ELEVATION AT GREYSTANES

Modification 3 - Warehouse 3 and 6
Noise Impact Assessment

Prepared for:

Aliro Group
Level 38
Gateway
1 Macquarie Place
Sydney NSW 2000

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EXECUTIVE SUMMARY

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Aliro Group (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30560.00000-R04-v2.0	24 August 2022	Antony Williams Jason Rasquinha	Aaron McKenzie	Antony Williams
610.30560.00000-R04-v1.0	19 July 2022	Antony Williams Jason Rasquinha	Aaron McKenzie	Antony Williams

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APPENDICES

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Aliro Group on behalf of ISPT Pty Ltd (the Applicant) to assess the potential noise imparts of Elevation at Greystanes, located at 44 Clunies Ross Street, Lot 107 Clunies Ross Street, Prospect NSW and 615A Great Western Highway Pemulwuy, NSW (the development/project).

Development consent SSD-10399 was obtained from the Department of Planning and Environment (DPE) on 2 July 2021, which allows for the establishment of a warehouse and logistics estate with a combined gross floor area of 95,150 m^2.

A noise impact assessment was prepared as part of the SSD-10399 application in *'Clunies Ross Street, SSD 10399 – Prospect Logistics Estate, Noise Impact Assessment'* in August 2020 (the SDDA NIA). An addendum report to the SSDA was prepared in *'SSD10399 Prospect Logistic Estate, Peer Review & Acoustic Assessment, Clunies Ross Street, Greystanes, NSW'*, in December 2020 (the NIA Addendum). A modification noise assessment has also been prepared in *'Prospect Logistic Estate, Warehouse 7 Acoustic Assessment for SSD10399 Modification, 44 Clunies Ross Street Prospect, NSW'* (MOD 2 NIA), in August 2021, which amended the layout, built form and operational of Warehouse 7.

The design of the development has been updated as part of a modification (MOD 3) to Development Consent SSD-10399. This report presents a review of the potential noise impacts for MOD 3.

SLR is suitably qualified and endorsed by the Planning Secretary to produce this noise impact assessment. SLR is a member of the Australian Acoustical Society (AAS) and a member firm of the Association of Australasian Acoustical Consultants (AAAC).

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

1.1 MOD 3 Design Changes

Following the further development of the estate, the Applicant is proposing the following changes:

- Consolidating Warehouses 3, 4 and 5 to a single building (to become Warehouse 3)
- Amendments to Warehouse 6 to support a cold storage facility, with minor amendments to the layout

Warehouse 3

The proposed amendments would consolidate the three buildings into a single warehouse and align the loading docks to orient away from residential receivers on Clunies Ross Street. Key elements of the proposed changes include:

- Reduction in the total Gross Floor Area from 31,209 m^2 to 28,184 m^2, comprising the following:
  - Existing Warehouse 3 – 12,556 m^2 warehouse, 1,318 m^2 office
  - Existing Warehouse 4 – 5,349 m^2 warehouse, 476 m^2 office
  - Existing Warehouse 5 – 10,401 m^2 warehouse 1,109 m^2 office
  - Proposed Warehouse 3 – 27,132 m^2 warehouse 1,220 m^2 office

- Revised earthworks to establish a warehouse pad level of around 76.5 m RL, increasing the floor level by 2.5 m, however the proposed building ridge would be around 7.6 m lower than the approved ridge height of Warehouse 4 (98.7m RL)
- Amended access arrangements, including the removal of truck access points from Clunies Ross Street to provide a single private vehicle access to the proposed warehouse from Clunies Ross Street
- 173 parking spaces servicing the Proposed Warehouse 3 and Warehouse 6 (from 226 spaces)
- Realignment of loading docks to west facing only, from north and south
- Use of the building for refrigerated storage
- Associated changes to landscaping.

Warehouse 6

The Applicant also proposes to operate Warehouse 6 as a cold storage warehouse. Key proposed changes to the warehouse include:

- The use of temperature-controlled building (freezers)
- An increase in warehouse GFA (from 8,441 m^2 to 9,317 m^2) and reduction in office GFA (from 1,013 m^2 to 390 m^2)
- Reconfiguration of the building layout to locate the loading dock to the south and offices above the car park on the north western corner.

No changes are proposed to the building height and access arrangements, noting the access to Clunies Ross Street is no longer proposed due to the amalgamation of Warehouses 3, 4 and 5.

The location of the development and surrounding receivers is shown in **Figure 1**. The approved Masterplan design is shown in **Figure 2**. The proposed MOD 3 Masterplan design is shown in **Figure 3**.

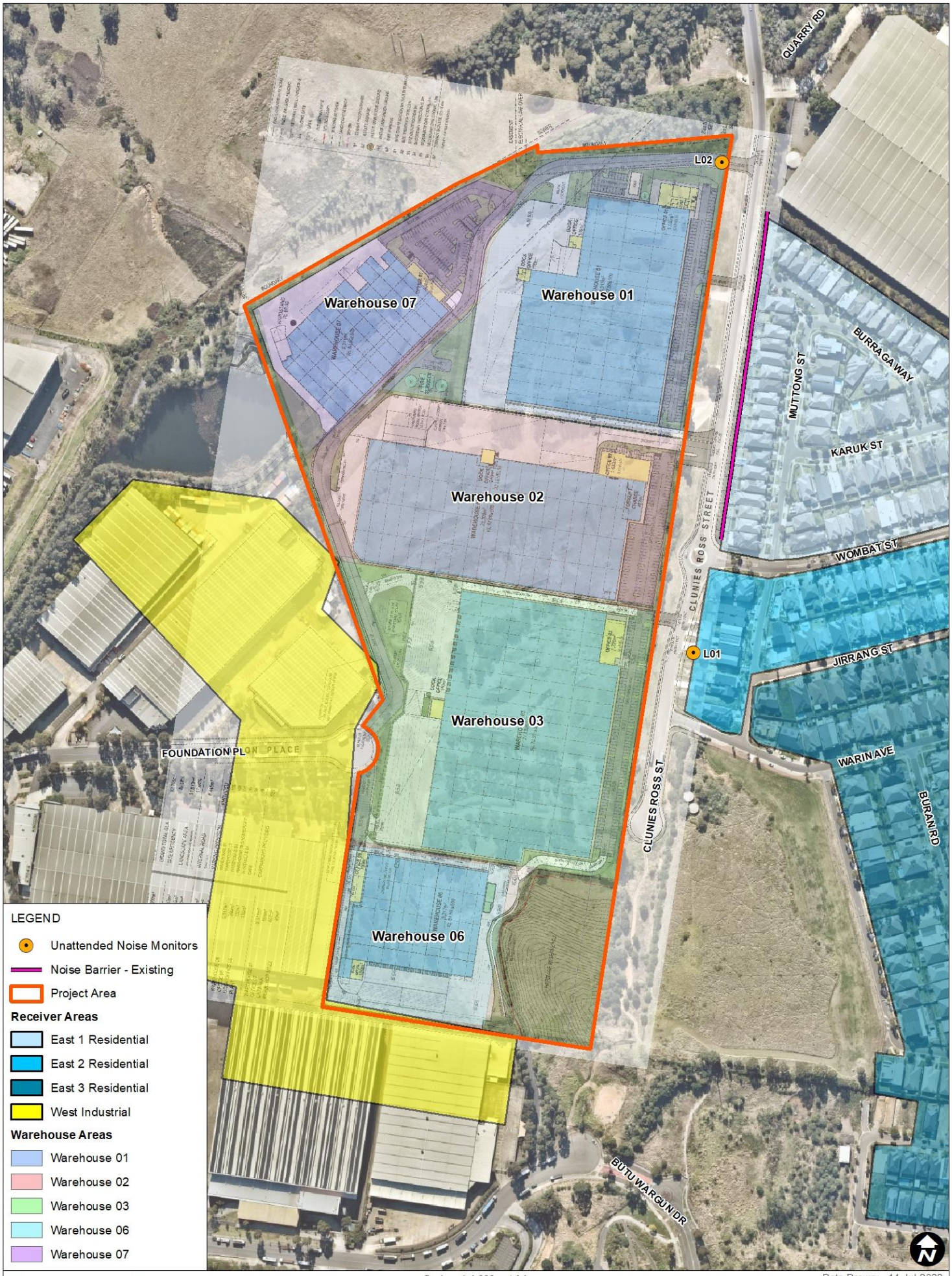

L02
L01
Warehouse 07
Warehouse 01
Warehouse 02
Warehouse 03
Warehouse 06
QUARRY RD
BURRAGA WAY
MUTTONG ST
KARUK ST
CLUNIES ROSS STREET
WOMBAT ST
JIRRANG ST
WARIN AVE
BURAN RD
FOUNDATION PLACE
BUTUWARGUN DR
LEGEND
Unattended Noise Monitors
Noise Barrier - Existing
Project Area
Receiver Areas
East 1 Residential
East 2 Residential
East 3 Residential
West Industrial
Warehouse Areas
Warehouse 01
Warehouse 02
Warehouse 03
Warehouse 06
Warehouse 07
0
100
200
m
Scale: 1:4,000 at A4
Coordinate System: GDA 1994 MGA Zone 56
Date Drawn: 14-Jul-2022
Project Number: 610.30560
Data Source:
Nearmap Imagery August 2021
Site Plan
FIGURE 1
H:\Projects-SLR\610-Srv\SYD\610-SYD\610.30560.00000 Greystanes Acoustic Validation & CNVMP\06 SLR Data\01 CAD\GIS\GIS\SLR610305560_Site_Plan_02.mxd

Figure 2 Approved Masterplan Design

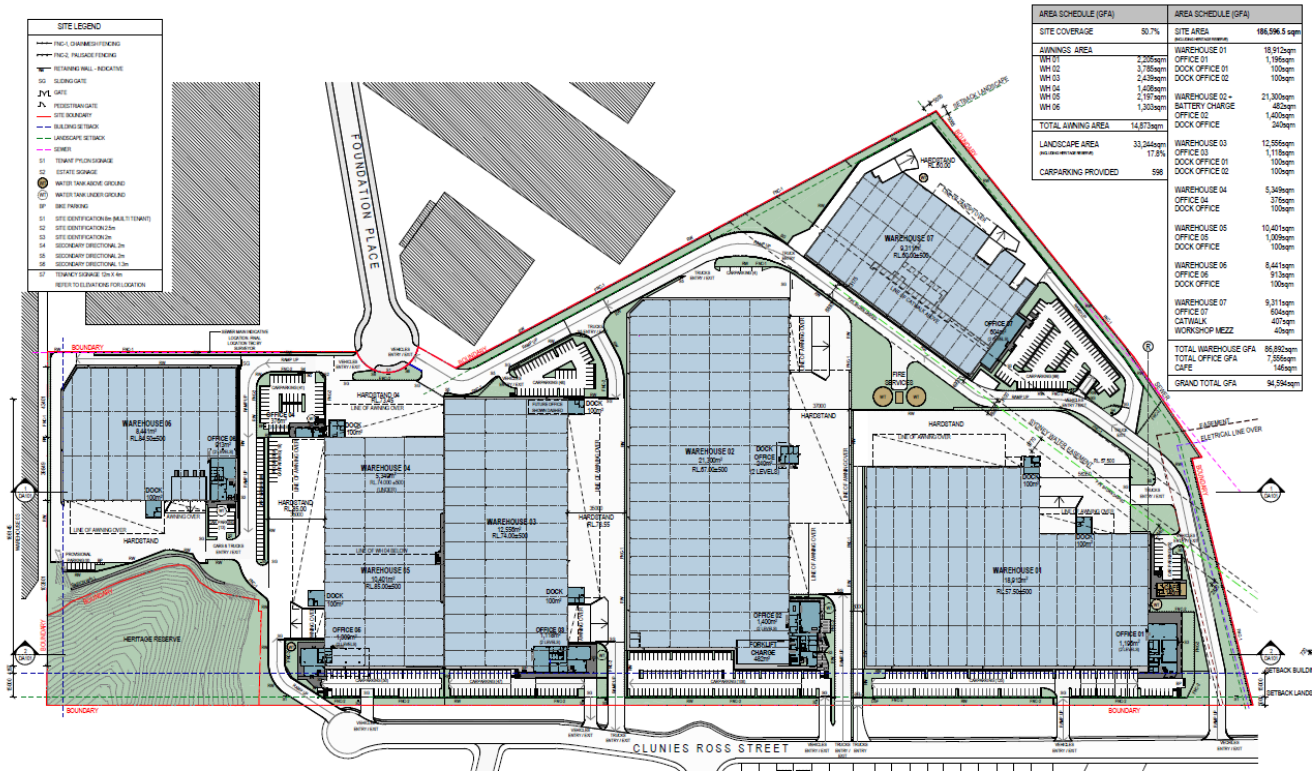
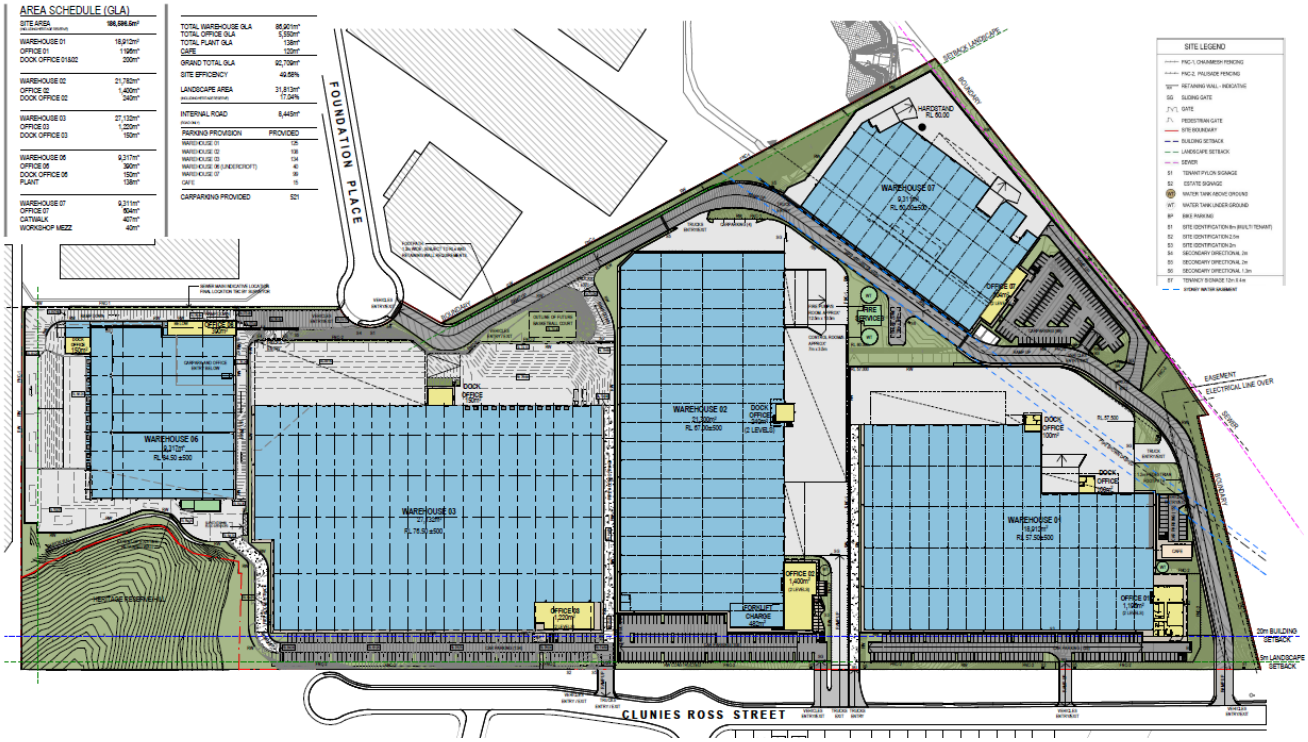


Figure 3 Proposed MOD 3 Masterplan Design



1.2 Nearest Receivers

The nearest sensitive receivers are residential properties to the east. The nearest commercial receivers are located to the immediate west. The nearest receivers are shown in **Figure 1** and detailed in **Table 1**.

Table 1 Surrounding Sensitive Receivers

ID	Address	Type	Distance (m)	Direction
East 1 Residential	Residences north of Wombat Street, Pemulwuy	Residential	50	East
East 2 Residential	Residences south of Wombat Street, Pemulwuy	Residential	50	East
East 3 Residential	Residences on Durawi Street, Pemulwuy	Residential	180	South east
West Industrial	Industrial developments on Foundation Place, Pemulwuy	Industrial	40	West

1.3 Assessment Requirements

DPE issued Environmental Assessment Requirements for MOD 3 in May 2022. The requirements relevant to noise and vibration are shown in **Table 2**.

Table 2 Assessment Requirements

Requirement	Where Addressed
6. Noise and vibration, to be prepared by a suitably qualified and experienced noise expert including:	**Section 1**
○ a quantitative assessment of potential construction[1], operational and transport noise and vibration impacts in accordance with relevant Environment Protection Authority guidelines and including details of the proposed on-going monitoring regime to be implemented	**Section 3**, **4**, **5** and **6**
○ an operational noise assessment that includes plant and equipment associated with refrigeration and freezer units, backup generators (if any) and reversing vehicles, and measures to mitigate identified impacts	**Section 4**, **5** and **6**

Note 1: The potential construction impacts were assessed in the SSDA NIA. The proposed modification would not significantly change the construction impacts and have not been assessed further.

2 Existing Noise Environment

Unattended noise monitoring was completed in the study area during January and February 2020 and as part of the SSDA NIA. The measured noise levels have been used to determine the existing noise environment and to set the criteria used to assess the potential impacts from the development.

The noise monitoring locations are shown in **Figure 1** and the results are summarised in **Table 3**.

Table 3 Summary of Unattended Noise Monitoring Results

ID	Address	Measured Noise Levels (dBA)[1,2]					
		Background Noise (RBL)			Average Noise (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
L01	Southern location	48	46	40	52	51	44
L02	Northern location	52	50	44	58	54	52

Note 1: The assessment periods are the daytime which is 7 am to 6 pm Monday to Saturday and 8 am to 6 pm on Sundays and public holidays, the evening which is 6 pm to 10 pm, and the night-time which is 10 pm to 7 am on Monday to Saturday and 10 pm to 8 am on Sunday and public holidays. See the NSW EPA *Noise Policy for Industry*.

Note 2: The survey was completed by White Noise Acoustics in 2020.

Short-term attended noise monitoring was also completed at each monitoring location for the SSDA NIA. The attended measurements concluded that the noise levels during the survey were dominated by vehicle movements of Clunies Ross Street, nearby motorways and industrial noise from the existing industrial facilities.

3 Assessment Criteria

3.1 Noise Policy for Industry

The NSW *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the requirements for the assessment and management of operational noise from industry in NSW.

3.1.1 Industrial Noise Trigger Levels

The NPfI defines how to determine 'trigger levels' for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.

There are two types of trigger levels – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses:

- The **intrusiveness** of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfI for that particular land use.

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

The NPfI provides guidance on assigning residential receiver amenity noise categories based on the site-specific features shown in **Table 4**.

Table 4 Residential Receiver Amenity

Receiver Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Rural	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime <40 dBA Evening <35 dBA Night <30 dBA	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 due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.

Receiver Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Suburban residential	RU5 – village RU6 – transition R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Daytime <45 dBA Evening <40 dBA Night <35dBA	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 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime >45 dBA Evening >40 dBA Night >35 dBA	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 or industrial districts • Has any combination of the above.

Amenity noise categories have been determined with reference to the NPFI. The assessment is shown in **Table 5**.

Table 5 Residential Receiver Amenity Category Assessment

Area	Land Use Zoning	Existing Background Noise Levels RBL (dBA)			Resulting Amenity Classification	Discussion
		Day	Eve	Night		
East 1 (L02)	R3 – medium density residential	52	50	44	Urban	The area is zoned as R3 – medium density residential, however, residences have been classified as urban due to high existing background noise levels that are dominated by road traffic and industrial noise, and due to the location being near to commercial/industrial districts.
East 2 and East 3 (L01)		48	46	40	Urban	

3.1.2 Project Noise Trigger Levels

The trigger levels for industrial noise from the project are summarised in **Table 6**. They are based on the previously measured background noise levels, where appropriate. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each period and are highlighted below.

Table 6 Project Noise Trigger Levels

Receiver Location/ Type	Period	Amenity Noise Level L_{Aeq} (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
			RBL[1]	L_{Aeq}	Intrusiveness	Amenity[2]
East 1 Residential (L02)	Day	60	52	58	**57**	63[3]
	Evening	50	50	54	55	**53**[3]
	Night	45	44	52	49	**48**[3]
East 2 and East 3 Residential (L01)	Day	60	48	52	**53**	58[4]
	Evening	50	46	51	51	**48**[4]
	Night	45	40	44	45	**43**[4]
Commercial	When in use	65	-		-	63
Industrial		70	-		-	68

Note 1: RBL = Rating Background Level.

Note 2: The project amenity noise levels have been converted to a 15-minute level by adding 3 dB, as outlined in the NPfI.

Note 3: The recommended amenity noise levels have been used as the project amenity noise levels as no other sources of additional industrial noise would likely be introduced in the area that would affect these receivers and all existing sources are shielded by intervening buildings and structures.

Note 4: The recommended amenity noise levels have been reduced by 5 dB, where appropriate, to give the project amenity noise levels.

The residential receivers in the East 1 Residential area are in close proximity to the development site and noise from the development would be dominant at facades which face west. The existing industrial sites in the area are shielded from these facades by other intervening buildings and structures, and no future development is likely to occur that would introduce additional sources of industrial noise that would impact these receivers. For this reason, the recommended amenity noise levels have been used as the project amenity noise levels for receivers in the East 1 Residential area.

The residential areas to the south (East 2 and East 3 Residential areas) are potentially exposed to industrial noise from existing (or future) developments and the recommended amenity noise levels for these areas have been reduced by 5 dB to give the project amenity noise levels.

3.1.3 Sleep Disturbance

The potential for sleep disturbance from maximum noise level events during the night-time from the development is required to be considered.

The NPfI defines the sleep disturbance screening level as 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is greater.

The sleep disturbance screening levels for the development are shown in **Table 7**.

Table 7 Sleep Disturbance Screening Levels

Location	Noise Level (dBA)	
	Measured Prevailing Night-time Background Level	Sleep Disturbance Screening Level[1]
East 1	44	59
East 2 and East 3	40	55

Note 1: The sleep disturbance screening level as 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is greater

A detailed maximum noise level event assessment should be completed where the sleep disturbance screening level is exceeded. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

The NPfI refers to the *Road Noise Policy* (RNP) for additional information regarding sleep disturbance. enHealth Council studies are referenced which indicate that for short-term or transient noise events, for good sleep over eight hours the indoor L_{AFmax} sound pressure level should ideally not exceed around 45 dBA more than 10 or 15 times per night.

The RNP goes on to conclude that from the research on sleep disturbance to date:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep
- One or two events per night with maximum internal noise levels of 65-70 dBA are not likely to affect health and wellbeing significantly.

3.1.4 Corrections for Annoying Noise Characteristics

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factors, shown in **Table 8**, which are to be applied where annoying characteristics are present.

Table 8 NPfI Modifying Factors

Factor	Assessment/Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the NPfI are exceeded.	2 or 5 dB[2]

Factor	Assessment/Measurement	When to Apply	Correction[1]
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible. The NPfI further defines intermittent noise as noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB, for example, equipment cycling on and off. The intermittency correction is not intended to be applied to changes in noise level due to meteorology.	5 dB[3]
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB[2] (excluding duration correction)

Note 1: Corrections to be added to the measured or predicted levels.

Note 2: Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Adjustment to be applied to night-time only.

Details of the modifying factors applied in the assessment are provided in **Section 4.1**.

3.2 Traffic on Surrounding Roads

The potential impacts from project related traffic on the surrounding public roads are assessed using the NSW EPA *Road Noise Policy* (RNP).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB. Where this is considered likely, further assessment is required using the RNP criteria shown in **Table 9**.

Table 9 RNP/NCG Criteria for Assessing Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	**Night-time (10 pm – 7 am)**
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

4 Methodology

4.1 Operational Noise Assessment

The project is in the early design stages and certain future tenants are currently unknown. Several assumptions have been made by Aliro Group regarding the unknown future tenants and sources of noise, based on the likely uses which include logistic and distribution centres, depots, food processing facilities, freight transport facilities, and hardware and building supplies. These assumptions have been used to develop representative worst-case noise modelling scenarios that reflect the expected highest noise emissions that the development would likely emit.

The potential operational noise levels from the development have been predicted to the surrounding receivers using CONCAWE industrial noise algorithms in SoundPLAN. The model includes ground topography, buildings and representative worst-case noise sources from the development.

The potential impacts have been determined by comparing the predicted worst-case noise levels to the NPfI PNTLs in a 15-minute assessment period.

4.1.1 Operational Noise Sources

The development comprises of seven warehouse buildings with associated ancillary offices, internal roads and carparking, and landscaping. The majority of vehicles would access the site from the west via Prospect Highway and Foundation Place through the existing industrial estate. A relatively small amount of light and heavy vehicles would access from the east via Clunies Ross Street. Heavy vehicle deliveries would park in the hard stand loading areas or recessed loading docks while they are loaded/unloaded, before exiting the site. Light vehicle carparking is provided at each warehouse which would generally be used by staff.

Internal noise sources would generally be minimal and associated with typical logistical, distribution, warehousing and office space activities. There would be no use of manufacturing equipment within any warehouses. The development would operate 24 hours a day.

The main sources of operational noise at the development are expected to include:

- On-site light and heavy vehicle movements
- Loading dock activities in hardstands
- Mechanical plant
- Off-site vehicle movements.

The proposed modification to Warehouse 3 and 6 includes the following alterations which have the potential to alter noise emissions from the development compared to the approved layout:

- Heavy vehicle access to both Warehouse 3 and 6 is via Foundation Place only, which removes heavy vehicles from Clunies Ross Street. The is likely to result in a reduction in noise impacts at residential receivers on Clunies Ross Street.

- The loading docks for Warehouse 3 are moved to the less sensitive western side of the development, facing Foundation Place. The is likely to result in a reduction in noise impacts at residential receivers on Clunies Ross Street.
- Operation of Warehouse 6 as a cold storage warehouse. This may result in a minor increase in noise emissions due to the use of refrigerated trucks for certain deliveries.

The noise modelling methodology and source noise levels have been updated since completion of the SSDA NIA. A summary of the updated noise sources and expected worst-case assessment scenarios associated with the operation of the development and proposed modification is provided below.

On-Site Traffic

On-site vehicles have been modelled using the data in **Table 10**. The volumes are representative of the expected worst-case 15-minute period for the daytime, evening and night-time. The volumes conservatively assume that light and heavy vehicles concurrently access at all warehouses during the worst-case 15-minute assessment period. In reality, vehicle access would be spread over a longer period, particularly during the night-time. The vehicle routes are shown in **Figure 4** and **Figure 5**.

Table 10 Vehicle Traffic Data – Worst-case 15-Minute Period

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)	Access Point	Number of Vehicles in Worst-case 15-minute Period[1]		
					Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 7am)
Warehouse 1							
Large trucks	Access routes	108[2]	25	Entry via Clunies Ross St (100%), exit via Foundation Pl (70%) and Clunies Ross (30%)	3	3	2
	Loading docks		5				
Light vehicles	Car park	96[3]	20	Clunies Ross Street (100%)	7	7	6
Warehouse 2							
Large trucks	Access routes	108[2]	25	Entry and exit via Foundation Pl (70%) and Clunies Ross (30%)	2	2	2
	Loading docks		5				
Light vehicles	Car park	96[3]	20	Clunies Ross Street (100%)	3	3	2
Warehouse 3 (this modification)							
Large trucks	Access routes	108[2]	25	Entry and exit via Foundation Pl (100%)	2	2	2
	Loading docks		5				
Light vehicles	Car park	96[3]	20	Clunies Ross Street (100%)	5	5	4

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)	Access Point	Number of Vehicles in Worst-case 15-minute Period[1]		
					Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 7am)
Warehouse 6 (this modification)							
Large trucks	Access routes	108[2]	25	Entry and exit via Foundation Pl (100%)	1	1	1
	Loading docks		5				
Light vehicles	Car park	96[3]	20	Foundation Pl (100%)	3	3	3
Warehouse 7							
Large trucks	Access routes	108[2]	25	Entry and exit via Foundation Pl (70%) and Clunies Ross (30%)	2	1	1
	Loading docks		5				
Light vehicles	Car park	96[3]	20	Foundation Pl (70%) and Clunies Ross (30%)	10	5	25

Note 1: Total vehicles, includes both inbound and outbound vehicles.

Note 2: Sound power level for large trucks based on 106 dBA for trucks at slow speed for 80% of the time and 111 dBA for trucks accelerating for 20% of the time. Sound power levels taken from the Federal Highway Administration's Traffic Noise Model.

Note 3: Taken from *Road Traffic Noise Prediction Model "ASJ RTN-Model 2013" Proposed by the Acoustical Society of Japan – Part 2: Study on Sound Emission of Road Vehicles*, OKADA et al, Internoise 2014, and accounts for vehicles accelerating.

Figure 4 Truck Routes

Figure 5 Light Vehicle Routes

Loading Docks

Details of the loading dock noise sources are shown in **Table 11**. The various sources have been modelled in the loading docks and hardstands (see **Figure 6**) based on the corresponding number of heavy vehicle movements in the worst-case 15-minute period (see **Table 10**).

Table 11 Typical Loading Dock Noise Sources – All Warehouses

Noise Source	Sound Power Level (dBA)	Typical Duration of Use in Worst-case 15-minute Period
All Warehouses		
Truck reversing alarm[1]	107[2]	30 seconds
Forklift reversing alarm[1]	102[2]	90 seconds
Air brakes	118	1 second
Roller door	94	15 seconds
Electric forklift	84[3]	900 seconds
Cold Storage Warehouses (Warehouse 6 and 7)		
Refrigeration truck trailer	102[4]	900 seconds

Note 1: SWL based on recommendation to use broadband reversing alarms, see **Section 6.1**.

Note 2: SWL includes a -3 dB reduction due to alarms being discrete events.

Note 3: SWL based on measurement data.

Note 4: SWL based on measurement data and *Sound Power Levels and Directivity Patterns of Refrigerated Transport Trailers*, Roy et al, 2017.

Figure 6 Loading Dock Locations

Internal Activities

The future tenants of the warehouses would be associated with logistic and distribution centres, depots, food processing facilities, freight transport facilities and hardware and building supplies. Internal noise-generating activities at all warehouses are expected to generally be minimal. An internal sound power level of 75 dBA has been included for each warehouse to cover general internal activities, based on observations of loading activities at similar warehouse facilities. Warehouse roller shutter doors are assumed to be open during loading dock activities.

Mechanical Plant

Mechanical plant associated with the development includes air-conditioning equipment (condensers) serving the office buildings for each warehouse and ventilation/fans mounted on the roofs of the warehouses and the roof of the Warehouse 7 plant room. Compressors would be required within the Warehouse 6 and 7 plant rooms for cold storage needs, together with condensers on the roofs of the Warehouse 6 and 7 plant rooms. A containerised back-up generator would also be required at Warehouse 6. This would only be used in the event of an emergency during a power outage to maintain operations.

The details of the assessed mechanical plant are shown in **Table 12**. The assumed hours of operational of the various items are shown in table. The locations of the sources are shown in **Figure 7**.

Table 12 Mechanical Plant

Noise Source	Sound Power Level (dBA)	Location and Operational Hours
All Warehouses		
Office air-conditioning (condensers)	78	Office and dock offices for all warehouses (see **Figure 7**). Office condenser operational hours are 7 am to 6 pm, except for Warehouse 6 and 7 which would be 24/7
Warehouse roof fans	98	Roof of all warehouses and roof of Warehouse 7 plant room (see **Figure 7**). Roof fans may operate at any time so have been assumed to be 24/7 at all warehouses.
Cold Storage Warehouses (Warehouse 6 and 7)		
Compressor	98 (two compressors)	Within Warehouse 6 and 7 plant rooms, assumes facade is precast concrete. Compressor operational hours for Warehouse 6 and 7 are 24/7.
Condenser	100 (95 during the night when on low power)	Roof of Warehouse 6 and 7 plant rooms. Condenser operational hours for Warehouse 6 and 7 are 24/7.
Emergency Power Outage (Warehouse 6)		
Containerised backup generator	101[1]	Located outside the Warehouse 6 plantroom. Would only be used in an emergency situation during a power outage. A separate scenario has been assessed in **Section 5.1** including the operation of the backup generator.

Note 1: SWL based on manufacturer data for Kohler B1500 containerised industrial diesel generator set.

Figure 7 Modelled Source Locations

4.1.2 Corrections for Annoying Noise Characteristics

The potential annoying noise characteristics and modifying factor corrections relevant to the project are:

- **Tonality** – the only source identified with potential tonal characteristics is reversing alarms. However, when considering broadband reversing alarms have been recommended as a noise mitigation measure (see **Section 6**), it is unlikely that this noise source would result in tonal noise impacts and no corrections have been applied.
- **Low frequency noise** – previous measurements of sources similar to those operating at the development indicate that no sources are expected to result in low frequency noise impacts.
- **Intermittent noise** – the NPfI defines intermittent noise as noise heard at the receiver where the level suddenly drops or increases several times during the assessment period, with a noticeable change of at least 5 dB. The audibility of noise would depend on several factors occurring at the time of potentially intermittent noise events, including the other noise sources operating at the development site and the existing background noise level at the receiver.

  The only source identified with potential intermittent characteristics is reversing alarms. Broadband reversing alarms have been recommended as a noise mitigation measure (see **Section 6**), however, noise levels from reversing alarms have been assumed to potentially result in annoying noise levels at the nearest receivers due to their proximity to the site. As such, the intermittent noise correction has been applied for this source during the night-time.

4.1.3 Noise Sources with Potential for Sleep Disturbance

As the development would operate 24-hours a day, noise emissions during the night-time require assessment for potential sleep disturbance at the nearest residential receivers. The details of typical activities with the potential to cause sleep disturbance are shown in **Table 13**.

Table 13 Sleep Disturbance Noise Events – L_{Amax} Sound Power Levels

Noise Source	Sound Power Level L_{Amax} (dBA)	Source Height
Truck movement on access roads	111	1 m
Truck airbrake	118	1 m
Truck reversing alarm	110	1 m
Forklift reversing alarm	105	0.5 m
Roller door	94	4 m

These sources have been assumed to be in each operational loading dock.

4.1.4 Off-site Road Traffic

Transport Noise Model (TNM) has been used in SoundPLAN to model traffic on the surrounding roads. The following has been included in the assessment:

- Heavy vehicle volumes have been modelled as 'heavy trucks' in TNM
- Development related traffic has been modelled separately with all vehicles accelerating from the site entrances for a distance of 150 m (distance calculated based on a typical acceleration rate for a cat 3 semi-trailer heavy vehicle to 60 km/h). Once the site vehicles are past this point, they are assumed to be free-flowing.

Light and heavy vehicles would access the development directly from Prospect Highway from the west, via Foundation Place, and Clunies Ross Street from the east. The potential noise impacts from additional traffic have been assessed based on traffic data shown in **Table 14**.

Table 14 Traffic Volumes – All Warehouses

Road	Existing Traffic volumes				Development Related Traffic Volumes			
	Daytime (7am to 10pm)		Night-time (10pm to 7am)		Daytime (7am to 10pm)		Night-time (10pm to 7am)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Prospect Hwy	24,231	5,020	1,547	320	435	109	77	19
Clunies Ross Street[1]	5,757	240	1,016	15	219	55	39	10

Note 1: Traffic volumes have been split equally between the various site entrances/roundabouts.

5 Assessment of Impacts

5.1 Operational Noise Assessment

5.1.1 Predicted Unmitigated Noise Levels

A summary of the worst-case noise assessment at the receivers surrounding the development is shown in **Table 15**. Impacts have been predicted at all floors of the nearest receivers. The predicted worst-case levels are compared to the relevant criteria to determine the potential impact from the development.

Noise contours of the operational noise levels are in **Appendix B.**

Table 15 Operational Noise Assessment – Unmitigated

Warehouse	Receiver Location	Period	Noise Level $L_{Aeq(15minute)}$ (dBA)			Compliance
			Noise Criteria	Predicted	Exceedance	
All Warehouses	East 1 Residential	Day	57	54	-	Yes
		Evening	53	54	1	**No**
		Night	48	54	6	**No**
	East 2 Residential	Day	53	56	3	**No**
		Evening	48	56	8	**No**
		Night	43	56	13	**No**
	East 3 Residential	Day	53	49	-	Yes
		Evening	48	49	1	**No**
		Night	43	49	6	**No**
	West Industrial	When in use	68	63	-	Yes
Warehouse 3 and 6 only	East 1 Residential	Day	57	45	-	Yes
		Evening	53	45	-	Yes
		Night	48	45	-	Yes
	East 2 Residential	Day	53	46	-	Yes
		Evening	48	46	-	Yes
		Night	43	46	3	**No**
	East 3 Residential	Day	53	46	-	Yes
		Evening	48	46	-	Yes
		Night	43	46	3	**No**
	West Industrial	When in use	68	64	-	Yes

The above assessment indicates the following:

- Unmitigated noise from the operation of the site is predicted to exceed the Project Noise Trigger Levels at some of the nearest receivers to the east.
- Unmitigated noise from 'all warehouses' is predicted to result in exceedances of up to 3 dB during the daytime, 8 dB during the evening and 13 dB during the night-time, which are all in the East 2 Residential area. This area is adjacent to the eastern entrance of Warehouse 2. Exceedances in the East 1 and East 3 Residential areas are lower, which is due to receivers in the East 1 Residential area being shielded by the existing noise barrier and receivers in the East 3 Residential area being further from the site.
- Unmitigated noise from 'Warehouse 3 and 6 only' is generally predicted to comply the Project Noise Trigger Levels. Relatively minor exceedances are predicted during the night-time in the East 2 and East 3 Residential areas.
- The predicted exceedances in the East 1 Residential area are caused by a combination of noise from the roof mounted fans, and noise from loading activities and heavy vehicle movements in the Warehouse 2 loading areas.
- The predicted exceedances in the East 2 Residential area caused by a combination of noise from the roof mounted fans, light vehicle movements in the car parks of Warehouse 1, 2 and 3, and loading activities and heavy vehicle movements at Warehouse 2.
- The predicted exceedances in the East 3 Residential area caused by noise from the roof mounted fans.

5.1.2 Predicted Mitigated Noise Levels

Feasible and reasonable mitigation measures have been investigated for the development with the aim of reducing noise levels to the Project Noise Trigger Levels. A detailed investigation of feasible and reasonable mitigation is provided in **Section 6.1**.

In summary, the following measures have been applied to reduce noise emissions (a number of these are already included in the design and operation of the development):

- Lower noise output roof mounted fans for Warehouse 1, 2, 3 and 6.
- The majority of trucks would access the site from the west, via Foundation Place. Around 70% of trucks are expected to use this route with only 30% accessing via Clunies Ross Street.
- Trucks would only access Warehouse 3 and 6 via Foundation Place.
- Absorptive materials to be used on the underside of the loading dock awnings of Warehouse 2, adjacent to Clunies Ross Street.
- A driver code of conduct will be produced (required as part Consent Condition B34(d)). This will promote awareness of the proximity of residential receivers to the site and the need to minimise noise emissions from trucks, where possible.
- Use of broadband and/or ambient noise sensing reversing alarms to minimise potentially annoyance.
- Roller doors will be kept closed when un/loading is not occurring.
- It is noted that an existing noise barrier already provides noise mitigation to residential receivers in the East 1 Residential area.

A summary of the predicted impacts in the mitigated scenario is shown in **Table 16**.

Table 16 Operational Noise Assessment – Mitigated

Warehouse	Receiver Location	Period	Noise Level $L_{Aeq(15minute)}$ (dBA)			Compliance
			Noise Criteria	**Predicted**	**Exceedance**	
All Warehouses	East 1 Residential	Day	57	47	-	Yes
		Evening	53	47	-	Yes
		Night	48	48	-	Yes
	East 2 Residential	Day	53	48	-	Yes
		Evening	48	47	-	Yes
		Night	43	48	5	**No**
	East 3 Residential	Day	53	38	-	Yes
		Evening	48	38	-	Yes
		Night	43	37	-	Yes
	West Industrial	When in use	68	63	-	Yes
Warehouse 3 and 6 only	East 1 Residential	Day	57	37	-	Yes
		Evening	53	37	-	Yes
		Night	48	36	-	Yes
	East 2 Residential	Day	53	43	-	Yes
		Evening	48	43	-	Yes
		Night	43	41	-	Yes
	East 3 Residential	Day	53	36	-	Yes
		Evening	48	36	-	Yes
		Night	43	34	-	Yes
	West Industrial	When in use	68	64	-	Yes

The above assessment indicates the following:

- The proposed mitigation is expected to reduce noise levels at the nearest receivers, with most locations predicted to comply the Project Noise Trigger Levels.
- Mitigated noise from 'all warehouses' is predicted to comply with the Project Noise Trigger Levels in both the East 1 Residential area and East 3 Residential during all periods, however, exceedances of up to 5 dB are predicted in the East 2 Residential area during the night-time. These exceedances are caused by a combination of noise from the light vehicle movements in the carparks of Warehouse 2 and 3, and loading activities and heavy vehicle movements in the Warehouse 2 loading areas.
- Mitigated noise from 'Warehouse 3 and 6 only' is predicted to comply in all locations during all periods.

Comparison to Approved Layout

The potential operational noise impacts from the approved layout (see **Figure 2**) have been predicted to the nearest receivers using the updated assessment methodology and source noise levels detailed in **Section 4.1**. The results from this are compared to the above results from the modified layout (including noise mitigation) in **Table 17**.

Table 17 Operational Noise Assessment – Approved Layout vs Modified Layout

Warehouse	Receiver Location	Period	Noise Level $L_{Aeq(15minute)}$ (dBA)				
			Noise Criteria	Approved Layout		Modified Layout	
				Predicted	Exceedance	Predicted	Exceedance
All Warehouses	East 1 Residential	Day	57	55	-	47	-
		Evening	53	55	2	47	-
		Night	48	55	7	48	-
	East 2 Residential	Day	53	57	4	48	-
		Evening	48	57	9	47	-
		Night	43	58	15	48	5
	East 3 Residential	Day	53	52	-	38	-
		Evening	48	52	4	38	-
		Night	43	52	9	37	-
	West Industrial	When in use	68	62	-	63	-

The above assessment indicates the following:

- The modified layout results in substantially lower noise levels at the nearest residential receivers in the East 1, East 2 and East 3 Residential areas when compared to the approved layout. This is partly due to the modified layout relocating the loading docks of Warehouse 3 and 6 to the western and southern sides of the development respectively, and from restricting heavy vehicles access to Warehouse 3 and 6 to Foundation Place only.
- The lower noise levels are predicted to mostly comply with Project Noise Trigger Levels, whereas the approved layout results in relatively large exceedances.

Residual Noise Impacts

The NPfI defines residual noise impacts as exceedances of the Project Noise Trigger Levels which remain after all source and pathway feasible and reasonable mitigation measures have been considered. Residual noise impacts that exceed the Project Noise Trigger Levels by ≤2 dB are considered negligible and would not be discernible by most people. Exceedances of ≥3 dB are considered potentially significant and may require further consideration.

The predicted residual impacts from the development are shown in **Figure 8**.

Figure 8 Residual Exceedances of PNTLs

Exceedances at Clunies Ross Street Residential Frontage

The residential receivers on Clunies Ross Street are of recent construction and are on land covered by the *Pemulwuy Residential Controls – Holroyd Development Control Plan 2013* (the Holroyd DCP). The Holroyd DCP acknowledges the Clunies Ross Street residential frontage is adjacent to an existing industrial employment site and specified the following Development Controls to minimise potential noise impacts:

> ***4.10. Clunies Ross Street Residential Frontage***
>
> ***Objectives***
>
> ***O1.*** *To minimise the impact of noise from the existing employment sites to proposed residential areas.*
>
> ***O2.*** *To achieve external noise goals where feasible or reasonable.*
>
> ***O3.*** *Where this is considered impractical, to achieve internal noise criteria by appropriate facade treatment.*
>
> ***Development Controls***
>
> ***C1.*** *A noise barrier ranging from 4.0 to 4.5m in height is to be erected along the western site boundary between the employment lands and the Clunies Ross Street access road to control noise to the ground floor of future dwellings (refer to Figure 43);*

> ***C2.*** *To control sleep arousal to second storey bedrooms, additional attenuation measures are required. These should consist of, but are not limited to:*
>
> > ***a)*** *Improved glazing to windows and the provision of air conditioning to allow windows to be kept closed during night time periods; and/or*
> >
> > ***b)*** *Locating bedrooms on the eastern side of the house away from the noise source, with bathrooms, study, media rooms and the like on the western side of the house.*
>
> *Note: The combination of attenuation measures to the built form is to be determined at Development Application stage.*

The noise barrier required in C1 above has been constructed at the site (see **Figure 8**). It is assumed that improved glazing and air conditioning to allow windows to be closed as a mitigation measure has been provided as required by C2(a). Facades with closed windows would be expected to provide around 20 to 25 dB noise reduction. Where improved glazing is provided reductions of at least 25 to 30 dB could be expected, depending on the type of glazing used. Review of dwelling floor plans indicates that, contrary to the requirements of C2(b), bedrooms have been located on the western side of houses and face towards the development site.

Further discussion regarding the proposed mitigation for residual impacts is provided in **Section 6.1**.

Warehouse 6 Backup Generator

The predicted noise levels for the additional modelling scenario which includes the operation of the backup generator in an emergency are generally consistent with the predicted mitigated noise levels in **Table 16**. The operation of the backup generator is not predicted to result in any additional impacts and no specific mitigation is required to be considered.

5.1.3 Sleep Disturbance

The predicted maximum noise levels at the nearest residential receivers during the night-time are shown in **Table 18**. These include the mitigation measures specified in **Section 5.1.2**.

The worst-case sleep disturbance impacts are also shown in **Figure 9** and **Figure 10** for truck movements and truck airbrakes, respectively.

Table 18 Sleep Disturbance Assessment

Warehouse	Receiver Location	Source	Maximum Noise Level LAmax (dBA)			Below Screening Level
			Sleep Dist. Screening Level	**Predicted**	**Exceedance**	
All Warehouses	East 1 Residential	Truck movement	59	56	-	Yes
		Truck airbrake		63	4	**No**
		Truck reversing alarm		55	-	Yes
		Forklift reversing alarm		49	-	Yes
		Roller door		37	-	Yes
All Warehouses	East 2 Residential	Truck movement	55	59	4	**No**
		Truck airbrake		63	8	**No**
		Truck reversing alarm		55	-	Yes
		Forklift reversing alarm		50	-	Yes
		Roller door		41	-	Yes
All Warehouses	East 3 Residential	Truck movement	55	44	-	Yes
		Truck airbrake		48	-	Yes
		Truck reversing alarm		40	-	Yes
		Forklift reversing alarm		30	-	Yes
		Roller door		<30	-	Yes

Figure 9 Worst-case Exceedances of Sleep Disturbance Screening Level – Truck Movements

Figure 10 Worst-case Exceedances of Sleep Disturbance Screening Level – Truck Airbrakes

The above shows that maximum noise levels are generally expected to comply with the sleep disturbance screening level at receivers in the East 1 Residential area. Exceedances of up to 4 dB are, however, predicted at receivers opposite the entrance to Warehouse 2 and on the corner of Clunies Ross Street and Wombat Street when truck airbrakes are infrequently used in the eastern loading docks of Warehouse 2.

Maximum noise levels at receivers in the East 2 Residential area are predicted to exceed the sleep disturbance screening level by up to 4 and 8 dB during truck movements and the use of truck airbrakes in the eastern loading docks of Warehouse 2, respectively.

Maximum noise levels at receivers in the East 3 Residential area are predicted to comply with the sleep disturbance screening level.

The NPfI requires a detailed maximum noise level assessment to be completed where night-time noise levels exceed the sleep disturbance screening level.

5.1.3.1 Detailed Maximum Noise Level Assessment

The detailed maximum noise levels assessment is summarised in **Table 19**. Noise from trucks are predicted to occasionally exceed of the sleep disturbance screening level at certain receivers in the East 1 and 2 Residential areas.

Table 19 Detailed Maximum Noise Level Assessment

Source	Maximum Noise Level L_{Amax} (dBA)					Comments
	External Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels	
	Awakening Response[1]	Good Sleep[2]	Predicted	Frequency of Occurrence		
East 1 Residential Area						
Truck airbrakes at WH2	75	Around 65 (should not occur more than 10 to 15 times per night)	63	<15 events	Unknown – not reported in the SSDA NIA and site no longer operational	**Awakening Response:** maximum noise levels are predicted to be below the 'awakening response' level. **Good Sleep:** maximum noise events from truck airbrakes at Warehouse 2 are predicted to be below the level that could adversely affect 'good sleep'. **Existing maximum noise levels:** the affected residential receivers were also adjacent to the entrance of the previous industrial facility which operated 24/7. Development related maximum noise levels are likely to be similar in magnitude to the maximum levels from the previous use of the site.

Source	Maximum Noise Level L_{Amax} (dBA)					Comments
	External Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels	
	Awakening Response[1]	Good Sleep[2]	Predicted	Frequency of Occurrence		
East 2 Residential Area						
Truck movements or airbrakes at WH2	75	Around 65 (should not occur more than 10 to 15 times per night)	59-63	<10 events	Unknown – not reported in the SSDA NIA and site no longer operational	**Awakening Response:** maximum noise levels are predicted to be below the 'awakening response' level. **Good Sleep:** maximum noise events from truck airbrakes at Warehouse 2 are predicted to be below the level that could adversely affect 'good sleep'. **Existing maximum noise levels:** the affected residential receivers were also adjacent to the entrance of the previous industrial facility which operated 24/7. Development related maximum noise levels are likely to be similar in magnitude to the maximum levels from the previous use of the site.

Note 1: Based on RNP guidance that maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep. This equates to an external noise level of 75 dBA when assuming a conservative 20 dB loss for closed windows (noting that condition C2(a) of the Holroyd DCP required improved glazing and air conditioning to be applied to these receivers to allow windows to be closed as a mitigation measure).

Note 2: Based on RNP guidance (from enHealth studies) that for a good sleep over eight hours the indoor L_{Amax} sound pressure level should not exceed around 45 dBA more than 10 or 15 times per night. This equates to an external noise level of around 65 dBA when assuming a conservative 20 dB loss for closed windows.

The above indicates that the predicted sleep disturbance screening level exceedances in the East 1 and 2 Residential areas are unlikely to result in internal noise levels of dwellings that result in awakenings or adversely affect good sleep. Development related maximum noise levels are also likely to be similar to maximum events from the previous industrial use of the site.

The predicted maximum noise levels in the East 1 and 2 Residential areas, therefore, do not warrant consideration of any specific additional mitigation measures.

5.1.4 Off-site Traffic Assessment

The results of the off-site traffic assessment are shown in **Table 20**. The assessment has been completed at the sensitive receivers adjacent to Clunies Ross Street and Prospect Highway.

Table 20 Traffic Noise Assessment

Location	Road	RNP Increase Criterion (dB)	Predicted Increase (dB)	
			Day	Night
East 1 Residential	Clunies Ross Street	2.0	<1.0	<1.0
East 2 Residential	Clunies Ross Street		1.0	1.5
East 3 Residential	Clunies Ross Street		<1.0	<1.0
West	Prospect Highway		<1.0	<1.0

The above assessment shows that the increase in noise from vehicle movements on the surrounding roads at the nearest receivers are expected to be below 2.0 dB. Increases of less than 2.0 dB represent a minor impact that is considered barely perceptible to the average person.

It is noted that the assessment predicts the potential increase in road traffic noise by comparing the existing situation with the existing situation plus development related traffic. A significant proportion of the existing traffic volumes on Clunies Ross Street would be associated with the previous use of the site which is replaced by the subject development (and not in addition too). This means that the actual increase would likely be lower than predicted above.

6 Mitigation and Management Measures

6.1 Operational Noise – Feasible and Reasonable Mitigation Assessment

A detailed assessment of all potential feasible and reasonable mitigation measures that can be applied to the development to minimise the impacts has been completed and is summarised in **Table 21**.

Table 21 Feasible and Reasonable Mitigation Options

Mitigation Option	Noise Impact/Benefit	Comments	Reasonable and Feasible to Apply
Source Control			
Roof mounted fans	The roof mounted fans contribute to the predicted exceedances. Reduction in SWL provides substantial noise benefit	Roof fans SWL reduced from 98 dBA to 78 dBA for Warehouse 1 to 6.	Yes
Limit truck volumes, particularly during the night-time	Noise from trucks on site roads and in loading docks contributes to the predicted exceedances	The majority of trucks would access the site from the west, via Foundation Place. Around 70% of trucks are expected to use this route with only 30% accessing via Clunies Ross Street. The modification of Warehouse 3 and 6 restricts truck access to Foundation Place only, which further reduces the number of trucks on Clunies Ross Street.	Yes
		The truck volumes used in this assessment are needed to meet tenant's requirements. Changes to internal truck routes and/or numbers not considered feasible.	No
Absorption used in loading dock	Reduce noise emissions from the site	Absorptive materials with a minimum Noise Reduction Coefficient of 0.8 to be used on underside of the canopy of Warehouse 2 loading docks (see **Figure 11**).	Yes
Broadband and/or ambient sensing reversing alarms	Reduce potential for annoying noise emissions during the night-time from heavy vehicles and forklifts	Use broadband and/or ambient sensing alarms on heavy vehicles and forklifts where they are required to reverse during the night-time.	Yes
Noise from abnormal heavy vehicle events	Minimise noise emissions the potential annoying characteristics	A driver code of conduct (required as per Consent Condition B34(d)) will be produced. This will promote awareness of the proximity of residential receivers to the site and the need to minimise noise emissions from trucks, where possible.	Yes

Mitigation Option	Noise Impact/Benefit	Comments	Reasonable and Feasible to Apply
Roller doors	Use of roller doors	Roller doors will be kept closed when un/loading is not occurring.	Yes
Path Control			
Noise barriers	Noise barriers can provide around 5 to 15 dB noise benefit where they screen the source of noise from the receiver(s).	An existing noise barrier already provides noise mitigation to residential receivers in the East 1 Residential area.	Already provided
		On-site noise barriers on the eastern boundary of the development site were investigated, however, they generally provided negligible noise benefit to residential receivers to the east. This is due to the elevated nature of the two storey receivers overlooking the site and the need for gaps in the noise barriers for access requirements.	No
Receiver Control			
At-property treatments	Residual impacts are predicted at certain residential receivers (see **Figure 11**) after the application of all feasible and reasonable source control and path control measures. The NPfI notes that noise mitigation at a residence may be required to be considered where the residual impact exceeds the PNTLs by ≥3 dB.	At-property treatments typically include mechanical ventilation to allow windows to be closed as a noise mitigation measure, together with upgraded facade elements such as windows, doors and acoustic seals. It is noted that the Holroyd DCP requires bedrooms of dwellings fronting Clunies Ross Street to have *"improved glazing to windows and the provision of air conditioning to allow windows to be kept closed during night-time periods"*.	Already provided, as required by the Holroyd DCP
Verification Monitoring			
Noise monitoring	Verify post-construction operational noise levels	Verification monitoring would be completed within three months of commencement of operation of each warehouse, as per the requirements of Consent Condition B36 and B37.	Yes

The recommended noise mitigation measures for the development are shown in **Figure 11** together with the predicted residual impacts. The residual impacts are at receivers which the Holroyd DCP requires to have *"improved glazing to windows and the provision of air conditioning to allow windows to be kept closed during night-time periods"*.

Figure 11 Recommended Noise Mitigation Measures and Residual Noise Impacts

7 Conclusion

SLR has been engaged to assess the potential operational noise emissions from the Elevation at Greystanes development, including the proposed modification of Warehouse 3 and 6.

The site is being developed to offer modern, high-quality warehousing, distribution and logistics facilities with associated ancillary offices, internal roads and carparking, landscaping and a small café. The development, comprising of seven warehouse buildings, will allow a range of potential industrial uses, each consistent with the land use zoning approved under the WSEA SEPP. These may include but not be limited to, logistics and distribution centres, depots, food processing facilities, freight transport facilities and hardware and building supplies.

Operational noise levels are generally expected to comply with the trigger levels. Exceedances are predicted at a small number of the nearest receivers to the east. A range of feasible and reasonable mitigation measures have been recommended to control the impacts.

The proposed modification of Warehouse 3 and 6 is predicted to result in lower noise emissions from the development compared to the approved layout. This is due to the modified layout relocating the loading docks of Warehouse 3 and 6 to the western and southern sides of the development respectively, in locations shielded from the nearest residential receivers to the east, and from restricting heavy vehicles access to Warehouse 3 and 6 to Foundation Place only.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

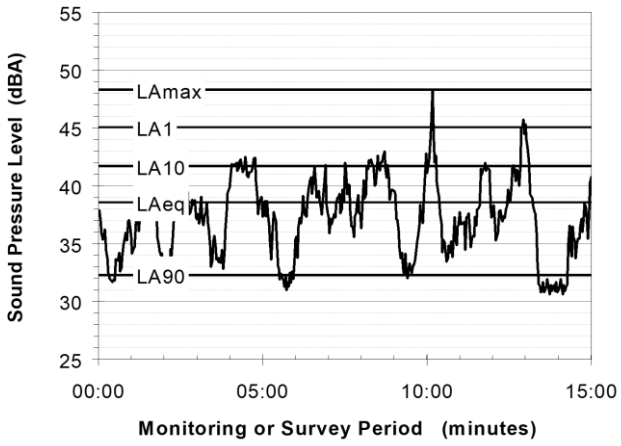
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

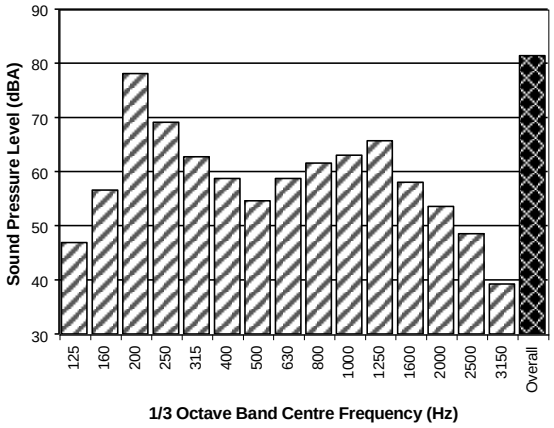
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

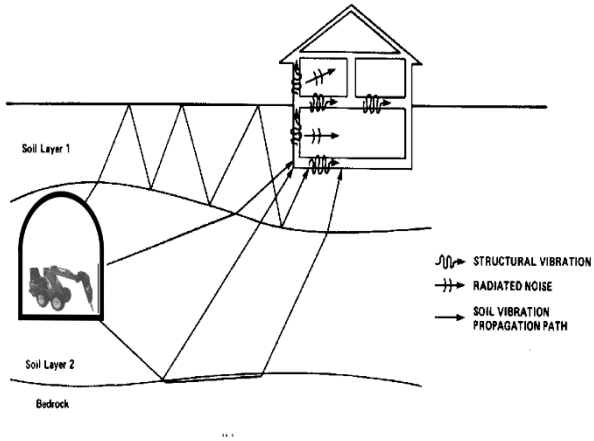
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. 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.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

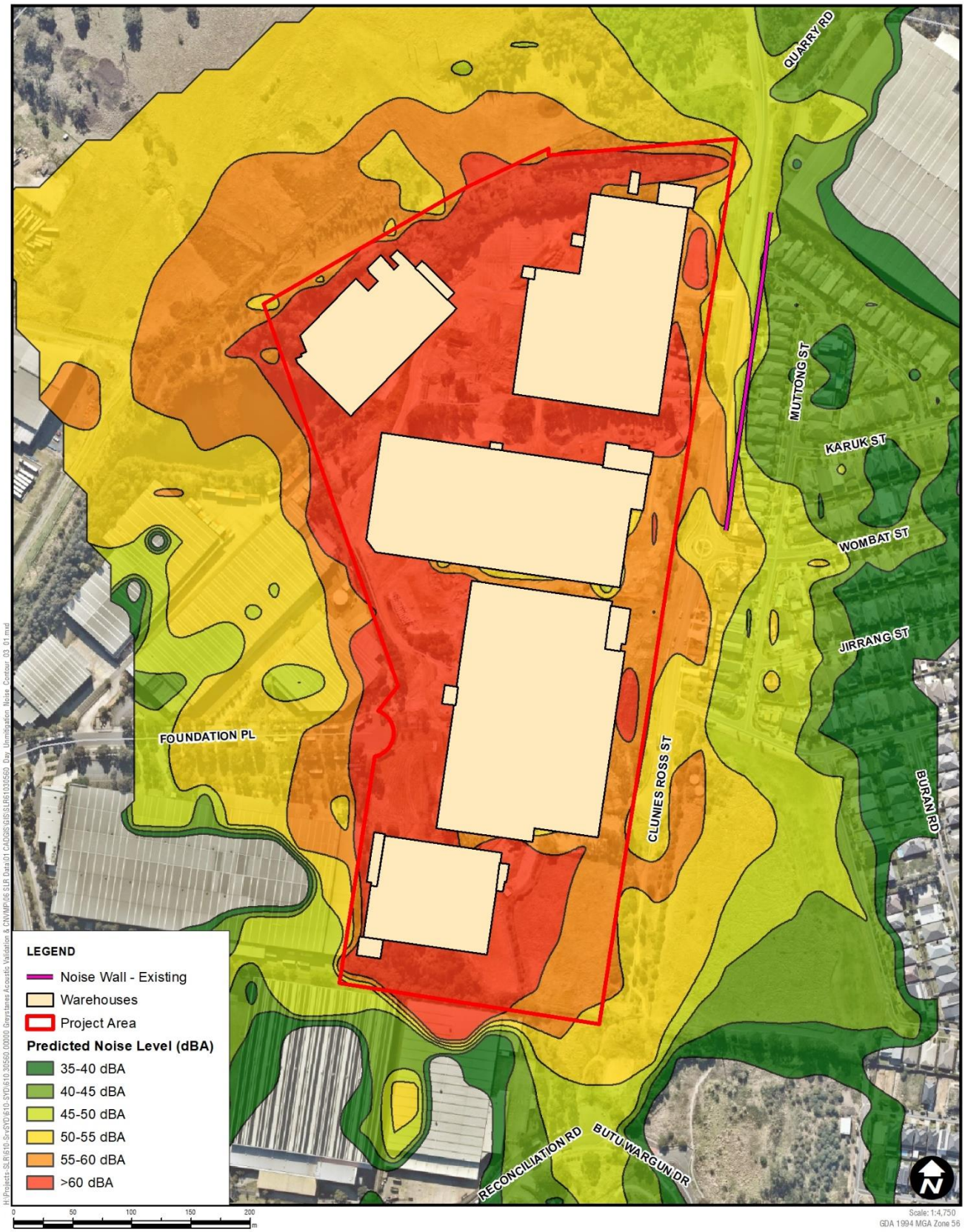


The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

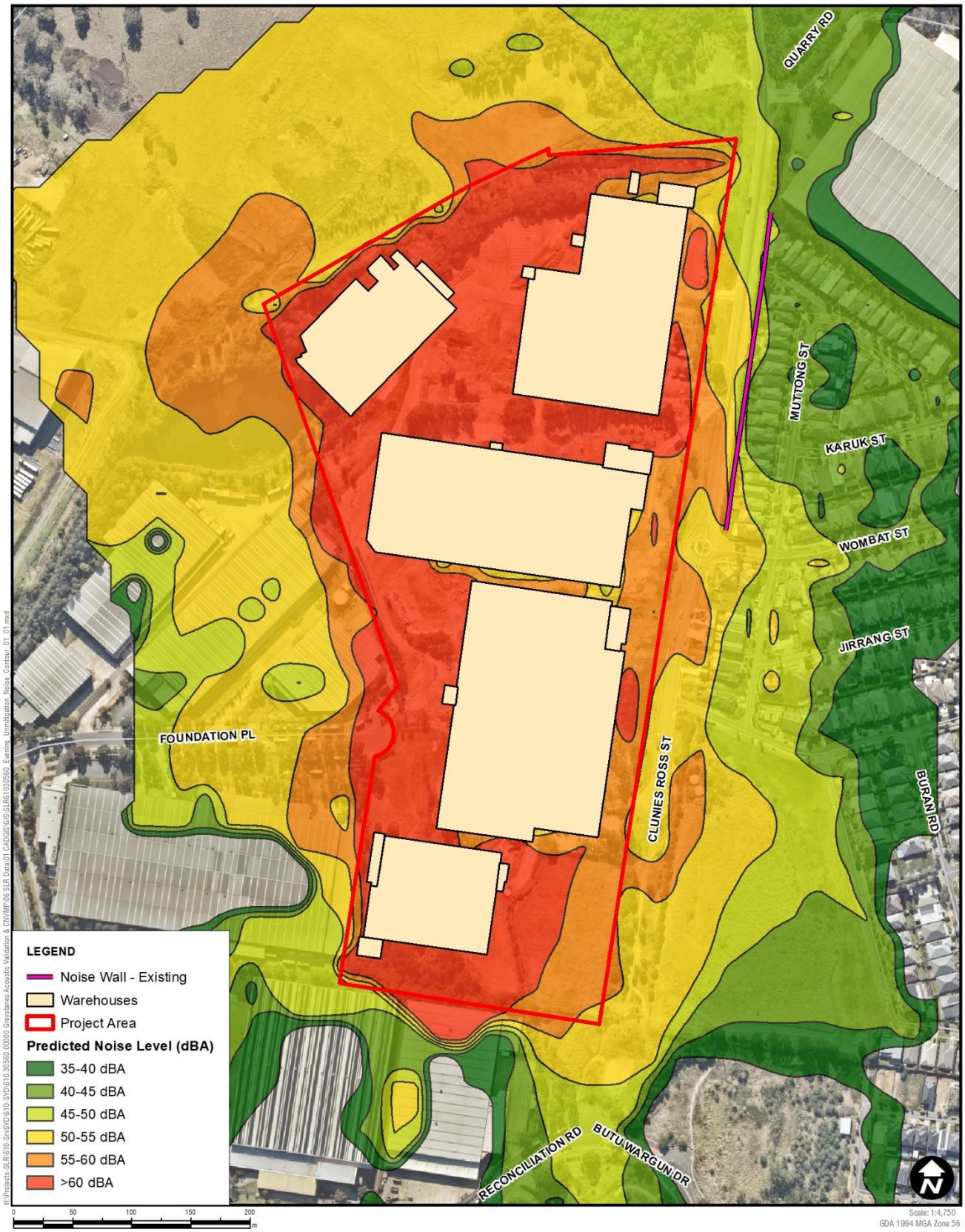
APPENDIX B

Operational Noise Contours

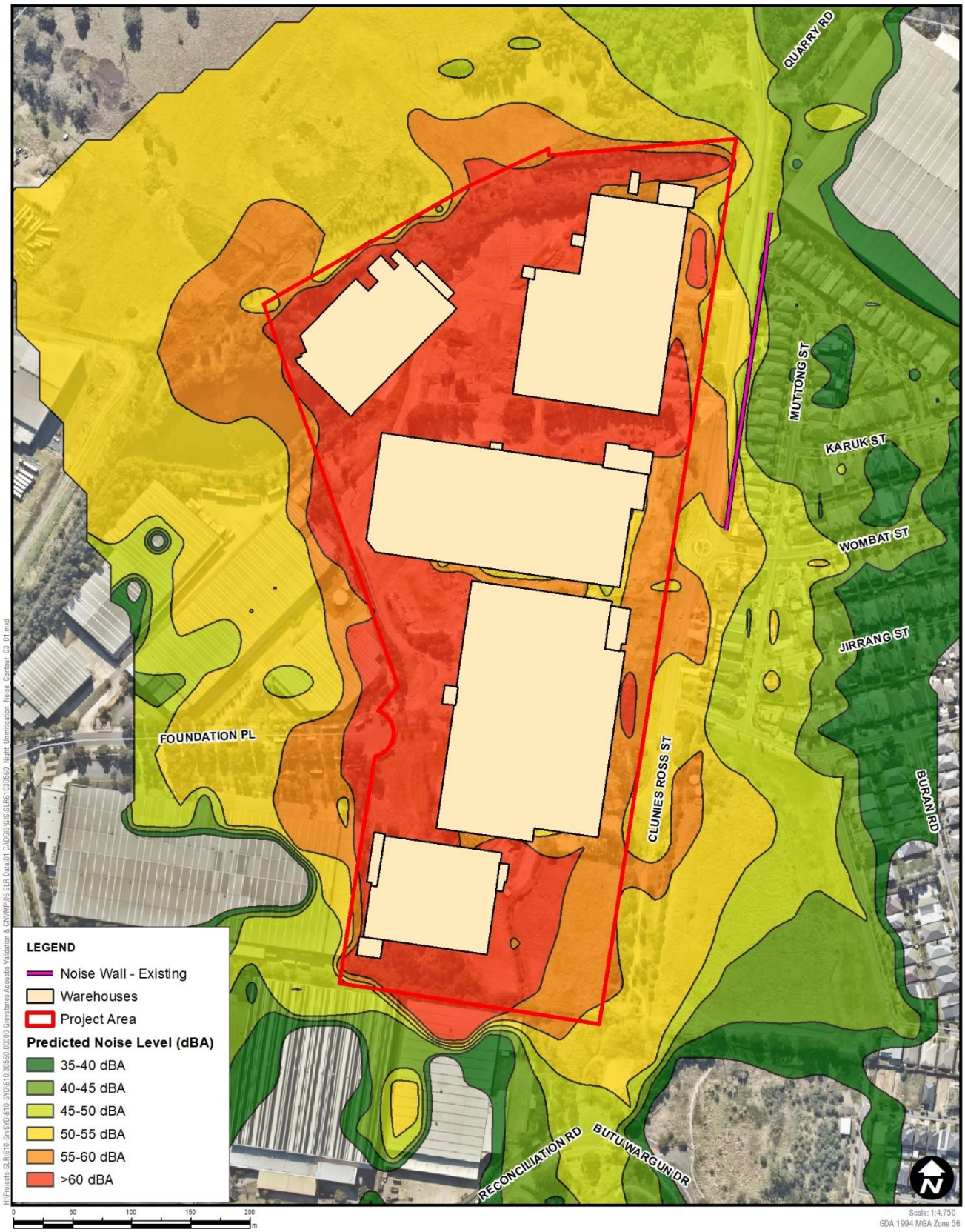
Site Operations – Day (Unmitigated)



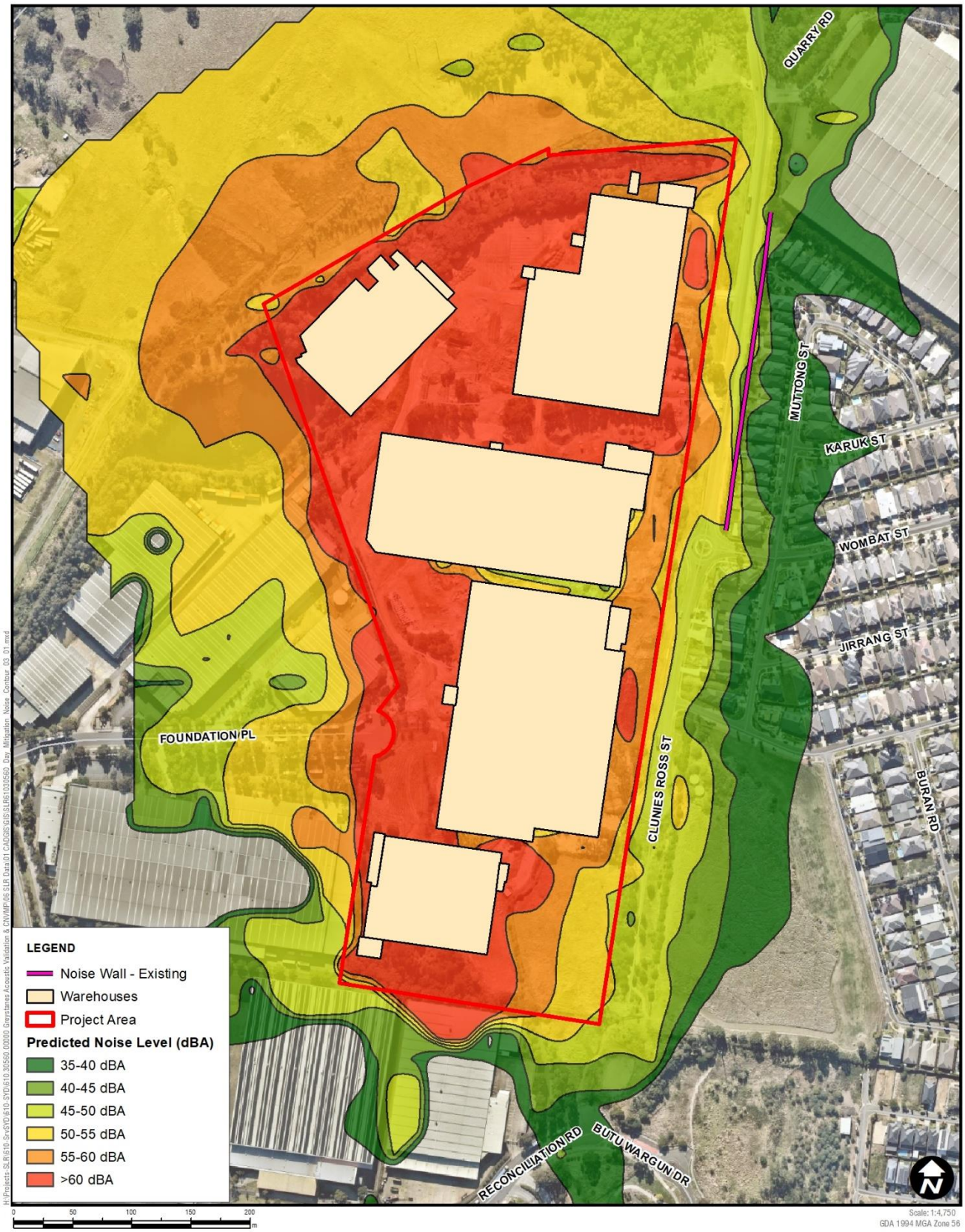
Site Operations – Evening (Unmitigated)



Site Operations – Night (Unmitigated)



Site Operations – Day (Mitigated)



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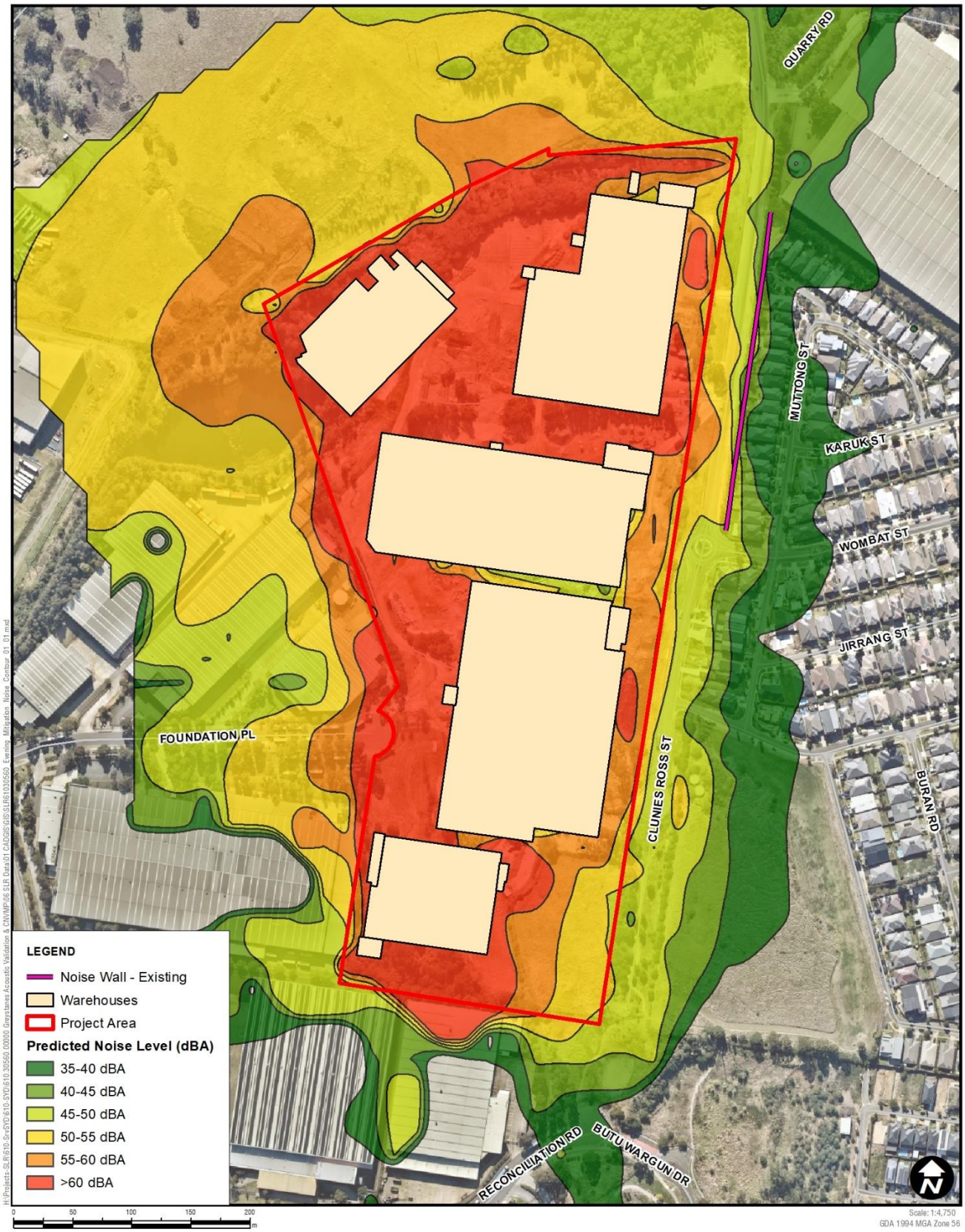
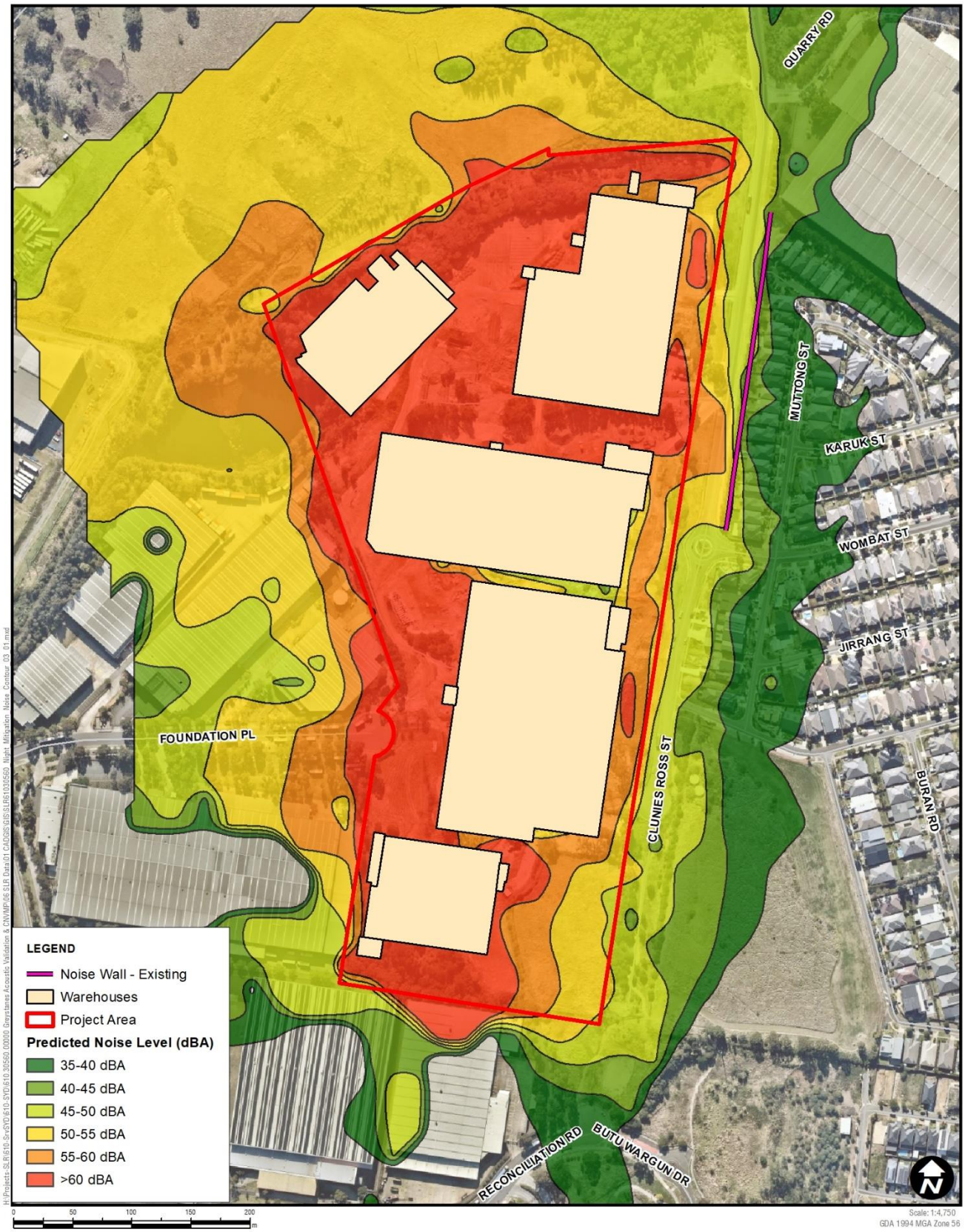


Site Operations – Night (Mitigated)



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