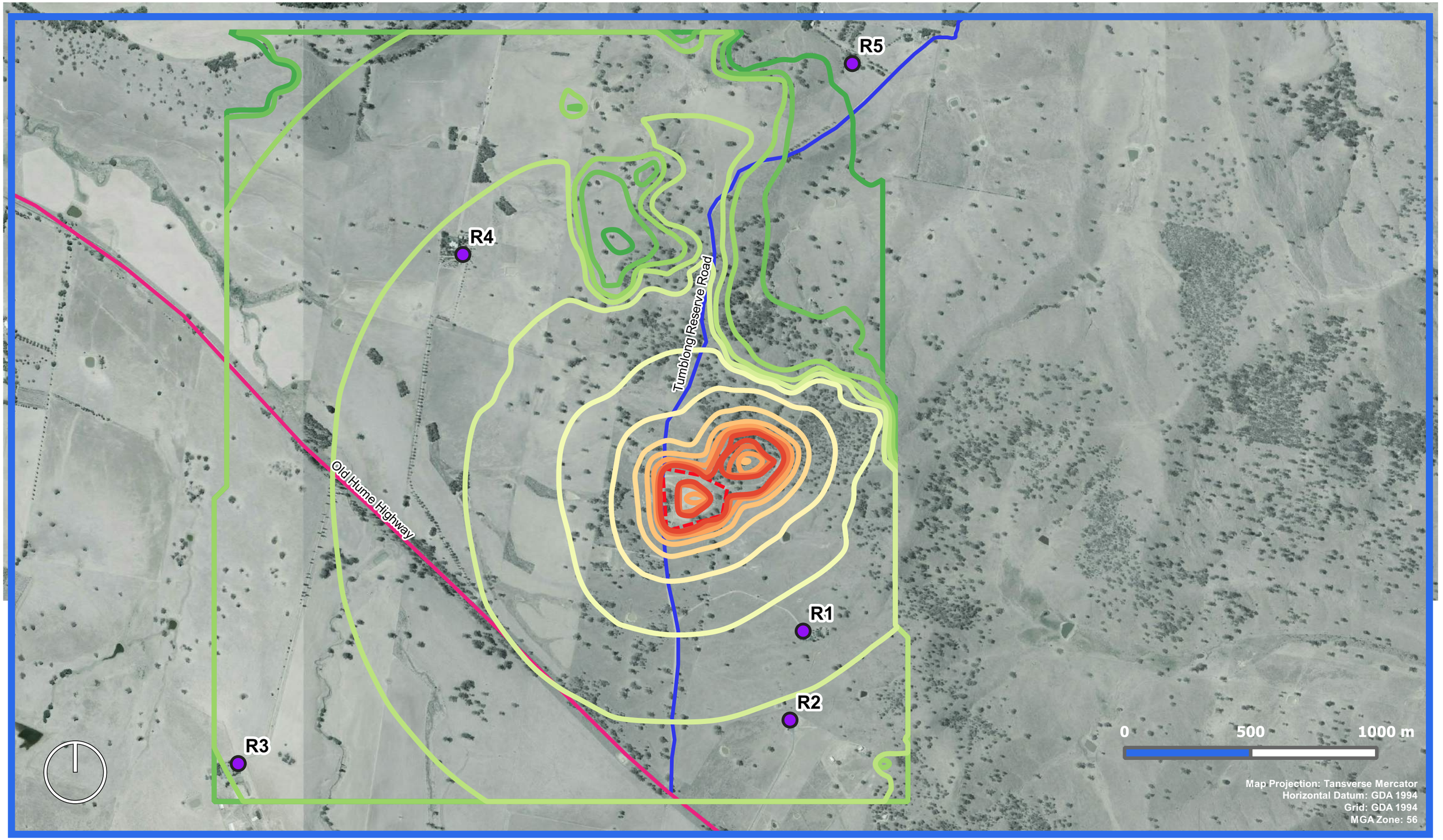
*Images courtesy of NSW Imagery

OPERATIONAL NOISE CONTOURS

Bangus Quarry Landfill Development
Tumblong Reserve Road, Tumblong, NSW

Waves CONSULTING

Project Number: 60.00805.01
Date: 08 October 2019
Revision: 01
Prepared by: TC



Key

- Site Boundary
- Receivers
- Old Hume Highway
- Tumblong Reserve Road

LAeq (dB) - Standard Hours

25	55
30	60
35	65
40	70
45	75
50	80

*Images courtesy of NSW Imagery

CONSTRUCTION NOISE CONTOURS

Bangus Quarry Landfill Development
Tumblong Reserve Road, Tumblong, NSW

Waves CONSULTING

Project Number: 60.00805.01
Date: 08 October 2019
Revision: 01
Prepared by: TC