AIBP Lot11 Storage and Distribution Warehouse

Noise and Vibration Impact Assessment

Prepared for HBB Property Pty Ltd

June 2025

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E241141 RP1

June 2025

Version	Date	Prepared by	Reviewed by	Comments
1	5 June 2025	Ryan Bruniges	Robert Kirwan	Draft
2	12 June 2025	Ryan Bruniges	Robert Kirwan	Final

Approved by

Robert Kirwan
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12 June 2025

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Executive Summary

This Noise and Vibration Impact Assessment (NVIA) has been prepared by EMM Consulting (EMM) to accompany a State Significant Development Application (SSDA) SSD-81434988 for a storage and distribution warehouse. The project seeks detailed approval for a new storage and distribution warehouse within the Alspec Industrial Business Park (AIBP) at 221-235 Luddenham Road, Orchard Hills (the site). The site is legally described as Lot 1 in DP 1293805. The proposed warehouse will be designated as lot 11 in the new community subdivision plan (DP271602) following completion of the estate subdivision

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the project (SSD-81434988).

A summary of findings from this NVIA are as follows:

- Construction noise predictions indicate NML exceedances of up to 2 decibels (dB) for some assessment locations during the worst-case construction scenario. No exceedances of the highly noise affected management level are predicted for any receptor. Mitigation measures are provided in section 6.
- Operational noise predictions comply with intrusive noise levels at all locations within the NCA1 and NCA2. An exceedance of 2 dB of the morning shoulder period intrusive noise level is predicted at R24. This exceedance would be considered negligible and unlikely to be discernible by the average listener.
- Noise predictions from Lot 11 are the same or lower than the masterplan assessment for all assessment locations within NCA1, NCA2 and R15. Predicted noise impacts are up to 4 dB higher than the masterplan assessment for NCA3. While there is an increase in predicted noise impact for NCA3 (R24), amenity levels at this location for the entire masterplan remain in compliance with noise targets.
- No exceedance of sleep disturbance criteria is predicted.
- Additional road traffic movements on Luddenham Road will be generated by the development. Increases in road traffic noise along Luddenham Road due to site generated traffic is not predicted to exceed the 2 dB requirement of the RNP.
- Construction and operation at the site are not anticipated to generate significant vibration impacts at any assessment location.

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1 Introduction

1.1 Project context and overview

This report has been prepared in support of a development at 221-235 Luddenham Road, Orchard Hills (the site), including detailed approval for a storage and distribution centre. The project seeks to deliver a new a new storage and distribution warehouse within the Alspec Industrial Business Park (AIBP). The proposed warehouse will be designated as lot 11 in the new community subdivision plan (DP271602) following completion of the estate subdivision. Specifically, the project comprises the following:

- Construction of a new warehouse with a two-level ancillary office. The warehouse is predominantly 14.7 metres in height, with a high-bay warehouse component at the western portion of the building which achieves a maximum height of 39 metres.
- A total building area of 45,512 square metres (sqm); broken down as follows:
  - Warehouse area: 43,607 sqm
  - Office Area: 1,905 sqm.
- Loading areas at the north and south sides of the warehouse, with hardstand surrounding the perimeter of the warehouse. Hardstand and carpark areas are accessed via four new driveways from the AIBP internal estate road.
- Provision of vehicular parking onsite to accommodate cars, vans, semi-trailers and B-doubles. It is envisaged that approximately 246 spaces will be provided on site within the proposed hardstand and carparking areas.
- Perimeter landscaping and tree planting with a total area of 10,236 sqm (10%).

1.2 Purpose of this report

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 4 April 2025 and issued for the SSDA (SSD-81434988). Specifically, this report has been prepared to respond to the SEARs requirement and government agency comments issued below.

Table 1.1 SEARs requirements and Government agency comments

Item	Description of requirement	Section reference (this report)
11. Noise and Vibration	Provide a noise and vibration assessment prepared in accordance with the relevant EPA guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that will be implemented	This report

This NVIA documents the existing acoustical environment; applicable noise and vibration objectives; noise modelling methodology and assumptions; and predicted noise emissions from site operations assessed against relevant objectives.

The NVIA report has been prepared in general accordance with the following relevant guidelines and policies:

- Noise Policy for Industry (NPfI) (EPA 2017)
- Interim Construction Noise Guideline (ICNG) (DECC 2009)
- Road Noise Policy (RNP) (DECCW 2011)
- Assessing Vibration: a technical guideline (the vibration guideline) (DEC 2006).

2 Project and site description

2.1 Site location

The site is located at 221-235 Luddenham Road, Orchard Hills, NSW within the AIBP. The AIBP layout and location of the project are shown in Figure 2.1.

The proposed site and adjacent allotments are located within the Penrith City Council local government area (LGA). The site is zoned E4 General Industrial.

2.2 Previous assessments

EMM has undertaken the following assessments for the AIBP based on an indicative site masterplan:

- Construction Noise and Vibration Impact Assessment (EMM report E230636 RP2) - July 2023
- Masterplan operational and traffic noise impact assessment (EMM report E230918_RP2_AlspecMasterplanNIA_V4- February 2025).

2.3 Warehouse description

The development comprises a storage and distribution facility and associated site office. A site plan is shown in Figure 2.2.

The storage and distribution facility primarily supports the logistics of retail beverage goods, handling large volumes of product movement through automated systems. Its operations are structured around the following workflows: inbound product receipt, pallet distribution, delayering for smaller shipments, and empty keg handling. Each workflow leverages automation and guided conveyor transport systems to streamline the flow of goods.

The inbound operation occurs at the north-eastern dock, where bulk beverage products arrive from the manufacturing facility. The palletised goods are unloaded either via skate docks, manual forklifts, or containers are unloaded and emptied on site. Once received, the pallets enter the facility's conveyor guided circulation system, which transports them to either the ASRS (Automated Storage and Retrieval System) racking within a high-bay storage area or transferred directly to outbound distribution points.

For outbound pallet distribution, the process involves the transfer of pallets from ASRS storage to staging lanes near the northeast dock via conveyor systems.

For wholesale and smaller format deliveries, a delayering operation is conducted beneath the mezzanine area, where pallets are unwrapped and separated into smaller units. These smaller loads are then transported by Automated Guided Vehicles (AGVs) to staging areas at the southeastern dock, where outbound vans are loaded via forklifts for delivery to various wholesale partners.

The warehouse also manages the return and redistribution of empty kegs. These are received at the northeast dock and moved to dedicated storage areas via AGVs. When required, kegs are picked and transported to the southeast dock for outbound shipment using AGVs or robotic systems.

The site will operate 24 hours per day, 7 days a week.

2.4 Site visit to existing storage and distribution facility

A site visit was undertaken to an existing storage and distribution facility in Heathwood QLD on 17 April 2025. While the site layout in Heathwood was not identical to the proposed distribution facility the same automated systems, product movement and workflows are proposed. The purpose of this site visit was to identify significant noise sources and quantify operational noise emissions from site.

During the site visit the following observations were made:

- Heavy vehicle movements and forklifts were identified as the primary noise sources.
- Automated systems including skate docks, conveyor system and automated storage and retrieval system were all noted as insignificant noise contributors and were not measurable over forklifts operating or heavy vehicles moving and idling on the hardstand.
- Ambient noise levels on the hard stand and inside the distribution facility were typically between L_{Aeq}. 50 and 65 decibels (dB), with noise from fork lift engine surges, horns and impact noises the primary noise source.
- Heavy vehicles were generally noted as being shutdown while being loaded. Some vehicles at the skate docks were noted to be idling while being loaded.

2.5 Noise generating activities

Based on this site visit heavy vehicles and forklifts operating on hardstand areas were noted as the only significant noise sources relevant to assessment of environmental noise from the project. Mechanical ventilation based on preliminary specifications has also been assessed.

2.6 On-site vehicle movements

The client has provided an estimate of operational hardstand heavy vehicle movements that will be generated by the project. These estimates are based on actual counts from their existing operations and represent total heavy vehicle movements generated by the development when it reaches full capacity. Peak daily heavy vehicle movements are shown in Table 2.1.

Table 2.1 Distribution warehouse peak operational hardstand movements

Heavy vehicle type	Daily peak heavy vehicle two-way movements	
	In	Out
B-double	110	110
Semi-trailers	123	123
Small trucks and delivery vans	112	112
Total	345	345

The anticipated operational window for each heavy vehicle type is as follows:

- B-doubles evenly spread over a 20 hour operational window - 05:00-01:00
- Semi-trailers evenly spread over a 20 hour operational window – 01:00 – 21:00

- Rigid delivery vans leave over approximately three hours in the morning (05:00 – 08:00) and return in the afternoon (15:00 – 18:00)

Based on the above requirements the client has provided the below breakdown of peak-hour heavy vehicles has been assessed assessment period.

Table 2.2 Lot 11 peak hour heavy vehicle movements (two way)

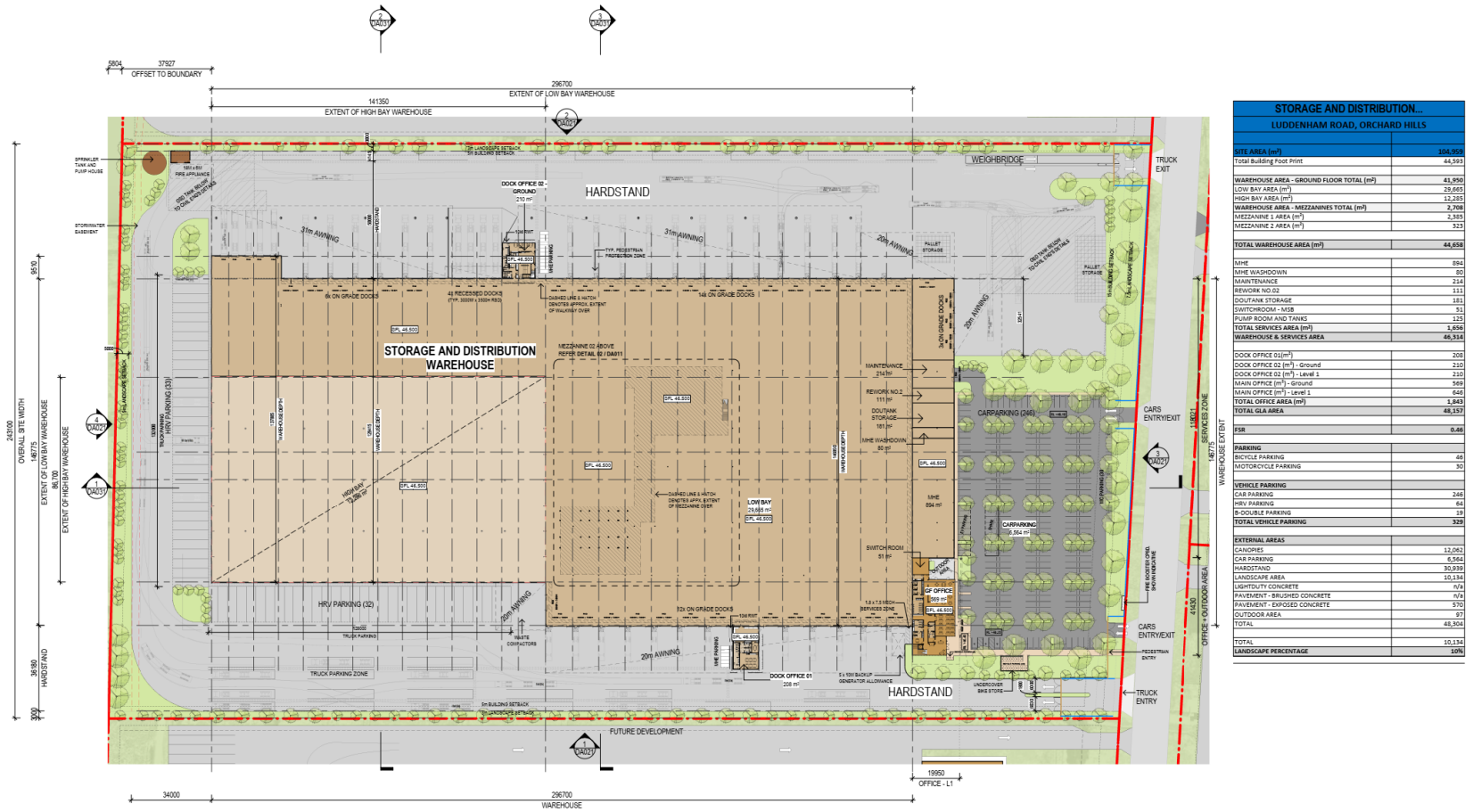
Type	Morning shoulder (05:00 – 07:00)	Day (07:00 – 18:00)	Evening (18:00 – 22:00)	Night (22:00 – 05:00)
B-double	12	12	12	12
Semi trailer	14	14	14	14
Small trucks and vans	38	38	0	0
Total peak hour movements	64	64	26	14[1]

Notes: There is no overlap between B-double and semi-trailer movements between 21:00 and 05:00. Worst case of 14 semi-trailer movements has been assessed.

The site layout includes truck entry to the south-east and truck exit to the north-east, with one-way traffic along the south, west and north boundary. An indicative material flow diagram provided by the client is shown in Figure 2.3.

Light vehicle movements have been estimated based on traffic movements provided in the Arcadis Traffic Impact Assessment. They have estimated light vehicle movements using RMS trip generation data for industrial parks. They have estimated approximately 130 light vehicles during the morning and afternoon peak hour and less than 30 movements during other periods.

Figure 2.1 AIBP layout and site location



STORAGE AND DISTRIBUTION...	
LUDDENHAM ROAD, ORCHARD HILLS	
SITE AREA (m²)	**104,959**
Total Building Foot Print	44,593
WAREHOUSE AREA - GROUND FLOOR TOTAL (m²)	**41,950**
LOW BAY AREA (m²)	29,665
HIGH BAY AREA (m²)	12,285
WAREHOUSE AREA - MEZZANINES TOTAL (m²)	**2,708**
MEZZANINE 1 AREA (m²)	2,385
MEZZANINE 2 AREA (m²)	323
TOTAL WAREHOUSE AREA (m²)	**44,658**
MHE	894
MHE WASHDOWN	80
MAINTENANCE	214
REWORK NO.02	111
DOUTANK STORAGE	181
SWITCHROOM - MSB	51
PUMP ROOM AND TANKS	125
TOTAL SERVICES AREA (m²)	**1,656**
WAREHOUSE & SERVICES AREA	**46,314**
DOCK OFFICE 01(m²)	208
DOCK OFFICE 02 (m²) - Ground	210
DOCK OFFICE 02 (m²) - Level 1	210
MAIN OFFICE (m²) - Ground	569
MAIN OFFICE (m²) - Level 1	646
TOTAL OFFICE AREA (m²)	**1,843**
TOTAL GLA AREA	**48,157**
FSR	**0.46**
PARKING	
BICYCLE PARKING	46
MOTORCYCLE PARKING	30
VEHICLE PARKING	
CAR PARKING	246
HRV PARKING	64
B-DOUBLE PARKING	19
TOTAL VEHICLE PARKING	**329**
EXTERNAL AREAS	
CANOPIES	12,062
CAR PARKING	6,564
HARDSTAND	30,939
LANDSCAPE AREA	10,134
LIGHTDUTY CONCRETE	n/a
PAVEMENT - BRUSHED CONCRETE	n/a
PAVEMENT - EXPOSED CONCRETE	570
OUTDOOR AREA	97
TOTAL	48,304
TOTAL	10,134
LANDSCAPE PERCENTAGE	**10%**

Client: albp. IBB

Project Name: Alspec Industrial Business Park
Storage and Distribution Warehouse

Project Address: Luddenham Road, Orchard Hills NSW

Drawing Title: GENERAL ARRANGEMENT PLAN - WAREHOUSE

Date: 23/05/25 | Sheet Size: A1 | Scale: 1:750

Drawing Number: 14291_DA010 | Issue: P5

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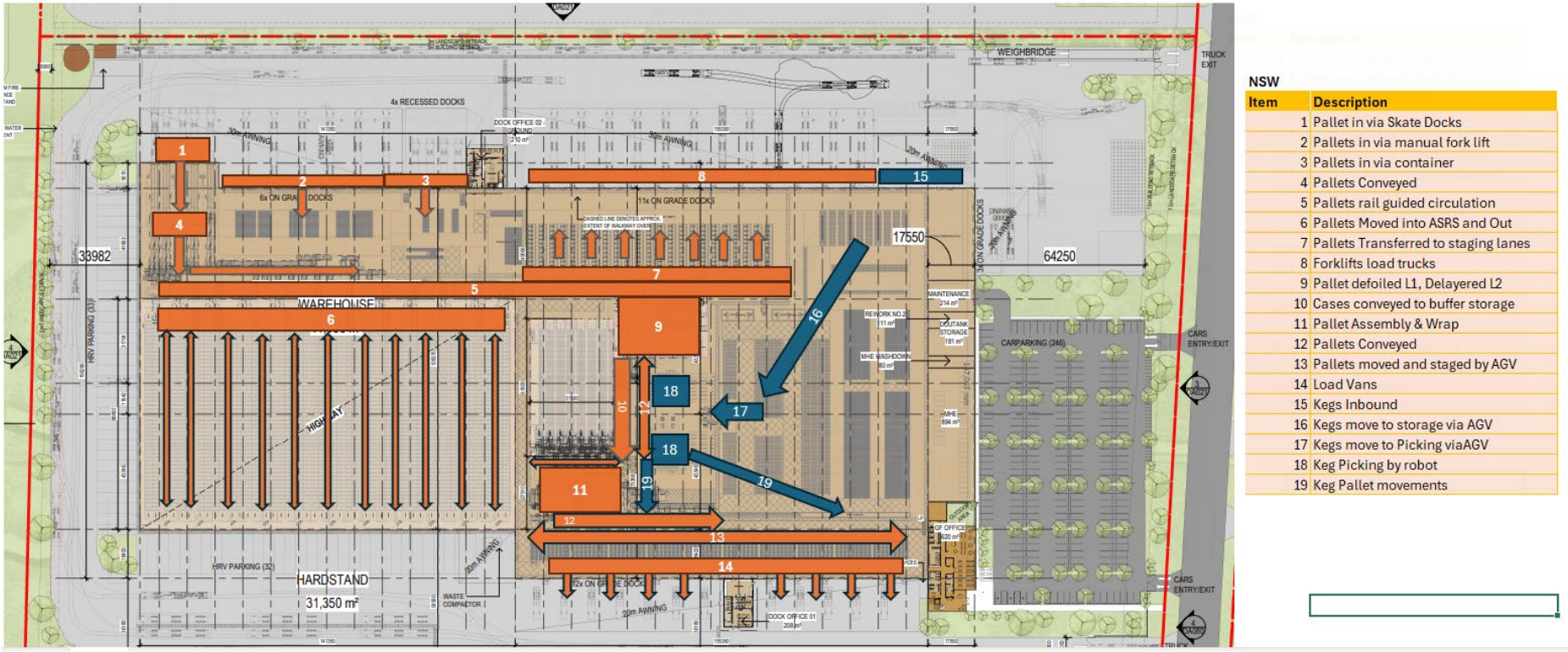
Figure 2.2 Proposed site plan



NSW

Item	Description
1	Pallet in via Skate Docks
2	Pallets in via manual fork lift
3	Pallets in via container
4	Pallets Conveyed
5	Pallets rail guided circulation
6	Pallets Moved into ASRS and Out
7	Pallets Transferred to staging lanes
8	Forklifts load trucks
9	Pallet defoiled L1, Delayered L2
10	Cases conveyed to buffer storage
11	Pallet Assembly & Wrap
12	Pallets Conveyed
13	Pallets moved and staged by AGV
14	Load Vans
15	Kegs Inbound
16	Kegs move to storage via AGV
17	Kegs move to Picking viaAGV
18	Keg Picking by robot
19	Keg Pallet movements

Figure 2.3 Indicative material flow diagram

2.7 Assessment locations

Noise assessment locations were considered as part of the AIBP masterplan. These locations are considered suitable for assessment of noise impacts from this project. Off site assessment locations that could potentially experience noise from the development have been separated into three noise catchment areas (NCAs) which have been derived based on noise environments and are discussed as follows:

- NCA1 represents residential assessment locations on the eastern side of Luddenham Road. The dwelling façades face the development and Luddenham Road; they are exposed to road traffic noise.
- NCA2 represents residential assessment locations on the western side of Luddenham Road. These properties are all set back from Luddenham Road and would be expected to experience lower noise from existing road traffic which is consistent with noise monitoring conducted at the site. It is noted that these residential properties have been included in the precinct structure plan and rezoned to E4 General Industrial.
- NCA3 represents remote assessment locations which are well removed from Luddenham Road.

Assessment locations are provided in Table 2.3 and are shown on Figure 3.1.

Table 2.3 Assessment locations

Noise catchment area	Assessment location ID	Address	Coordinates (MGA56)		Land use
			Easting	Northing	
NCA1	R1	182 Luddenham Road, Orchard Hills	292707	6255864	Residential
NCA1	R2	202 Luddenham Road, Orchard Hills	292718	6255742	Residential
NCA1	R3	212 Luddenham Road, Orchard Hills	292729	6255685	Residential
NCA1	R4	216 Luddenham Road, Orchard Hills	292737	6255636	Residential
NCA1	R5	222 Luddenham Road, Orchard Hills	292745	6255592	Residential
NCA1	R6	226 Luddenham Road, Orchard Hills	292752	6255550	Residential
NCA1	R7	230 Luddenham Road, Orchard Hills	292760	6255500	Residential
NCA1	R8	236 Luddenham Road, Orchard Hills	292768	6255452	Residential
NCA1	R9	240 Luddenham Road, Orchard Hills	292782	6255398	Residential
NCA1	R10	246 Luddenham Road, Orchard Hills	292786	6255352	Residential
NCA1	R11	250 Luddenham Road, Orchard Hills	292797	6255301	Residential
NCA1	R12	256 Luddenham Road, Orchard Hills	292804	6255252	Residential
NCA1	R13	262 Luddenham Road, Orchard Hills	292802	6255208	Residential
NCA1	R14	268 Luddenham Road, Orchard Hills	292750	6255017	Residential
NCA1	R21	320 Luddenham Road, Orchard Hills	292641	6254644	Residential
NCA2	R15	229 Luddenham Road, Orchard Hills	292458	6255431	Commercial/Active recreation
NCA2	R16	233 Luddenham Road, Orchard Hills	292603	6255351	Residential

Noise catchment area	Assessment location ID	Address	Coordinates (MGA56)		Land use
			Easting	Northing	
NCA2	R17	251 Luddenham Road, Orchard Hills	292575	6255258	Residential
NCA2	R18	275 Luddenham Road, Orchard Hills	292561	6255025	Residential
NCA2	R19	287 Luddenham Road Orchard Hills	292552	6254987	Residential
NCA2	R20	319 Luddenham Road, Orchard Hills	292377	6254700	Residential
NCA2	R22	339 Luddenham Road, Orchard Hills	292428	6254440	Residential
NCA3	R23	405 Luddenham Road, Orchard Hills	291959	6254260	Residential
NCA3	R24	327 Luddenham Road, Orchard Hills	291497	6254625	Residential

HBB Property entered into a sales agreement for the residential dwelling at R19 (287 Luddenham Road). This is significant as this dwelling is the closest receiver to the project and adjoins a future driveway to the development. The dwelling is expected to be vacated prior to Project construction work.

3 Existing environment

Noise monitoring was undertaken to quantify the existing noise environment around the proposed development site. Four unattended noise loggers were deployed at locations representative of the acoustic environment at the nearest assessment locations close to Luddenham Road and at locations representative of receivers further removed from it.

3.1 Measurement equipment and locations

Noise monitoring was carried out using three Acoustic Research Labs (ARL) NGARA environmental noise loggers and one Svantek 979 environmental noise logger. The details of each noise monitoring location are provided in Table 3.1 and illustrated on Figure 3.1.

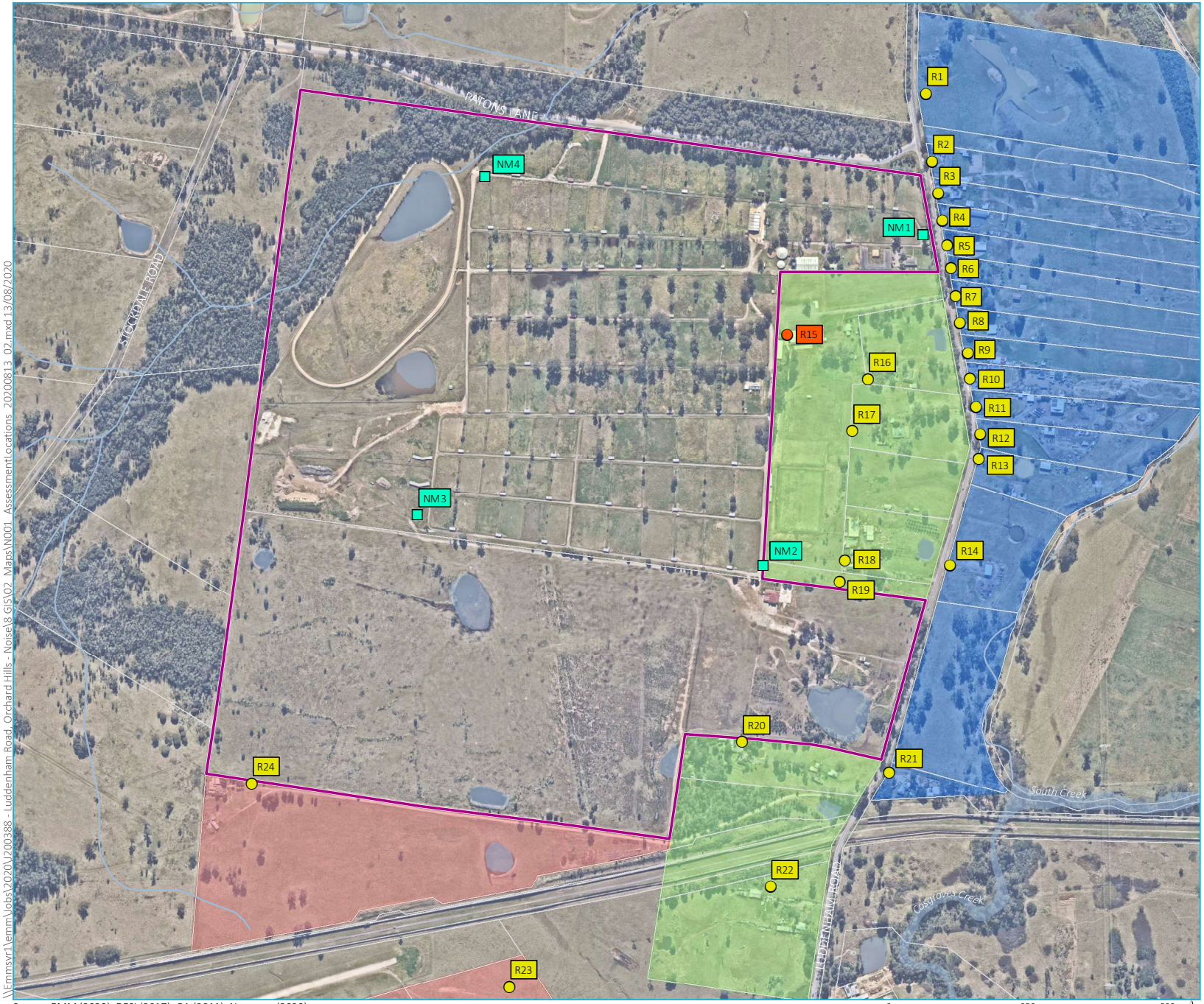
Table 3.1 Monitoring locations

Monitor ID	Equipment type and serial number	Period of measurement (2020)	Monitoring location		
			Address	Easting (MGA56)	Northing (MGA56)
NM1	Svantek 979, 21095	24 July to 4 August	221-227 Luddenham Road, Orchard Hills	292703	6255625
NM2	ARL NGARA, 878125	1 to 13 July	221-227 Luddenham Road, Orchard Hills	292376	6254999
NM3	ARL NGARA, 878123	1 to 13 July	221-227 Luddenham Road, Orchard Hills	291825	6255085
NM4	ARL NGARA, 878138	1 to 13 July	221-227 Luddenham Road, Orchard Hills	291902	6255708

Loggers were programmed to record statistical noise level indices continuously in 15 minute intervals in accordance with the requirements of the NPfI, including the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}. Calibration of all instrumentation was checked prior to and following measurements. All equipment had current NATA (or manufacturer) calibration status.

3.2 Weather affected noise data

Weather data for the survey period was obtained from the BOM weather station at Badgerys Creek (ID 067108). Wind speed and the rainfall data were used to exclude noise data during periods of any rainfall and/or wind speed in excess of 5 metres per second (m/s) in accordance with NPfI requirements.



KEY

- Site boundary
- Watercourse/drainage line
- Waterbody
- Cadastral boundary
- Noise monitoring location

Assessment location

- Active recreation
- Residential

Noise catchment areas

- NCA1
- NCA2
- NCA3

INSET KEY

- Main road
- NPWS reserve
- State forest

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Source: EMM (2020); DFSI (2017); GA (2011); Nearmap (2020)

0 250 500 m

GDA 1994 MGA Zone 56

N

Noise monitoring and assessment locations

Alspec Industrial Business Park
Noise and vibration impact assessment
Figure 3.1

EMM creating opportunities

3.3 Measured noise levels

A summary of the existing background and ambient noise levels is provided in Table 3.2.

Table 3.2 Summary of unattended ambient noise monitoring

Noise monitoring location	Time period[1]	Existing noise levels, dB	
		$L_{Aeq,period}$	Rating background level (RBL)
NM1	Morning shoulder	58	37
	Day	58	40
	Evening shoulder	59	44
	Evening	56	39
	Night	53	34
NM2	Morning shoulder	46	32
	Day	52	34
	Evening shoulder	52	36
	Evening	43	35
	Night	41	30
NM3	Morning shoulder	42	30
	Day	47	29
	Evening shoulder	46	31
	Evening	41	34
	Night	39	30
NM4	Morning shoulder	46	32
	Day	50	29
	Evening shoulder	43	31
	Evening	41	36
	Night	40	33

Notes: 1. Morning shoulder is 5 am to 7 am, Day 7 am to 6 pm; evening shoulder 4pm to 6pm, evening 6 pm to 10 pm; night 10 pm to 7 am. On Sundays and Public Holidays, day is 8 am to 6 pm; night 10 pm to 8 am.

Noise levels measured at NM2, NM3 and NM4 indicate that the evening RBL is consistently higher than the day RBL. Monitoring was done during the colder winter months which would typically negate insect noise which more commonly contributes to higher evening noise levels. Monitoring locations were also far removed from each other and thus removed from a possible singular extraneous noise source which may impact the data. Further analysis of this data and additional attended measurements were undertaken at the request of regulators with results presented in (E230918_RP3_ABP_AdditionalMonitoring_V1).

Analysis of data for NM1 and NM2 show noise levels typical of regular morning and afternoon peak traffic flows. Given their proximity to Luddenham Road it is clear this is the source of elevated evening background noise. As the source of elevated evening background noise levels at location NM3 and NM4 is less clear minimum background levels will be used for the evening at these locations.

Section 2.3 of the NPfI provides guidance where the recorded RBL is below the minimum assumed background noise level and is reproduced in Table 3.3. In these cases, the minimum background noise level is adopted for assessment purposes in accordance with the NPfI.

Table 3.3 Minimum assumed RBLs

Time of day	Minimum assumed rating background noise level, dBA
Day	35
Evening	30
Night	30

3.4 Attended noise monitoring

To further understand and demonstrate the noise environment present in the study area, EMM conducted additional attended noise monitoring at a selection of residential assessment locations to the east of the AIBP. The measurements were conducted during the morning shoulder period of 8 November 2024 and the evening and night periods of 14 November 2024. Further details of the assessment and methodology can be found in (EMM letter E230918_RP3_ABP_AdditionalMonitoring_V1).

Attended noise measurements were taken to delineate the impact of current industrial operations. EMM conducted measurements during the following periods:

- Morning shoulder: where industry is expected to be most significant
- Evening: where traffic was believed to dominate the noise environment
- Night: where noise from existing traffic is expected to be lowest.

Industrial noise was audible at low levels (up to L_{Aeq} 28 dB) on Luddenham Road during the evening and night periods and Mandalong Close (up to L_{Aeq} 26 dB) during the night period only. Measured industrial noise levels were more than 10 dB below amenity criteria at each location and would be considered insignificant in the context of existing road traffic noise.

Given the proximity of the AIBP to Luddenham Road and the relatively low noise contribution from existing industrial activity during the evening and night, the Alspec Warehouse would likely be the only significant industrial noise contribution at residences in this area.

3.5 Morning shoulder period

Fact Sheet A, Section 3A, of the NPfI provides guidance on determining noise criteria for shoulder periods. The NPfI states that "*where early morning (5 am to 7 am) operations are proposed, it may be unreasonable to expect such operations to be assessed against the night-time project noise trigger levels – especially if existing background noise levels are steadily rising in these early morning hours*".

Attended monitoring and further analysis of background monitoring data from NM1 shows that noise levels from traffic on Luddenham Road steadily increases in the morning shoulder period from 5am. Average $L_{Aeq,period}$ noise levels at NM1 in the morning shoulder period are 58 dB, the same as during the day period.

Since noise levels increase from 5 am, and given road traffic noise has been noted as the primary source of existing noise levels during the morning shoulder period, it is reasonable to assess operational noise generated between 5 am and 7 am (which is expected to be primarily from vehicle movements), against a separate morning-shoulder period criteria.

4 Assessment criteria

4.1 Construction noise

The ICNG promotes a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. It recommends standard construction hours where noise from construction activities is audible at residential premises (i.e. assessment locations), as follows:

- Monday to Friday - 7 am to 6 pm
- Saturday - 8 am to 1 pm
- Sundays or public holidays - no construction work.

The ICNG acknowledges that works outside standard hours may be necessary, with justification provided to the relevant authorities.

The ICNG provides two methodologies to assess construction noise emissions. The first is a quantitative approach that is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

This assessment has adopted the quantitative approach. The qualitative aspects of the assessment include identification of assessment locations, description of works involved, including predicted noise levels and proposed management measures that include a complaint handling procedure.

4.1.1 Construction noise management levels

Table 4.1 provides ICNG noise management levels (NML) which apply to residential assessment locations.

Table 4.1 ICNG construction noise management levels for residences

Time of day	NML $L_{Aeq,15min}$	Application
Recommended standard hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, no work on Sundays or public holidays	Noise-affected rated background level (RBL) 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 Leq(15-min) is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Time of day	NML $L_{Aeq,15min}$	Application
	Highly noise affected 75 dBA	The highly noise-affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for 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 standard hours	Noise-affected 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 practices have been applied and noise is more than 5 dBA above the noise-affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Source: ICNG (EPA 2009).

The only non-residential use near the site is the Bosna Croatian Club at 229 Luddenham Road (Receiver 15). This receiver is considered both active recreation (soccer oval) and commercial premises (club) in accordance with the ICNG. For this assessment construction noise will be assessed against the more conservative noise management level for active recreation areas of $L_{Aeq,15minute}$ 65 dB.

Table 4.2 Construction noise management levels – all assessment locations

Assessment location	Adopted RBL[1]	NML, $L_{Aeq,15minute}$ dB	HNML, $L_{Aeq,15minute}$ dB
R1-R14 & R21 (NM1)	40	50	75
R15	n/a	65	n/a
R16-R20 & R22 (NM2)	35	45	75
R23, R24 (NM3)	35	45	75

Notes: 1. Based on the day period RBL established in Table 3.2 and Table 3.3.

2. NML – Noise management Level, HNML – highly noise affected management level.

4.2 Construction vibration

4.2.1 Human perception of vibration

Humans can detect vibration levels that are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not in itself be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived vibration source. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2 1999. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 4.3.

Table 4.3 suggests that people will just be able to feel floor vibration at peak levels of approximately 0.15 millimetres per second (mm/s) and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

Table 4.3 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hertz (Hz) to 80 Hz.

4.2.2 Assessing vibration - a technical guideline

The vibration guideline is based on BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1–80 Hz) (British Standards Institution 2008). It presents preferred and maximum vibration values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation.

For vibration levels below preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are beyond the relevant maximum value, it is recommended that the operator negotiate directly with the affected community.

The vibration guideline defines three vibration types and provides direction for assessing and evaluating against applicable criteria. Table 2.3 of the guideline provides examples of the three vibration types and has been reproduced in Table 4.4.

Table 4.4 Examples of types of vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZEC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Source: DEC (2006).

Continuous vibration associated with compaction of road base and fill is most relevant to the construction of this project.

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time. Intermittent vibration is representative of heavy vehicle pass-bys and construction activities such as impact hammering, rolling or general excavation work.

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz.

To calculate VDV the following formula is used (refer to Section 2.4.1 of the guideline):

$$VDV = \left[\int_0^T a^4(t)dt\right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted rms of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 4.5.

Table 4.5 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: Day time is 7:00 am to 10:00 pm and night-time is 10:00 pm to 7:00 am.
These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline recommends that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

4.2.3 Structural vibration

i Australian Standard AS 2187.2 – 2006

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 *Explosives - Storage and Use - Use of Explosives* recommends that the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2* be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to manage minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4.6 and graphically in Figure 4.1.

Table 4.6 Transient vibration guide values - minimal risk of cosmetic damage

Line[1]	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: 1. Refers to the "Line" in Figure 4.1.

The standard notes that the guide values in Table 4.6 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 4.6 may need to be reduced by up to 50%.

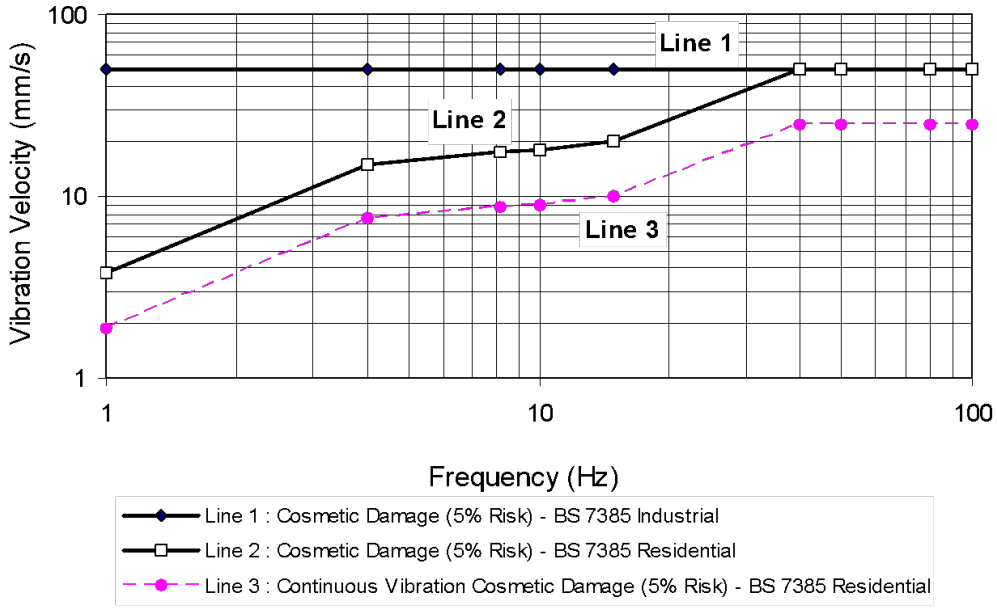


Figure 4.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz (as shown in Figure 4.1).

Fatigue considerations are also addressed in the standard, and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 4.6 should not be reduced for fatigue considerations.

To assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be made at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 4.6.

It is noteworthy that extra to the guide values nominated in Table 4.6. The Standard states that:

> Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

Also that:

> A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

A vibration screening criterion of 15 mm/s is recommended for structures surrounding the site for vibration inducing construction. This should be reduced to 7.5 mm/s (by 50%) if the vibration activity is continuous and has the potential to cause resonance effects in surrounding structures (e.g. sheet piling).

4.3 Operational noise

Noise from development in NSW is regulated by the local council, DPE and/or the EPA, and sites generally have environmental protection licence and/or development consent conditions stipulating noise limits. These limits are typically derived from project specific trigger or operational noise levels predicted at assessment locations. They are based on EPA guidelines (e.g. NPfI) or noise levels that can be achieved by a specific site following the application of all feasible and reasonable noise mitigation.

The objectives of noise trigger levels for industry, established in accordance with the NPfI, are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. It should be noted that the audibility of a noise source does not necessarily equate to non-compliance at an assessment location.

In consultation with regulators a whole of precinct approach has been adopted. To ensure that industrial noise levels (existing plus new) remain within recommended amenity noise levels for an area, a masterplan noise study for the whole of the AIBP has been completed (refer to EMM report *E230918_RP2_AlspecMasterplanNIA_V4*) which established relevant cumulative noise targets.

Noise predictions for individual lots within the AIBP, such as this project, will be assessed against project intrusive noise criteria. Compliance with amenity noise limits will be demonstrated by comparing results in this report against the estimated impact from the corresponding lot from the masterplan assessment.

4.3.1 Intrusiveness noise levels

The intrusiveness noise level is expressed as:

$L_{Aeq,15minute}$ = Rating Background Level + 5 dB

Where:

- $L_{Aeq,15minute}$ represents the equivalent continuous (energy average) A-weighted sound pressure level of the source over 15 minutes
- RBL represents the background level to be used for assessment purposes.

Intrusive noise levels are only applied to residential receptors (residences). For other receptor categories, recommended amenity noise levels apply.

Table 4.7 presents the site intrusiveness noise levels based on adopted RBLs.

Table 4.7 Project intrusiveness noise levels (dB)

Assessment location	Representative NM[1]	RBL				Project Intrusiveness noise level, $L_{Aeq,15min}$			
		Morning shoulder	Day	Evening	Night	Morning shoulder	Day	Evening	Night
NCA1	NM1	37	40	39	34	42	45	44	39
NCA2	NM2	32	35[1]	35	30	37	40	40	35
NCA3	NM3	30	35[1]	30[1]	30	35	40	35	35

Notes: 1. Minimum RBL for this period from the NPfI has been adopted.

4.3.2 Amenity noise levels

In consultation with regulators a whole of precinct approach has been adopted. To ensure that industrial noise levels (existing plus new) remain within recommended amenity noise levels for an area, a masterplan noise study for the whole of the AIBP has been completed (refer to EMM report *E230918_RP2_AlspecMasterplanNIA_V4*) which established relevant cumulative noise targets.

Noise predictions for individual lots within the AIBP, such as this project, will be assessed against project intrusive noise criteria. Compliance with amenity noise limits will be demonstrated by comparing results in this report against the estimated impact from the corresponding lot from the masterplan assessment. Lot 11 occupies the area previously presented as WH8 and WH9 in the masterplan assessment. Predicted noise levels in this assessment will be compared to the combined noise levels from these two sites.

The only non-residential use near the site is the Bosna Croatian Club at 229 Luddenham Road (Receiver 15). This receiver is considered both active recreation (soccer oval) and commercial premises (club) in accordance with the NPfI. For this assessment operational noise will be assessed against the more conservative project amenity noise level for active recreation areas of $L_{Aeq,15minute}$ 53 dB.

4.3.3 Mitigating noise

Where noise levels above the relevant goals are predicted, all feasible and reasonable mitigation are to be considered for the project to reduce noise levels towards the goals, before any residual impacts are determined and addressed.

The significance of the residual noise impacts is generally based around the human perception to changes in noise levels as explained in the glossary of the acoustic terms. For example, a change in noise level of 1 to 2 dB is typically indiscernible to the human ear. The characterisation of a residual noise impact of 0 to 2 dB above the noise goal is therefore considered negligible. Table 4.1 of the NPfI provides a characterisation of residual noise impact as outlined in Table 4.8.

Table 4.8 Significance of residual noise impacts

If the predicted noise level minus the goal is:	And the total cumulative industrial noise level is:	Then the significance of the residual noise level is:
≤2 dB	Not applicable	Negligible
≥3 but ≤5 dB	Less than recommended amenity noise level, or Greater than recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from development is ≤1 dB.	Marginal
≥ 3 but ≤5 dB	Greater than recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is >1 dB.	Moderate
>5 dB	Less than or equal to recommended amenity noise level.	Moderate
>5 dB	Greater than recommended amenity noise level.	Significant

4.4 Sleep disturbance

The NPfI suggests that a detailed maximum noise level event assessment should be undertaken where operation or construction night period noise at a residential location exceed screening levels of:

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

Guidance regarding potential for sleep disturbance is also provided in the RNP. The RNP calls upon numerous studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current (2011) level of understanding, it is not possible to establish absolute noise level criteria that will correlate to an acceptable level of sleep disturbance.

Additional information is outlined in *WHO* [World Health Organization] *Night Noise Guidelines for Europe* (WHO 2009) and the *Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep* (Basner and McGuire 2018). Further guidance is also provided in the NSW RNP with reference to enHealth "as a rule for planning for short-term or transient noise events, for good sleep over 8 hours the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dB(A) L_{Amax} more than 10 or 15 times per night". It is commonly accepted by acoustic practitioners and regulatory bodies (i.e. EPA) that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 55 dB calculated at the facade of a residence is unlikely to impact sleep according to the RNP.

If noise levels over the screening criteria are identified, then additional analysis will consider factors such as:

- how often the events will occur
- the time the events will occur
- 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 regarding the impact of maximum noise level events at night.

Considering the current research and NSW guidelines and existing traffic noise on Luddenham, we believe that an appropriate noise limit for the assessment of sleep disturbance is a façade level of L_{Amax} 55 dB.

4.5 Road traffic noise

Construction and operational traffic require consideration for potential noise impacts. The principal guidance to assess the impact of road traffic noise on assessment locations is in the RNP. Table 4.9 presents the road noise assessment criteria for residential land uses (i.e. assessment locations), reproduced from Table 3 of the RNP for road categories relevant to construction and use of the Project.

Table 4.9 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Assessment criteria – dB	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/ sub-arterial roads generated by land use developments.	$L_{Aeq,15hour}$ 60 (external)	$L_{Aeq,9hour}$ 55 (external)
Freeway/arterial/ sub-arterial roads	Active recreation area affected by traffic generating development	$L_{Aeq,15hour}$ 60 (external)	NA

Additionally, the RNP states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to an increase of up to 2 dB.

In addition to meeting the assessment criteria in Table 4.9, any significant increase in total traffic noise at the relevant residential assessment locations must be considered. Residential assessment locations experiencing increases in total traffic noise levels above those presented in Table 4.10 should be considered for mitigation.

Table 4.10 Road traffic relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase – dB	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/ sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{Aeq,15hour}$ +12 dB (external)	Existing traffic $L_{Aeq,9hour}$ + 12 dB (external)

Appendix B of the RNP, states that noise levels shall be rounded to the nearest integer, whilst difference between two noise levels are to be rounded to a single decimal place.

4.6 Cumulative operational noise

To ensure that industrial noise levels (existing plus new) remain within RANL for an area, a whole of precinct assessment has been undertaken as part of the masterplan study to ensure amenity targets are satisfied (refer to EMM report *E230918_RP2_AlspecMasterplanNIA_V4*). Cumulative impact from the AIBP as well as other industrial sources has been assessed against RANL. Lot 11 occupies the area presented as WH8 and WH9 in the version of the masterplan previously assessed. Noise predictions in this assessment will be compared against the combined estimated impact from WH8 and WH9 from the masterplan assessment.

5 Assessment

5.1 Noise modelling methodology

Road traffic noise levels were predicted using DataKustik CadnA noise prediction software implementing the US EPA Federal Highways (FHWA) Traffic Noise Model TNM.

Operational and construction noise levels were predicted using DGMR Software proprietary modelling software, iNoise, implementing international standard ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors' algorithms. As per Section 1 of the Standard:

> The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.
>
> These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

The model calculates total noise levels at assessment locations from concurrent operation of multiple noise sources. It considers factors that influence noise propagation such as the lateral and vertical location of plant, source-to-receptor distances, ground effects, atmospheric absorption, topography of the site and surrounding area and applicable meteorological conditions.

The model was populated with 3-D topography of the project and surrounding area, extending out past all assessment locations. Plant and equipment representing the range of proposed construction and operation scenarios were placed at locations that would represent worst case noise levels throughout the construction and operational scenarios.

Table 5.1 Modelling standard parameters

Modelling Parameter	Input/s
Model	ISO 9613-2:1996
Environmental conditions	Humidity 70% Temperature 10°C Air pressure [mbar] 1013.3
Elevation contours	Contours adopted from NSW Elevation Data Services
Receiver height	1.5 m above ground for single storey
Ground absorption factor	0.7 over open grass 0.0 for concrete and paved industrial area
Warehouse height	14.6 m for larger warehouses 10 m for small and medium warehouses

5.2 Construction noise

Construction equipment sound power levels (L_W) have been sourced from an EMM database of similar equipment based on measurements at other construction sites. Earthworks and site-preparation are expected to be the most significant noise impact.

The model included cumulative operation of all construction plant and equipment as an area source across the project site providing a potential worst-case scenario.

Table 5.2 Construction equipment sound power levels $L_{Aeq,15minute}$ dB

Equipment/activity	Number of items (per 15 minutes)	L_{WA} per item	Total L_{WA}	Cumulative L_{WA}
Initial site preparation works/bulk earthworks				
Excavator	1	104	104	118
Dozer	1	112	112	
Dump truck	1	108	108	
Light vehicle	4	75	81	
FEL	1	105	105	
Road truck (deliveries)	1	104	104	
Grader	1	108	108	
Roller	1	114	114	
Crane	1	106	106	
Generator	1	97	97	

Works associated with commissioning and landscaping will generate significantly lower noise levels than the site preparation works identified in Table 5.2 and have not been considered further in this assessment. Worst case predictions for construction noise impact are shown in Table 5.3. The range of predicted noise levels represent the predicted worst case impact for the range of receptors in the noise catchment area.

Table 5.3 Predicted construction noise levels, $L_{Aeq,15minute}$ dB

Noise catchment area	Predicted noise level	Construction NML	Highly noise affected level	Exceedance of construction NML	Exceedance of highly noise affected level
NCA1	38 - 48	50	75	Nil	Nil
NCA2	41 - 50	45	75	Up to 5 dB	Nil
NCA3	41 - 46	45	75	Up to 1 dB	Nil
Receiver R15 (non-residential)	51	65	N/A	Nil	N/A

Construction noise levels are predicted to comply with the construction NML at NCA1 and R15 at all times. The range of noise levels expected at NCA2 and NCA3 will at times comply or exceed NMLs by up to 5dB for NCA2 and 1 dB at NCA3. No exceedances of the highly noise affected level are predicted.

5.3 Construction vibration

Minimum working distances for typical items of vibration intensive plant that may be used on the project are listed in Table 5.4. The minimum working distances are quoted for both structural vibration (refer AS2187.2 and BS 7385) and human comfort (refer OH&E Vibration guideline).

Table 5.4 Recommended safe working distances for vibration intensive plant

Plant Item	Rating / Description	Minimum working distance	
		Cosmetic damage (BS 7385)	Human comfort (Assessing Vibration: A technical guideline)
Small hydraulic hammer	300 kg on 5 t to 12 t excavator	2 m	7 m
Medium hydraulic hammer	900 kg hammer on 12 t to 18 t excavator	7 m	23 m
Large hydraulic hammer	1600 kg hammer on 18 t to 34 t excavator	22 m	73 m
Jackhammer	Hand-held	1 m (nominal)	Avoid contact with structure
Vibratory Rollers	<50kN (Typically 1-2 tonnes)	5 m	15 to 20 m
	<100kN (Typically 2-4 tonnes)	6 m	20 m
	<200kN (Typically 4-6 tonnes)	12 m	40 m
	<300kN (Typically 7-13 tonnes)	15 m	100 m
	>300kN (Typically 13-18 tonnes)	20 m	100 m
	>300kN (>18 tonnes)	25 m	100 m

Source: From Construction Noise and Vibration Guideline, July 2023

Safe work distances relate to continuous vibration. For most construction activity, vibration emissions are intermittent in nature. The safe working distances are therefore conservative.

The safe working distances presented in Table 5.4 are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

The nearest assessment location to the project is over 250 m from the lot boundary and 350 m from the nearest façade of the warehouse. Based on vibration data for equipment presented in Table 5.4 the nearest receiver is well beyond the recommended safe working distance for cosmetic damage or human comfort.

5.4 Operational noise

5.4.1 Noise barriers

Operational noise impact from the development has been modelled using the site plans provided. The model is based on the masterplan provided in Figure 2.1. All warehouse and office buildings in the masterplan are included as barriers in the noise model.

5.4.2 Traffic movements

On-site traffic movements have been assessed based on information provided by the client. Estimated traffic movements for the development are detailed in Section 2.6.

The site layout includes truck entry to the south-east and truck exit to the north-east, with one-way traffic along the south, west and north boundary. An indicative material flow diagram provided by the client is shown in Figure 2.3.

B-doubles and semi-trailers will generally be loaded and unloaded on the two northern hardstand areas. The south-eastern hard stand is proposed to be used by small trucks and delivery vans for wholesale and smaller format deliveries.

Each truck has been modelled as arriving at site by the south-east entrance and departing from site via the north-east exit. Trucks were generally observed to be shut down whilst being loaded during the site visit. Each truck has been assessed to be idling for 5 minutes after arrival or before departure. Trucks have been assumed to be travelling at 10 km/hr on site. The sound power for heavy vehicles provided in Table 5.5 is representative of each truck driving, manoeuvring and reversing while on site.

5.4.3 Material handling

Material handling on site is discussed in Section 2.3 with the proposed material flow shown on Figure 2.3. Based on the site visit discussed in Section 2.4, forklifts were the dominant noise source and the only component of material handling relevant to this assessment.

The client has advised that electric forklifts will be the primary means of freight handling on hardstand areas. Four forklifts will operate on the southern hardstand between approximately 3 pm and 7 am to load the delivery vans.

On the Northern dock approximately half of all freight inbound and outbound freight will occur via the skate docks. The remaining freight on the hardstand will be handled with up to ten forklifts and this will typically occur between the hours of 6 am to 9 pm. These forklifts have been assumed to be evenly split between the two northern hardstand areas.

The client has advised that additionally there may be up to three forklifts in operation between 5 am and 10 pm performing general tasks on the hardstand under the awning. For the purpose of this assessment two of these forklifts has been assessed to be operating on the two northern hardstand areas and one has been assessed operating on the southern hardstand area. While no forklift movements or unloading has been proposed between 10 pm and 5 am, one forklift operating on each of the three hardstand areas has been assessed.

Each forklift has been assessed operating with 100% utilisation on hardstand areas. The sound power provided in Table 5.5 is representative of each forklift, manoeuvring and reversing while on site and includes sounds such as impact noises and horns. This is likely conservative as periods of operation inside the workshop have not been considered and no shielding has been considered for the vehicle being loaded or unloaded.

5.4.4 Mechanical plant

Plans for the Lot 11 show a plant room at ground level immediately to the west of main office. Based on plant mechanical services tender information a sound power of L_{Aeq} 95 dB has been used to represent condensers in the plantroom and a sound power of L_{Aeq} 95 dB has been used to represent rooftop ventilation (if required).

5.4.5 Sound power data

All sources considered in the noise model and sound power used are presented in Table 5.5 with octave data provided in Appendix A.

Table 5.5 Equipment sound power levels $L_{Aeq,15minute}$ dB

Plant Item	Quantity	L_{WA}	Note
Traffic noise sources			
Heavy vehicle (B-double or semi-trailer)	each	105	Travelling at 10 km/hr
Heavy vehicle	each	95	Idling for 10 minutes
Rigid van	each	100	Travelling at 10 km/hr
Light vehicle	each	85	Travelling at 10 km/hr
Forklift	each	90	15 minutes operation per heavy vehicle on hardstand
Mechanical plant	each	95	Continuous operation, external to warehouse

5.4.6 Operational scenarios

Operational scenarios have been developed to assess a worst-case 15 minutes for the morning shoulder, day, evening and night periods.

Table 5.6 Plant and equipment quantities

Source	Sources assessed per period			
	Morning shoulder	Day	Evening	Night
Material handling				
Forklifts – southern hardstand	5	5	5	1
Forklifts – north-eastern hardstand	6	6	6	1
Forklifts – north-western hardstand	6	6	6	1
Light vehicle	50	120	50	0
Peak hour total movements assessed				
B-doubles	12	12	12	0
Semi-trailers	14	14	14	14
Rigid van	38	38	0	0

5.4.7 Predicted operational noise impacts

Predicted operational impacts are provided in Table 5.7. Results for each assessment location are provided for morning shoulder, day, evening and night periods. Operational noise contours are provided in Figure 5.1 to Figure 5.4.

Table 5.7 Predicted operational noise levels, $L_{Aeq,15min}$ dB

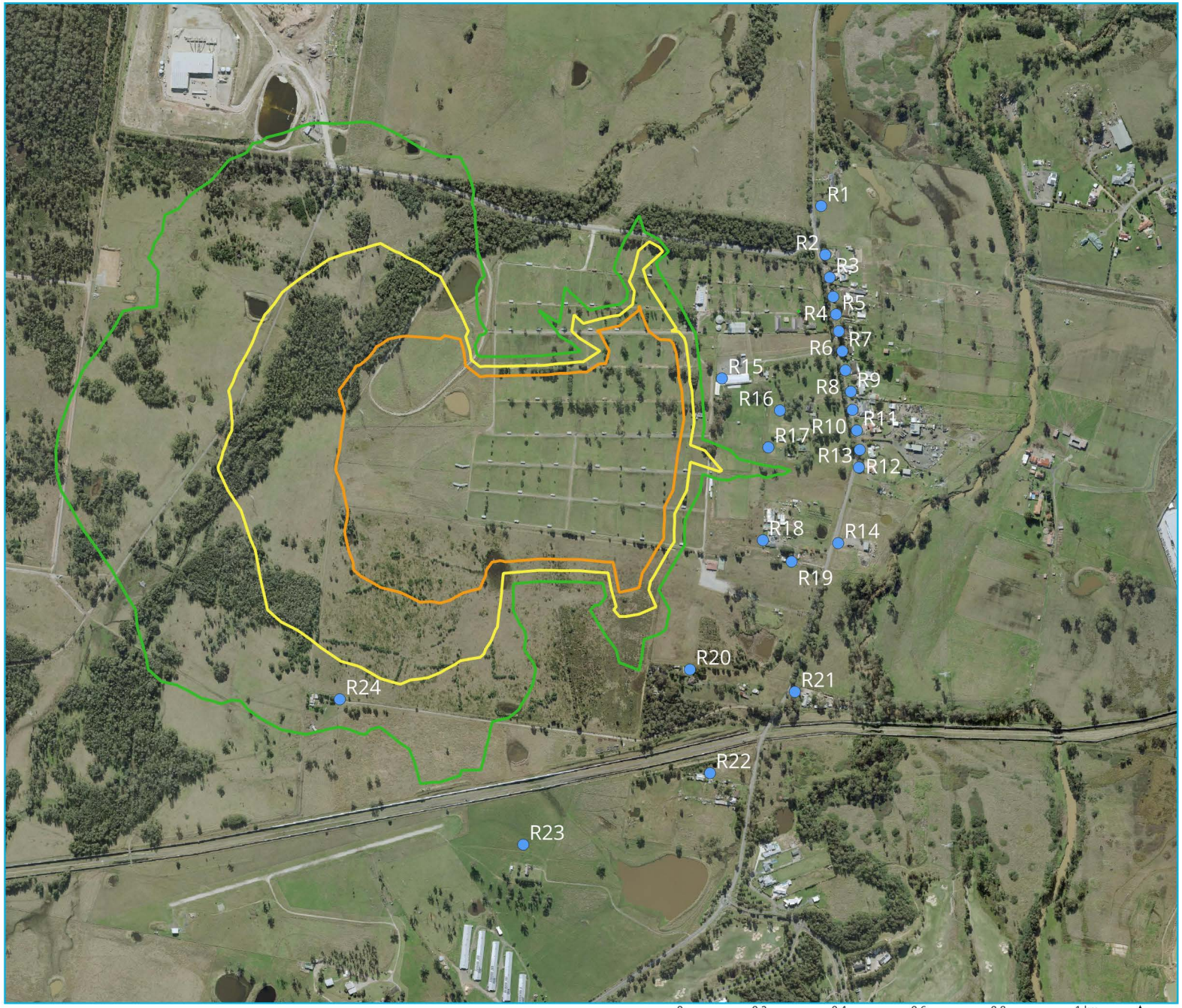
Assessment location	Noise catchment area	Project intrusiveness noise level (PINL)	Predicted noise level				Exceedance of PINL?
			Morning shoulder	Day	Evening	Night	
R1	NCA1	42/45/44/39	27	27	26	23	No
R2	NCA1	42/45/44/39	24	24	23	21	No
R3	NCA1	42/45/44/39	26	26	25	23	No
R4	NCA1	42/45/44/39	27	27	26	24	No
R5	NCA1	42/45/44/39	26	26	25	23	No
R6	NCA1	42/45/44/39	30	30	29	26	No
R7	NCA1	42/45/44/39	30	30	29	27	No
R8	NCA1	42/45/44/39	30	30	29	27	No
R9	NCA1	42/45/44/39	30	30	29	26	No
R10	NCA1	42/45/44/39	30	30	29	27	No
R11	NCA1	42/45/44/39	30	30	29	27	No
R12	NCA1	42/45/44/39	31	31	29	27	No
R13	NCA1	42/45/44/39	30	30	29	27	No
R14	NCA1	42/45/44/39	30	30	28	26	No
R15	NCA2	53/53/53/53	26	26	24	22	No
R16	NCA2	37/40/40/35	32	32	31	28	No
R17	NCA2	37/40/40/35	31	32	30	28	No
R18	NCA2	37/40/40/35	31	31	29	27	No
R19	NCA2	37/40/40/35	32	32	30	28	No
R20	NCA2	37/40/40/35	26	26	24	22	No
R21	NCA1	42/45/44/39	25	26	24	22	No
R22	NCA2	37/40/40/35	28	28	27	25	No
R23	NCA3	35/40/35/35	29	29	27	25	No
R24	NCA3	35/40/35/35	37	37	35	32	Yes

Notes: 1. Project intrusive noise level for morning shoulder/day/evening/night period.

Noise predictions comply with intrusive noise levels at all residential receivers at all locations within the NCA1 and NCA2. An Exceedance of 2 dB of the morning shoulder period intrusive noise level are predicted at R24.

5.4.8 Modifying factors

To evaluate noise modifying factor applicability, significant noise sources were modelled using one--third octave sound power data from EMM's library. Predicted one-third- octave L_{Aeq} spectra were evaluated directly against NPfI tonal noise and low frequency noise thresholds. Tonal noise and low frequency modifying factors were not applicable at any nearby assessment locations.



KEY

Assessment locations

Operational noise contours

Lot11

35 dBA

40 dBA

45 dBA

0 0.2 0.4 0.6 0.8 1 km

GDA2020 MGA Zone 55

N

Source: EMM (2024); ESRI (2023)

Lot 11
Day operational noise contours

Lot 11
Noise Impact Assessment
Figure 5.1

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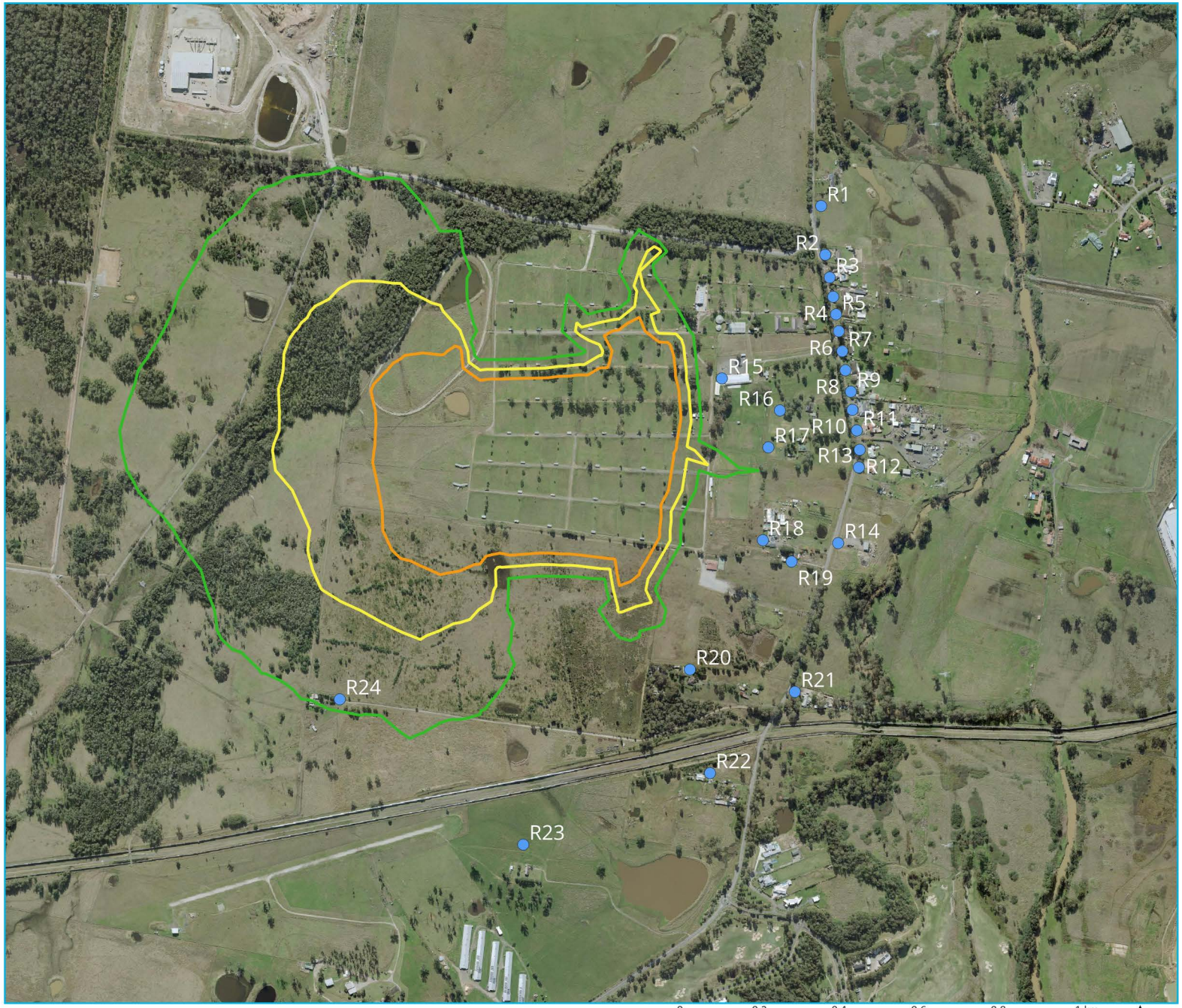

Source: EMM (2024); ESRI (2023)

Lot 11
Evening operational noise contours

Lot 11
Noise Impact Assessment
Figure 5.2

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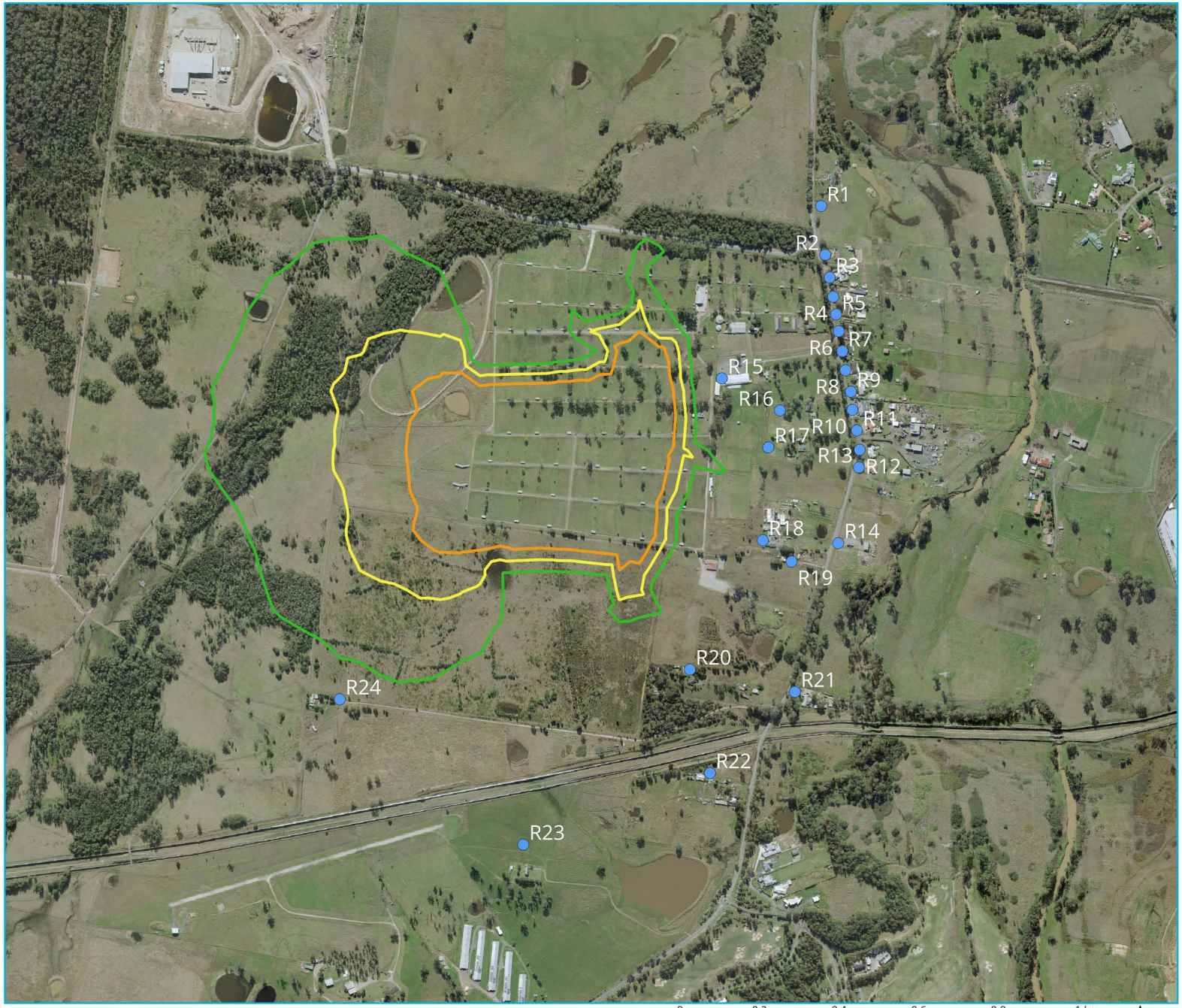

KEY

Assessment locations

Operational noise contours

Lot11

35 dBA

40 dBA

45 dBA

0 0.2 0.4 0.6 0.8 1 km

GDA2020 MGA Zone 55

N

Source: EMM (2024); ESRI (2023)

Lot 11
Night operational noise contours

Lot 11
Noise Impact Assessment
Figure 5.3

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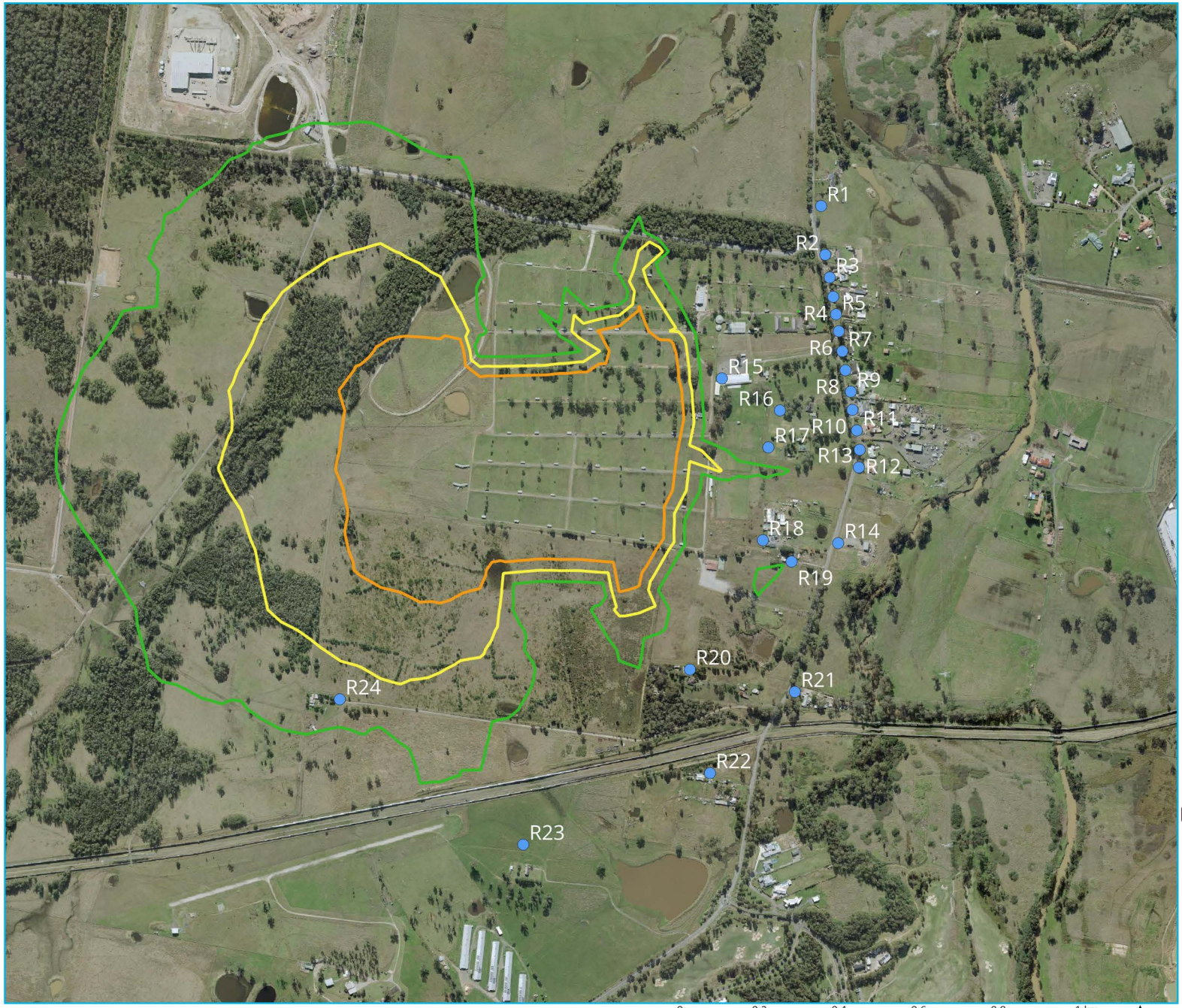

KEY

Assessment locations

Operational noise contours

Lot11

35 dBA

40 dBA

45 dBA

0 0.2 0.4 0.6 0.8 1 km

GDA2020 MGA Zone 55

N

Source: EMM (2024); ESRI (2023)

Lot 11
Morning shoulder operational noise contours

Lot 11
Noise Impact Assessment
Figure 5.4

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5.4.9 Sleep disturbance impact

For assessment of sleep disturbance an impact or airbrake release on the hard stand area have been assessed. An L_{Amax} sound power of 115 dB has been used to represent an impact noise or airbrake release and has been modelled on the north and south hard stand areas. The worst result for each receptor has been added to operational noise levels and presented below.

Predicted sleep disturbance impacts are provided in Table 5.8.

Table 5.8 Predicted maximum noise levels at residential assessment locations, L_{Amax} dB

Assessment location	Sleep disturbance criteria	Predicted noise level	Exceedance
R1	55	38	No
R2	55	35	No
R3	55	37	No
R4	55	37	No
R5	55	37	No
R6	55	37	No
R7	55	38	No
R8	55	38	No
R9	55	38	No
R10	55	38	No
R11	55	38	No
R12	55	38	No
R13	55	38	No
R14	55	37	No
R16	55	39	No
R17	55	38	No
R18	55	38	No
R19	55	38	No
R20	55	31	No
R21	55	33	No
R22	55	36	No
R23	55	34	No
R24	55	44	No

No exceedance of the sleep disturbance screening target is predicted.

5.4.10 Cumulative operational noise impact

Cumulative noise from the AIBP has been assessed in the masterplan noise impact assessment (EMM December 2024). Cumulative impact will be assessed in this report by comparing noise predictions from Lot 11 with the corresponding lot from the masterplan assessment. Lot 11 occupies the area previously presented as WH8 and WH9 in the masterplan assessment. Predicted noise levels in this assessment will be compared to the combined noise levels from these two sites. The results provided in Table 5.9 represent the highest impact for an assessment location within each noise catchment area.

Table 5.9 Predicted operational noise levels, $L_{Aeq,15minute}$ dB against PANL

Assessment period	Noise catchment area	Predicted noise level		Difference
		Lot 11	Masterplan – WH 8 + 9	
Morning shoulder	NCA1	31	32	-1
	NCA2	32	37	-5
	NCA3	37	34	3
	R15	26	27	-1
Day	NCA1	31	37	-6
	NCA2	32	41	-9
	NCA3	37	37	Nil
	R15	26	32	-6
Evening	NCA1	29	30	-1
	NCA2	31	35	-4
	NCA3	35	31	4
	R15	<25	<25	Nil
Night	NCA1	27	30	-3
	NCA2	28	35	-7
	NCA3	32	31	1
	R15	<25	<25	Nil

Noise predictions from Lot 11 are the same or lower than the masterplan assessment for all assessment locations within NCA1, NCA2 and R15. Predicted noise impacts are up to 4 dB higher than the masterplan assessment for NCA3.

While there is an increase in predicted noise impact for NCA3 (R24) amenity levels at this location for the entire masterplan remain in compliance with noise targets.

5.5 Road traffic noise generation

Road traffic noise generated by additional traffic movements from the site has been addressed for assessment locations along Luddenham Road. Road noise modelling has been done to quantify potential increases in road traffic noise due to site generated traffic when compared against the natural growth of traffic volumes in the absence of the development.

Development and background traffic data for this assessment has been provided by Arcadis.

The data in Table 5.10 describes the following:

- traffic volumes in the absence of the development ('no-build')
- traffic volumes expected to be generated by the development ('development traffic')
- the combined traffic volumes due to the development and under the 'no-build' scenario.

For Lot 11 the following project traffic movement data was supplied to EMM by Arcadis:

- daily light vehicle movements of 454 with 77 of those to occur during the night period
- daily HV movements of up to 748 per day with 310 of those to occur during the night period.

70% of development traffic has been assumed to travel north from the development and 30% assumed to travel south from the development, consistent with assumptions from the masterplan assessment.

Table 5.10 shows the comparison between volumes with and without the development. This assessment is based on estimated background traffic levels for 2027 when operations are proposed to commence.

Background noise measurements undertaken in 2020 show existing road traffic noise levels are $L_{Aeq,15hour}$ 61 dB and $L_{Aeq,9hour}$ 57 dB façade corrected as assessed at NM1, which is representative of the worst affected assessment locations on Luddenham Road. Existing road traffic noise levels are above the RNP planning levels for this road category. This means that a traffic noise increase limit of 2 dB is the relevant criterion.

No-build and Build traffic volumes have been assessed at each assessment location in Table 2.3 with the highest relative increase presented in Table 5.10.

Table 5.10 Predicted increase in Luddenham Road traffic, $L_{Aeq,period}$ dB

Assessment location	Period	No-build (2027)		Lot 11 development traffic		Build		Increase in road traffic noise
		Traffic volume	HV %	Traffic volume	HV %	Traffic volume	HV %	
Luddenham Road North of Patons Lane	Day (15hr)	14,413	6	571	54	14,984	7.8	0.5
	Night (9hr)	2,269	6	271	80	2,540	13.9	1.9
Luddenham Road South of Patons Lane	Day (15hr)	8,511	8	245	54	8,756	9.3	0.4
	Night (9hr)	1,340	8	116	80	1,456	13.8	1.5

Notes: 1. No-build traffic data provided by the AIBP project masterplan traffic consultant (Arcadis).

No exceedances of the 2dB relative increase criteria are predicted as a result of traffic generated by Lot 11.

Cumulative road traffic noise generated by the AIBP has been assessed in the masterplan noise impact assessment (EMM December2024). The Masterplan assessment demonstrates that existing traffic noise levels exceed the RNP planning levels for assessment locations on Luddenham Road. An exceedance of the 2 dB relative increase criteria is predicted for traffic on Luddenham Road north of Patons Lane at assessment location R1.

6 Noise mitigation and management

6.1 Construction noise

The ICNG requires that construction noise is assessed against NMLs. Where it is predicted to exceed NMLs, feasible and reasonable noise mitigation strategies should be adopted to minimise impacts as practicable.

6.1.1 Work practices

Work practice methods include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration
- regular identification of noisy activities and adoption of improvement techniques
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents
- develop routes for the delivery of materials and parking of vehicles to minimise noise
- where possible, avoid the use of equipment that generates impulsive noise
- minimise the movement of materials and plant and unnecessary metal-on-metal contact
- minimise truck movements
- schedule respite periods for intensive works as determined through consultation with potentially affected neighbours (e.g. a daily respite period for a minimum of one hour at midday).

6.1.2 Plant and equipment

Additional measures for plant and equipment include:

- where possible, choose quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks
- movement alarms and beepers to be replaced with non-tonal level varying quackers or equivalent
- operate plant and equipment in the quietest and most efficient manner
- regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

6.1.3 Quantifying noise reductions

Approximate noise reductions provided by some of these measures are provided in Table 6.1.

Table 6.1 Relative effectiveness of various forms of noise control

Noise control	Nominal noise reduction possible, in total A-weighted sound pressure level
Increase source to receiver distance[1]	approximately 6 dB for each doubling of distance
Reduce equipment operating times or turn off idling machinery[2]	approximately 3 dB per halving of operating time
Operating training on quiet operation[2]	up to 3 to 5 dB
Screening (e.g. noise barrier)[1]	normally 5 dB to 10 dB, maximum 15 dB
Enclosure (e.g. shed/building)[1]	normally 15 dB to 25 dB, maximum 50 dB
Silencing (e.g. exhaust mufflers)[1]	normally 5 dB to 10 dB, maximum 20 dB

Notes: 1. Sourced from AS2436-2010.

2. Based on EMM's measurement experience at construction and mining sites.

6.2 Operational noise

Noise predictions comply with intrusive noise levels at all locations within the NCA1 and NCA2. An exceedance of 2 dB of the morning shoulder period intrusive noise level is predicted at R24. This exceedance would be considered negligible and unlikely to be discernible by the average listener, particularly during the morning shoulder period where there is existing traffic noise in the area.

Noise predictions from Lot 11 are the same or lower than the masterplan assessment for all assessment locations within NCA1, NCA2 and R15. Predicted noise impacts are up to 4 dB higher than the masterplan assessment for NCA3. While there is an increase in predicted noise impact for NCA3 (R24) amenity levels at this location for the entire masterplan remain in compliance with noise targets.

The primary reason for the change in predicted noise impact at R24 is the change of orientation required for the development. The masterplan assessment proposed two warehouses, WH8 and WH9 both oriented north-south each with their own hardstand areas towards the centre of the industrial area to the east. The updated design for Lot 11 includes a single warehouse covering the area of WH8 and WH9 with hardstand areas to the south and north and one-way traffic around the south, west and north boundaries. This new layout naturally provides less shielding to the south-west of the development but increases safety and efficiency of traffic flow and is essential to the design of the distribution warehouse.

Given the design site limitations, there is limited scope to mitigate noise impacts to the south-west of site, particularly for heavy vehicles traveling around the site. To further mitigate operational noise levels the proponent should minimise noise, where possible, when operating on the hard stand areas by:

- minimising vehicle movements, particularly during the night period
- not leaving trucks to idle on the hard stand area
- avoiding impact noise from loading materials or air brake release
- operate with roller doors down when not loading or unloading trucks.

7 Conclusion

EMM has completed an assessment of potential noise impacts associated with the proposed Lot 11 storage and distribution warehouse at 221-235 Luddenham Road, Orchard Hills. The assessment considered the potential for operational, construction and road traffic noise and vibration impacts of the project and has been prepared in accordance with the methodologies outlined in the ICNG, NPfI and RNP, as well as other relevant guidelines and standards.

Construction noise management levels and operational project noise trigger levels for the project have been established based on the results of ambient noise monitoring and methodologies provided in the ICNG and NPfI.

Noise modelling has been done to predict likely levels generated during the site establishment construction period, and operations combined with typical worst-case vehicle movements. Findings of the assessment are summarised as follows:

- Construction noise predictions indicate NML exceedances of up to 2 dB for some assessment locations during the worst case construction scenario. No exceedances of the highly noise affected management level are predicted for any receptor. Mitigation measures are provided in section 6.
- Operational noise predictions comply with intrusive noise levels at all locations within the NCA1 and NCA2. An exceedance of 2 dB of the morning shoulder period intrusive noise level is predicted at R24. This exceedance would be considered negligible and unlikely to be discernible by the average listener.
- Noise predictions from Lot 11 are the same or lower than the masterplan assessment for all assessment locations within NCA1, NCA2 and R15. Predicted noise impacts are up to 4 dB higher than the masterplan assessment for NCA3. While there is an increase in predicted noise impact for NCA3 (R24) amenity levels at this location for the entire masterplan remain in compliance with noise targets.
- No exceedance of sleep disturbance criteria is predicted.
- Additional road traffic movements on Luddenham Road will be generated by the development. Increases in road traffic noise along Luddenham Road due to site generated traffic is not predicted to exceed the 2dB requirement of the RNP.
- Construction and operation at the site are not anticipated to generate significant vibration impacts at any assessment location.

References

NSW Noise Policy for Industry (NPfI) (EPA 2017).

Road Noise Policy (RNP) (DECCW 2011).

Interim Construction Noise Guideline (ICNG) (EPA 2009).

Glossary

Project and technical terms

Term	Meaning
dB(A)	Noise level measurement units are decibels (dB). The “A” weighting scale is used to approximate how humans hear noise.
L_{Amax}	The maximum root mean squared A-weighted noise level over a time period.
L_{A1}	The A-weighted noise level which is exceeded for 1% of the time.
$L_{A1,1minute}$	The A-weighted noise level which is exceeded for 1% of the specified time period of 1 minute.
L_{A10}	The A-weighted noise level which is exceeded for 10% of the time.
L_{Aeq}	The energy average A-weighted noise level.
L_{A50}	The A-weighted noise level which is exceeded for 50% of the time, also the median noise level during a measurement period.
L_{A90}	The A-weighted noise level exceeded for 90% of the time, also referred to as the “background” noise level and commonly used to derive noise limits.
L_{Amin}	The minimum A-weighted noise level over a time period.
L_{Ceq}	The energy average C-weighted noise energy during a measurement period. The “C” weighting scale is used to take into account low-frequency components of noise within the audibility range of humans.
SPL	Sound pressure level. Fluctuations in pressure measured as 10 times a logarithmic scale, with the reference pressure being 20 micropascals.
Hertz (Hz)	The frequency of fluctuations in pressure, measured in cycles per second. Most sounds are a combination of many frequencies together.
Day	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
Evening	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
Night	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
Sound power level (Lw)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

Appendix A Sound power data

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A.1 Octave sound power data

Octave sound power data $L_{Aeq,15minute}$ dB

Source	Total	Octave Band (Hz)							
		63	125	250	500	1000	2000	4000	8000
Electric forklift	90	81	78	80	83	80	85	87	68
Truck	105	79	87	92	97	101	99	93	80
Truck idling	95	69	77	82	87	91	89	83	70
Rigid van	100	76	83	87	82	96	94	88	76
Light vehicle	85	67	71	75	78	81	79	74	69
Mechanical plant	95	69	84	88	85	91	86	80	66

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