Badgerys Creek DHL Development Stage 1

Noise Impact Assessment

DHL Supply Chain (Australia) Pty Ltd

Level 4, Building C
1 Homebush Bay Drive
RHODES 2138

Prepared by:

SLR Consulting Australia

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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with DHL Supply Chain (Australia) Pty Ltd (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.

Table of Contents

Tables

Figures

Appendices

1.0 Introduction

This report supports a State Significant Development Application (SSDA) (SSD-70817958) submitted to the Department of Planning, Housing and Industry (DPHI) on behalf of DHL Supply Chain (Australia) Pty Ltd (DHL). DHL is seeking to secure consent for the construction and operation of warehouse and logistics facilities, including two warehouses and associated landscaping works within part of Lot 1 in DP 1306448 at 1953-2109 Elizabeth Drive, Badgerys Creek known as the DHL Masterplan site. This SSDA represents the second of two SSDAs proposed by DHL and will apply to the northern half of the DHL Masterplan site.

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

This report summarises the assessment of the potential construction and operational noise impacts associated with the proposal.

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

1.1 Reference Documentation

This report has been prepared in accordance with the following documents, guidelines and policies:

- Secretary's Environmental Assessment Requirements (SEARs) for SSD – 38201739 (North) and SSD – 38206707 (South) issued 23rd March 2022 (SEARs)
- Noise Planning Assessment Burrah Park Masterplan (Burrah Park NIA) prepared by EMM Consulting Pty Ltd (dated 10 June 2025, rev V5)
- Development Consent for SSD-70316465 (Burrah Park CoA) prepared by DPHI (dated 29 June 2026)
- AS2021-2015 Acoustics – Aircraft Noise Intrusion Building Siting and Construction
- NSW EPA's Noise Policy for Industry, dated October 2017 (NPfI).
- NSW EPA's Road Noise Policy, dated March 2011 (RNP)
- NSW EPA's Interim Construction Noise Guideline, dated July 2009 (ICNG)
- Transport for NSW's Construction Noise and Vibration Guideline, dated September 2023 (CNVG)
- Western Sydney Aerotropolis Development Control Plan 2022
- BS 7385.2:1993 Evaluation and Measurement for Vibration in Buildings Part 2: Guide to Damage Levels from Ground-borne Vibration (BS 7385.2)
- NSW Department of Environment and Conservation – Assessing Vibration: A Technical Guideline, dated February 2006 (AVTG)

1.2 Proposal Description

The DHL Masterplan site occupies 25 hectares (ha) of the larger 171.84ha site at 1953-2109 Elizabeth Drive, Badgerys Creek, which is known as "Burrah Park site". The wider Burrah Park site is subject to a separate SSDA (SSD-70316465) which has not been considered for

this assessment. Therefore, this report will only consider the acoustic impacts related to construction activities and operation for the Stage 1 development.

DHL Stage 2 site occupies the northern portion of the DHL Masterplan Site and is the subject of SSDA (SSD-70817958).

Specifically, the SSDA seeks consent for:

- Staged construction of warehouse buildings for use as a logistics centre with 24 hour/ day, seven days a week operation, comprising the following:
  - Construction of two warehouses
  - Building fit out
  - Construction of hardstand, loading and carparking
  - Landscaping works
  - Signage.

1.3 Site Description

The site is located within Badgerys Creek, 12.5 km south-east of the Penrith Central Business District (CBD), 27 km west of Parramatta, and 47 km from the Sydney CBD. In its current setting, the site is bounded by agricultural uses to the east and west, rural residential land uses to the north and Elizabeth Drive and the currently under construction Western Sydney Airport to the immediate south. The future M12 Motorway is also located to the north and east of the site.

The site forms part of the Northern Gateway Precinct which is a major interface for the Western Sydney Airport and a specialised centre linking the Airport with the metropolitan cluster. It will be an employment precinct that can be easily accessed and will provide skilled employment and business opportunities north of the Airport. Key objectives of the precinct are to:

- Facilitate the development of a high technology employment precinct.
- Facilitate a variety industrial and business enterprises in locations that support the principles of transit-oriented development.

Badgerys Creek Precinct is also to the east of the site. This precinct will support the Western Sydney Airport operations and be well connected to the Aerotropolis Core metropolitan centre to the south and the Northern Gateway to the north-west. The precinct will transform from lower density and less intensive land uses, buildings and structures to higher order employment-focused technology, advanced manufacturing and industry use.

1.4 Burrah Park Development Consent for Future Developments

The relevant conditions of approval in relation to operational noise of future developments within Burrah Park is detailed in Conditions A13 and B12 of the Burrah Park CoA. The identified conditions have been replicated below to inform this assessment.

NOISE

A13 The Applicant must ensure that the cumulative noise generated by operation of all operational stages of the development within the Concept Proposal does not exceed the noise limits in Table 2. (reproduced in **Table 1** in this report).

Table 1 Noise Limits for Consent Locations

Location	Day LAeq 15 minutes	Evening LAeq 15 minutes	Night LAeq 15 minutes
NCA1 – North East - Residential (C4 Environmental living zone), including RES_1 to RES_7	45	40	35
Commercial receivers - Enterprise NCA02 (East, West and North), including COM_1 to COM_6 and COM_8 to COM_10	60	60	60
Commercial receivers - Agribusiness NCA03 (South-West), including COM_7 and COM_11	60	60	60

B12 Future development on the site must demonstrate consideration of:

a) the noise allowances identified for each proposed lot in Tables 5.2, 5.3, 5.4 and 5.5 in the 'Noise Planning Assessment Burrah Park Masterplan and SSDA Stage 1', prepared by EMM Consulting Pty Ltd, version 5, dated 10 June 2025,

b) noise assessments undertaken for any previous stages of the Concept Proposal; and

c) cumulative noise management of each approved or proposed stage of the Concept Proposal and how the whole site will maintain compliance with the noise limits in Condition A13.

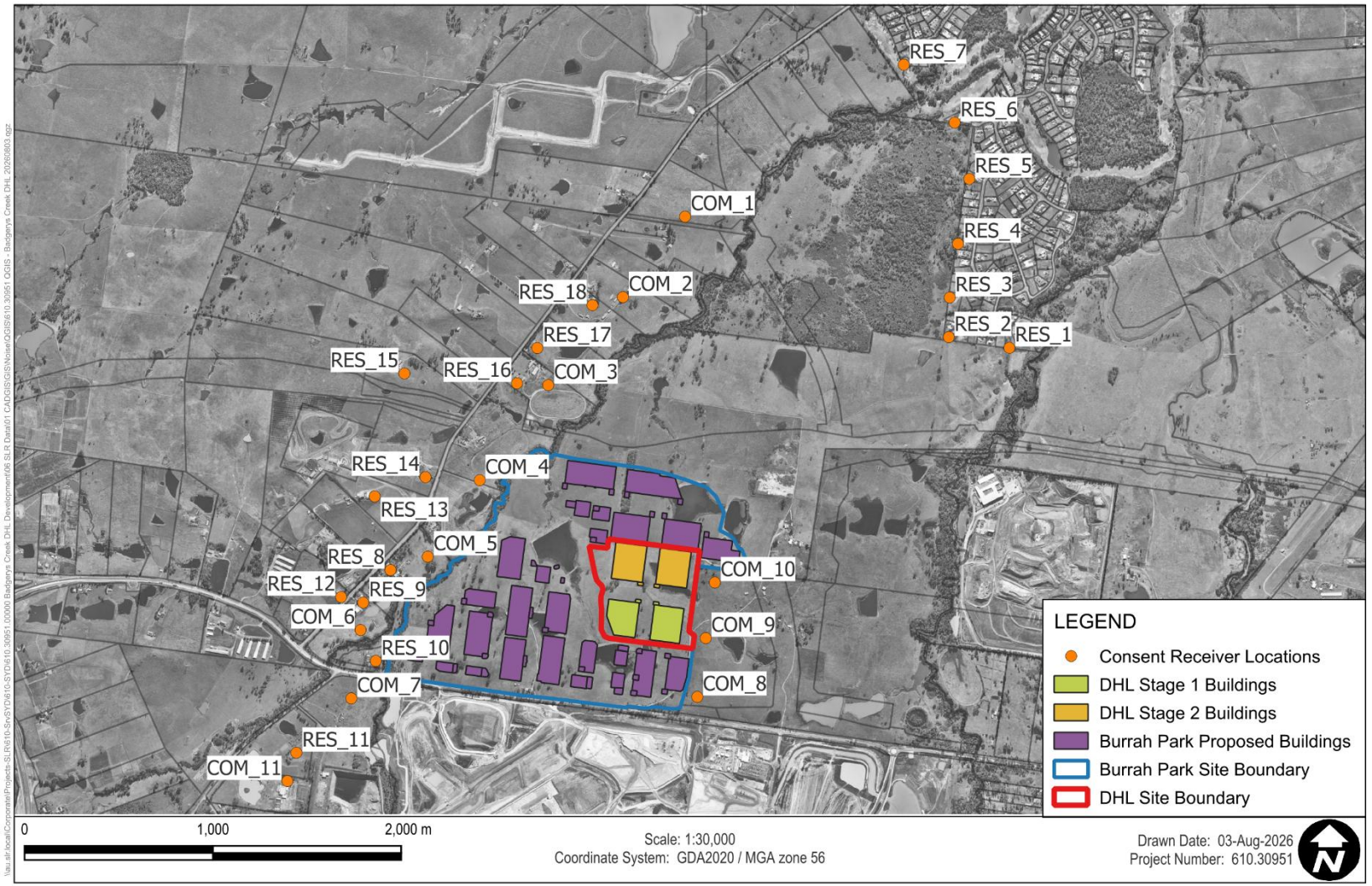
From this, it is understood the site will need to comply with the allocated noise allowances for the DHL warehouses detailed in the Burrah Park NIA in order to demonstrate compliance with the cumulative noise criteria shown in **Table 1**. This approach will demonstrate compliance with Conditions A13 and B12 of the Burrah Park CoA.

DPHI have identified the receiver points established in the Burrah Park NIA as consent locations which have been summarised in **Table 1** and are shown in **Figure 1**.

1.4.1 Burrah Park Site Area and Consent Receiver Locations

Figure 1 depicts the DHL site location within the Burrah Park precinct, surrounding proposed future developments and the operational noise consent receiver locations shown in **Table 1**.

Figure 1 Site Location, Burrah Park Precinct and Consent Receiver Locations



1.4.2 Residual Isolated Residential Receivers

It should be noted that isolated residential receivers (RES_8 – RES_18) are located within land rezoned as Enterprise and Agribusiness and do not adopt the criteria detailed in **Table 1.** Instead, these receivers will adopt an overall rural recommended amenity criteria consistent with the Burrah Park NIA (see Table 11.1) which is further discussed in **Section 2.3**.

1.5 Secretary's Environmental Assessment Requirements

1.5.1 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements (SEARs) were issued by the Department of Planning and Environment (DPE) in March 2022. The requirements relevant to noise and vibration are shown in Table 2.

Table 2 Secretary's Environmental Assessment Requirements

Noise and Vibration	Where Addressed
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 would be implemented.	Criteria: **Section 2.0** Impacts: **Section 3.0** **Section 4.0.** Mitigation: **Section 5.0**
Provide an assessment of the cumulative impacts (including noise, air quality and traffic) of the project and other approved and proposed developments in accordance with the Cumulative Impact Assessment Guidelines for State Significant Projects (DPIE, July 2021).	Criteria: **Section 2.0**

1.6 DCP Requirements

The Western Sydney Aerotropolis Development Control Plan 2022 (the DCP) contains noise related performance benchmarks for the development of Enterprise, Light Industry and Agribusiness within the Aerotropolis. These benchmarks are shown in Table 3.

Table 3 DCP Noise and Amenity Benchmarks

Performance Outcome	Benchmark Solution	Where Addressed
PO1 – To ensure noise and vibration do not adversely impact human health and amenity. To ensure building design adequately protects workers and surrounding receivers from noise and vibration.	1. Any machinery or activity considered to produce noise emissions from a premise shall be adequately sound-proofed so that noise emissions are in accordance with the provisions of the Protection of the Environment Operations Act 1997. 2. Noise should be assessed in accordance with Noise Policy for Industry (EPA, 2017) and NSW Road Noise Policy (Department of Environment, Climate Change and Water, 2011). 3. An Acoustic Report by a qualified acoustical engineer must be submitted where proposed development, including traffic generated by that development, will create noise and/or vibration impacts, either during	Introduction: **Section 1.0** Criteria (including approach to assessing cumulative impacts): **Section 2.0**

Performance Outcome	Benchmark Solution	Where Addressed
	construction or operation, that impacts on adjoining developments or nearby rural-residential areas. The Acoustic Report should outline the proposed noise amelioration strategies and management methods. 4. Acoustic Reports for individual developments must assess cumulative noise impacts, including likely future noise emissions from the development and operation of the Precinct. The consultant should liaise with the relevant consent authority to determine acceptable amenity goals for individual industrial developments and background noise levels. 5. The use of mechanical plant and equipment may be restricted in areas close to sensitive receivers, such as adjoining rural-residential development and educational establishments. 6. Building design is to incorporate noise amelioration features. Roof elements are to control potential breakout noise, having regard to surrounding topography. 7. Boundary fences are to incorporate noise amelioration features and control breakout noise having regard to developments adjoining rural-residential areas.	Methodology: **Section 3.0** Impacts: **Section 4.0** Mitigation: **Section 5.0**

2.0 Assessment Criteria

Assessment of construction and operational noise has adopted the approach detailed in the Burrah Park NIA to establish a consistent methodology for all developments within the Burrah Park precinct.

2.1 Construction Noise Criteria

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a proposal are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the proposal.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

2.1.1 Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in Table 4.

Table 4 ICNG NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard Construction Hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL[1] + 10 dB	• The noise affected level represents the point above which there may be some community reaction to noise • Where the predicted or measured $L_{Aeq(15minute)}$ 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.
	Highly Noise Affected 75 dBA	• The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: o 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 o If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Standard	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Construction Hours		• The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: The RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW Industrial Noise Policy (INP). The INP has been superseded by the NSW EPA *Noise Policy for Industry* (NPfI).

2.1.2 'Other Sensitive' Land Uses and Commercial Receivers

Non-residential land uses have been identified in the study area. The NMLs for 'other sensitive' receivers are shown in Table 5.

Table 5 Construction Noise Management Levels at 'Other Sensitive' Land Uses

Land Use	Noise management level $L_{Aeq(15minute)}$ (dBA) (applied when the property is in use)	
	Internal	External
ICNG 'other sensitive' receivers		
Commercial	-	70

2.1.3 NML Summary

Site specific construction NMLs are detailed in **Table 6**.

Table 6 Project Specific Noise Management Levels

Receiver Type	NML ($L_{Aeq(15minute)}$ (dBA)				Sleep Disturbance Screening Level[2] (L_{Amax} dBA)
	Standard Construction Hours (RBL[1]+10dB)	Out of Hours (RBL[1]+5dB)			
	Day	Day	Eve.	Night	Night
Residential	45	40	35	35	52
Commercial	70 (when in use)				n/a

Note 1: Assumed minimum RBLs in accordance with the NPfI consistent with the Burrah Park NIA.

Note 2: Sleep disturbance screening level is RBL+15 dB or 52 dBA, whichever is higher.

2.2 Construction Vibration Criteria

The effects of vibration from construction works can be divided into three categories:

- Those in which the occupants of buildings are disturbed (human comfort)
- Those where building contents may be affected (building contents)
- Those where the integrity of the building may be compromised (structural or cosmetic damage).

2.2.1 Human Comfort Vibration

People can sometimes perceive vibration impacts when vibration generating construction works are located close to occupied buildings.

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in Table 7.

Table 7 Vibration Dose Values for Intermittent Vibration

Building Type	Assessment Period	Vibration Dose Value[1] ($m/s^{1.75}$)	
		Preferred	Maximum
Critical Working Areas (eg operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration.

2.2.2 Effects on Building Contents

People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents.

Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes, are located in buildings near to construction works. No such items of equipment have been identified in the project area.

2.2.3 Structural and Cosmetic Damage Vibration

If vibration from construction works is sufficiently high it can cause damage to structural elements of affected buildings. The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (10 times) higher than those at which people can perceive vibration.

Examples of damage that can occur includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints. Structural damage vibration limits are contained in British Standard BS 7385 and German Standard DIN 4150.

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration judged to give a minimal risk of vibration induced damage to affected buildings. The limits for residential and industrial buildings are shown in Table 8.

Table 8 BS 7385 Transient Vibration Values for Minimal Risk of Damage

Group	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 at 4 Hz and above	
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

Note 1: Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%.

For heritage buildings, the standard states that *"a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive"*.

DIN 4150

For continuous long-term vibration or repetitive vibration with the potential to cause fatigue effects, DIN 4150 provides the following Peak Particle Velocity (PPV) values as safe limits, below which even superficial cosmetic damage is not to be expected:

- 2.5 mm/s for buildings of great intrinsic value (eg heritage listed buildings).

General Vibration Screening Criteria

The Transport for NSW *Construction Noise and Vibration Strategy* (CNVS) specifies general vibration screening criteria based on BS 7385. It notes that for most construction activities involving intermittent vibration such as rock breakers, piling rigs, vibratory rollers, excavators and the like, vibration predominantly occurs at frequencies greater than 4 Hz and therefore specifies the following conservative vibration damage screening levels:

- Reinforced or heavy frame structures: 25 mm/s
- Unreinforced or light frame structures: 7.5 mm/s.

At locations where the predicted and/or measured vibration levels are greater than shown above, a more detailed analysis of the building structure, vibration source, dominant frequency and dynamic characteristics of the structure would be required to determine the applicable safe vibration levels.

Heritage

Heritage structures are also assessed against the above screening criteria as they should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound following an inspection. In this case a 2.5 mm/s criterion can be applied in accordance with DIN 4150. No such structures have been identified in the project area.

2.2.4 Minimum Working Distances for Vibration Intensive Works

Minimum working distances for typical vibration intensive construction equipment are provided in the Roads and Maritime *Construction Noise and Vibration Guideline* (CNVG) and are shown in Table 9. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the NSW EPA Vibration Guideline). They are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.

The minimum working distances for human comfort relate to continuous vibration. For most construction activities, vibration emissions are intermittent and for this reason, higher vibration levels occurring over shorter periods are allowed.

Table 9 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	15 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to cosmetic damage of typical buildings under typical geotechnical conditions.

2.3 Operational Noise Criteria

Operational noise criteria to the surrounding consent receiver locations specified in the Burrah Park NIA and conditioned in the Burrah Park CoA are detailed in **Table 10** and **Table 11**.

Table 10 DHL Development Residential Noise Criteria – sourced from Table 5.2 of the Burrah Park NIA

Stage	Warehouse Operation	Noise Allowance $L_{Aeq, 15minutes}$		
		Day	Evening	Night-time
RES_01 – RES_08 (retained)				
Stage 1	Warehouse 3 and Warehouse 4	39	34	29
RES_09 – RES_18 (temporary)				
Cumulative	All warehouses	53	48	43

Table 11 DHL Development Non-residential Noise Criteria – sourced from Table 5.2 of the Burrah Park NIA

Stage	Warehouse Operation	Noise Allowance $L_{Aeq, 15minutes}$ (when in use)
COM_01 – COM_11		
Stage 1	Warehouse 3 and Warehouse 4	54

2.3.1 Sleep Disturbance

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

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

The sleep disturbance screening levels for the development are shown in **Table 12**.

Table 12 Sleep Disturbance Screening Levels

Location	Noise Level (dBA)
	Sleep Disturbance Screening Level[1]
All residential receivers	52

Note 1: The sleep disturbance screening level as 52 dBA LAFmax 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 LAFmax 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.

2.3.2 Noise Source Inventory

A noise source inventory which includes the details of the various operational noise sources at the development is shown in **Table 13**.

Table 13 Noise Source Inventory

Category	Noise Source	Usage	Reference for Noise Data
On-site traffic	Light vehicles	Light vehicles would access the development and park in the various car parks. Modelled in all locations shown in **Figure 2** using vehicle volumes in **Table 20**.	Sound power level taken from measurement data of various light vehicle types and models at speeds of up to around 40 km/h, including vehicle acceleration.
	Medium vehicles	Deliveries to the development would be via medium and heavy vehicles. Medium and heavy vehicles would access the development and travel to the various hardstands/loading docks. Modelled on all medium/heavy vehicle routes shown in **Figure 2** using vehicle volumes in **Table 20**.	Sound power level taken from historical measurement data of various medium rigid truck types and models in approximate 5 to 15 tonne range.
	Heavy vehicles		Sound power level taken from Federal Highway Administration's Traffic Noise Model. Assumes slow speed for 80% of the time and truck acceleration for 20% of the time.
Hardstand and loading docks	Forklifts, reversing alarms, air brakes, roller doors	Heavy vehicle deliveries would be unloaded by forklifts in the various hardstands/loading docks. Modelled in all hardstands/loading docks shown in **Figure 2** using vehicle volumes in **Table 20**. Forklifts have been conservatively assumed to operate externally at all hardstands/loading docks.	Sound power level taken from historical measurement data of typical loading dock activities at similar warehousing and distribution facilities.
Internal activities	Typical warehousing and distribution activities	Internal noise-generating activities at all warehouses would be associated with typical warehousing and distribution activities. Noise from these activities is expected to be minimal.	Sound power level based on observations of typical internal activities at similar warehousing and distribution facilities.
Mechanical plant	Warehouse air-conditioning units	All warehouses are expected to be temperature controlled and at this stage of design will include 15 outdoor air-conditioning rooftop mounted units.	Sound power level for warehouse mechanical plant are adopted from manufacturer provided data.
	Smoke exhaust fans	Smoke exhaust fans will only be used during an emergency and are not expected to be used during normal operation.	Not assessed.

Category	Noise Source	Usage	Reference for Noise Data
	Office air-conditioning units	Air-conditioning units would be used for all office buildings. At this early stage of the development, specific mechanical plant requirements for each building have not been determined.	Sound power level taken from measurement data and manufacturers specification data for typical air-conditioning units.

2.3.3 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 factor corrections, shown in Table 14, which are to be applied where annoying characteristics are present.

Table 14 NPfI Modifying Factor Corrections

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]
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 intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. 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]

Factor	Assessment / Measurement	When to Apply	Correction[1]
			(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 factor corrections applied in the assessment are provided in **Section 3.2**.

2.3.4 Residual Impacts

The NPfI defines residual noise impacts as exceedances of the Project Noise Trigger Levels which remain after all feasible and reasonable source and pathway mitigation measures have been considered.

The significance of residual noise impacts, as defined in the NPfI, is shown in **Table 15.** Examples of receiver-based treatments that can be used to mitigate residual impacts are shown in **Table 16.**

Table 15 NPfI Significance of Residual Noise Impacts

If the Predicted Noise Level minus the Project Noise Trigger Level is:	And the Total Cumulative Industrial Noise Levels is:	Then the Significance of the Residual Noise Level is:
≤ 2 dBA	Not applicable	Negligible
≥ 3 but ≤ 5 dBA	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from the development is less than or equal to 1dB	Marginal
≥ 3 but ≤ 5 dBA	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is more than 1 dB	Moderate
> 5 dBA	≤ recommended amenity noise level	Moderate
	> recommended amenity noise level	Significant

Table 16 NPfI Examples of Receiver-based Treatments to Mitigate Residual Noise Impacts

Significance of Residual Noise Impact	Example of Potential Treatment
Negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.
Marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.

Significance of Residual Noise Impact	Example of Potential Treatment
Moderate	As for 'marginal', but also upgraded facade elements, such as windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
Significant	May include suitable commercial agreements where considered feasible and reasonable.

2.3.5 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 17**.

Table 17 RNP 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)

2.4 Aircraft Noise

The potential aircraft noise impacts on the development site from Western Sydney Airport are assessed using *Australian Standard AS2021:2015 – Acoustics Aircraft Noise Intrusion – Building Siting and Construction*. The standard provides 'building site acceptability' guidance based on the Australian Noise Exposure Forecast (ANEF) zone of the site. The building site acceptability recommendations are shown in **Table 18**.

Table 18 Building Site Acceptability Based on ANEF Zones

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

3.0 Methodology

3.1 Construction Noise and Vibration Assessment

A noise model of the study area has been used to predict noise levels from the proposed construction work to all surrounding receivers. The model uses ISO 9613 algorithms in SoundPLAN software.

Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding areas.

Construction noise levels have been predicted for activities associated with DHL Stage 1 only.

3.1.1 Construction Activities

Representative scenarios have been developed to assess the likely impacts from the various construction phases of the proposal. These scenarios are shown in **Table 19**.

The assessment uses 'realistic worst-case' scenarios to determine the impacts from the noisiest 15-minute period that are likely to occur for each work scenario, as required by the ICNG. The impacts represent construction noise levels without mitigation applied.

The sound power levels for the construction equipment used in each scenario is presented in **Appendix C**.

Table 19 Construction Equipment

Scenario	Works Activity	Equipment
W.01	Site establishment	• Generator • Hand tools • Truck
W.02	Demolition	• Excavator with breaker • Excavator • Front end loader • Generator • Truck
W.03	Earth works	• Excavator • Generator • Roller – vibratory • Truck
W.04	Concreting works	• Concrete mixer truck • Concrete pump • Concrete vibrator • Generator • Truck
W.05	Road works	• Concrete mixer truck • Concrete pump • Excavator • Road profiler

Scenario	Works Activity	Equipment
		• Truck
W.06	Stormwater and Pavements	• Excavator with breaker • Excavator • Tipper truck • Truck • Grader • Roller – vibratory • Roller - smooth drum • Mobile crane – Franna • Concrete mixer truck
W.07	Finishing works	• Elevated working platform • Generator • Hand tools • Mobile crane – Franna • Truck

3.1.2 Hours of Construction

Construction activities for the proposal would only be undertaken during the following hours:

- 7:00 am to 6:00 pm, Mondays to Fridays
- 8:00 am to 1:00 pm on Saturdays
- At no time on Sundays or Public Holidays.

3.2 Operational Noise Assessment

The potential operational noise levels from the proposal have been predicted to the surrounding receivers using the ISO9613-2 industrial noise algorithm in SoundPLAN. The model includes ground topography, ground type (ground absorption modelled 0.75 for rural areas), buildings and representative worst-case noise sources from the proposal.

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

Operational noise levels have been assessed for the following scenarios:

- DHL Stage 1 (ie operation of Warehouse 3 and 4)

3.2.1 Operational Noise Sources

The development comprises of various lots with associated ancillary offices, estate roads, heavy vehicle access, hardstands, light vehicle access and carparking. Vehicles would access the site from Elizabeth Drive. Heavy vehicles would park in the hard stand loading areas while they are loaded/unloaded, before exiting the site. Light vehicle carparking is provided at each warehouse and 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.

Roof mounted mechanical plant would be provided for each office. 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.

A summary of the expected noise sources and worst-case assessment scenarios associated with the operation of the development is provided below.

On-Site Traffic

On-site vehicles have been modelled using the data in **Table 20** and **Table 21**. 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 the various warehouse tenancies during the worst-case 15-minute assessment period. In reality, vehicle access to each warehouse would be unlikely to occur concurrently, particularly during the night-time.

Heavy vehicle deliveries to the warehouses would be via a range of freight vehicles including medium trucks (ie rigid trucks or similar) and heavy trucks (ie semi-trailers or similar).

Table 20 Vehicle Traffic Data – Worst-case 15-Minute Period

Lot	Vehicle Type	Number of Vehicles in Worst-case 15-minute Period[1]		
		Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 7am)
WH3	Heavy trucks	5	2	3
	Medium trucks	10	1	4
	Light vehicles	58	14	28
WH4	Heavy trucks	5	2	3
	Medium trucks	10	1	5
	Light vehicles	55	12	30

Note 1: Total vehicles, includes both inbound and outbound vehicles. Volumes are rounded up to whole numbers for display purposes.

Table 21 Vehicle Sound Power Levels

Vehicle	Movement	Sound Power Level (dBA)	Vehicle Speed (km/h)
Heavy trucks	Access routes	108[1]	25
	On-lot routes and hardstands		10
Medium trucks	Access routes	103[1]	25
	On-lot routes and hardstands		10
Light vehicles	Car park	96[2]	20

Note 1: 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 and is representative of trucks with three or more axles. Sound power level for medium trucks based on 100 dBA for trucks at slow speed for 80% of the time and 106 dBA for trucks accelerating for 20% of the time and is representative of trucks with two

axles and six tires. Sound power levels taken from the Federal Highway Administration's Traffic Noise Model.

Note 2: Sound power level 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.

Hardstands and Loading Docks

Details of the hardstand and loading dock noise sources are shown in Table 22. The various sources have been modelled in the hardstand areas (see Figure 2) based on the corresponding number of heavy vehicle movements in the worst-case 15-minute periods (see Table 20).

Table 22 Typical Hardstand and Loading Dock Noise Sources

Noise Source	Sound Power Level (dBA)[1]	Typical Duration of Use in Worst-case 15-minute Period
Truck reversing alarm	107[2,3]	30 seconds
Forklift reversing alarm	102[2,3]	90 seconds
Air brakes	118	1 second
Roller door	94	15 seconds
Electric forklift	84	900 seconds

Note 1: SWLs based on measurement data, where appropriate.

Note 2: SWL based on recommendation to use broadband reversing alarms, see **Section 5.2.**

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

Internal Activities

The future tenants of the warehouses would likely be associated with typical warehousing and distribution uses. Internal noise-generating activities at all warehouses are expected to generally be minimal. A sound power level of 75 dBA has been applied at openings in the facades of each warehouse to cover potential break-out noise from 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.

The facade and roof construction of the warehouses would be metal sheeting (Colorbond or similar). The proposed warehouse construction is expected to be sufficient to minimise noise breakout through the facade and roof to a level that results in negligible to external noise emissions.

Mechanical Plant

Preliminary mechanical plant selections have been provided for the development. All warehouses are expected to be temperature controlled and will each consist of fifteen (15) rooftop mounted air-conditioning units.

Additionally, eight (8) rooftop smoke exhaust fans are expected to only operate during an emergency and have not been assessed for normal operations.

External mechanical plant has been modelled with indicative data for equipment typical to a development of this size, as shown in Table 23. The locations of the sources are shown in Figure 2.

Table 23 Mechanical Plant

Noise Source	Sound Power Level (dBA)	Location and Operating Hours
Air-conditioning equipment ActronAir PKV2000T	83	Warehouse roofs. Assumed to operate 24/7.
Smoke exhaust fans Fantech SS1256CA6/30	99	Warehouse roofs. Only operates during an emergency and is not assessed for normal operations.

3.2.2 Corrections for Annoying Noise Characteristics

The potential annoying noise characteristics and modifying factor corrections relevant to the proposal 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 5.2**), 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, such as where equipment cycles on and off. The intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. No sources have been identified with potential intermittent characteristics.

Figure 2 Modelled Noise Sources (Stage 1)

3.2.3 Noise Sources with Potential for Sleep Disturbance

As the development is proposed to 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 24.

Table 24 Sleep Disturbance Noise Events – LAmax Sound Power Levels

Noise Source	Sound Power Level L_{Amax} (dBA)
Heavy truck movement	111
Heavy truck airbrake	118
Truck reversing alarm	110
Forklift reversing alarm	105
Roller door	94

3.2.4 Off-site Road Traffic

Traffic associated with the development would enter and exit the development from the south via Elizabeth Drive, with the majority of traffic travelling directly to the Northern Road or the M7 Motorway. The potential noise impacts from additional traffic have been assessed based on traffic data shown in Table 25.

Table 25 Traffic Volumes – All Warehouses

Road	Existing Traffic volumes (2018)[1]				Development Related Traffic Volumes			
	Daytime (7am to 10pm)		Night-time (10pm to 7am)		Daytime (7am to 10pm)		Night-time (10pm to 7am)	
	Light	Heavy[2]	Light	Heavy[2]	Light	Heavy	Light	Heavy
Elizabeth Drive	8,595	2,149	2,025	506	7,479	1,535	394	81

3.2.5 Weather Conditions

Fact Sheet D of the NPfI requires noise assessments to consider the potential effects of noise-enhancing weather conditions, such as wind from the source to the receiver and/or temperature inversions.

The noise prediction modelling uses ISO 9613-2 algorithms which include noise-enhancing weather conditions including downwind propagation, or equivalently, propagation under a well-developed moderate ground-based temperature inversion.

3.3 Aircraft Noise Assessment

The potential aircraft noise impacts on the development site from Western Sydney Airport have been assessed using the Western Sydney Airport Noise Modelling Tool, which provides Australian Noise Exposure Concept (ANEC) contours for the area surrounding the airport. These have been compared to the 'building site acceptability' categories for 'light industrial' uses in *Australian Standard AS2021:2015 – Acoustics Aircraft Noise Intrusion*.

4.0 Assessment of Impacts

4.1 Construction Noise

The predicted construction noise levels from DHL Stage 1 at the most-affected sensitive receivers surrounding the site are shown in **Table 26** and exceedances of the NMLs are shown in **Table 27**.

The predictions represent a realistic worst-case scenario where the equipment in each scenario is working concurrently and the nearest location to each receiver. It is expected that noise levels would frequently be lower than the worst-case levels presented.

Table 26 Predicted Construction Noise Levels at Nearest Receivers

ID	Receiver Type	NML[1]	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)						
			W.01	W.02	W.03	W.04	W.05	W.06	W.07
			Site establishment	Demolition	Earth works	Concreting works	Structure works	Stormwater & Pavements	Finishing works
COM_1	Commercial	70	21	33	27	25	26	33	22
COM_2	Commercial	70	22	34	28	26	27	34	23
COM_3	Commercial	70	28	40	34	32	33	40	29
COM_4	Commercial	70	34	46	40	38	39	46	35
COM_5	Commercial	70	33	45	39	37	38	45	34
COM_6	Commercial	70	25	37	31	29	30	37	26
COM_7	Commercial	70	24	36	30	28	29	36	25
COM_8	Commercial	70	39	51	45	43	44	51	40
COM_9	Commercial	70	57	69	63	61	62	69	58
COM_10	Commercial	70	48	60	54	52	53	60	49
COM_11	Commercial	70	20	32	26	24	25	32	21
RES_1	Residential	45	17	29	23	21	22	29	18
RES_2	Residential	45	19	31	25	23	24	31	20
RES_3	Residential	45	18	30	24	22	23	30	19
RES_4	Residential	45	16	28	22	20	21	28	17
RES_5	Residential	45	15	27	21	19	20	27	16
RES_6	Residential	45	14	26	20	18	19	26	15
RES_7	Residential	45	13	25	19	17	18	25	14
RES_8	Residential	45	26	38	32	30	31	38	27
RES_9	Residential	45	26	38	32	30	31	38	27
RES_10	Residential	45	27	39	33	31	32	39	28
RES_11	Residential	45	22	34	28	26	27	34	23
RES_12	Residential	45	24	36	30	28	29	36	25
RES_13	Residential	45	29	41	35	33	34	41	30

ID	Receiver Type	NML[1]	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)						
			W.01	W.02	W.03	W.04	W.05	W.06	W.07
			Site establishment	Demolition	Earth works	Concreting works	Structure works	Stormwater & Pavements	Finishing works
RES_14	Residential	45	32	44	38	36	37	44	33
RES_15	Residential	45	26	38	32	30	31	38	27
RES_16	Residential	45	30	42	36	34	35	42	31
RES_17	Residential	45	24	36	30	28	29	36	25
RES_18	Residential	45	27	39	33	31	32	39	28

Note 1: Based on Daytime NMLs.

Table 27 Predicted Exceedances at Nearest Receivers

ID	Receiver Type	NML[1]	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)						
			W.01	W.02	W.03	W.04	W.05	W.06	W.07
			Site establish.	Demolition	Earth works	Concreting works	Structure works	Stormwater & Pavements	Finishing works
COM_1	Commercial	70	-	-	-	-	-	-	-
COM_2	Commercial	70	-	-	-	-	-	-	-
COM_3	Commercial	70	-	-	-	-	-	-	-
COM_4	Commercial	70	-	-	-	-	-	-	-
COM_5	Commercial	70	-	-	-	-	-	-	-
COM_6	Commercial	70	-	-	-	-	-	-	-
COM_7	Commercial	70	-	-	-	-	-	-	-
COM_8	Commercial	70	-	-	-	-	-	-	-
COM_9	Commercial	70	-	-	-	-	-	-	-
COM_1	Commercial	70	-	-	-	-	-	-	-
COM_1	Commercial	70	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_2	Residential	45	-	-	-	-	-	-	-
RES_3	Residential	45	-	-	-	-	-	-	-
RES_4	Residential	45	-	-	-	-	-	-	-
RES_5	Residential	45	-	-	-	-	-	-	-
RES_6	Residential	45	-	-	-	-	-	-	-
RES_7	Residential	45	-	-	-	-	-	-	-
RES_8	Residential	45	-	-	-	-	-	-	-

ID	Receiver Type	NML[1]	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)						
			W.01	W.02	W.03	W.04	W.05	W.06	W.07
			Site establish.	Demolition	Earth works	Concreting works	Structure works	Stormwater & Pavements	Finishing works
RES_9	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-
RES_1	Residential	45	-	-	-	-	-	-	-

Legend (NML exceedances) = Minor to marginal (1 to 10 dB exceedance); = Moderate (11 to 20 dB exceedance); = High (>20 dB exceedance)

Note 1: Based on Daytime NMLs.

The above worst-case predictions show the following:

- Noise levels are expected to comply with the NMLs at all receivers during all construction scenarios.
- No residential receivers are predicted to be highly noise affected (ie ≥75 dBA) during any of the construction work.

The presented worst-case impacts would only be expected to occur when noisy work is being completed close to the site boundaries, relative to each receiver. When work is in central areas of the site, or when less noise intensive equipment is being used, the noise levels are expected to reduce.

Feasible and reasonable construction noise mitigation measures should be applied where exceedances of the NMLs are predicted. Construction noise mitigation and management measures are discussed in **Section 5.1**.

4.2 Construction Vibration

The major potential sources of vibration from the proposed construction activities would likely be during:

- 'Earth works' when vibratory rollers are being used
- 'Demolition' when rockbreakers are being used.

Vibration offset distances have been determined from the CNVG minimum working distances for cosmetic damage and human comfort (see Table 9) and the assessment is summarised in **Figure 3** for a large vibratory roller.

Figure 3 Construction Vibration – Large Vibratory Roller

Cosmetic Damage and Human Comfort Assessment

The above figure shows that the nearest industrial buildings surrounding the site may potentially be within the cosmetic damage minimum working distance for vibration intensive equipment. However, it should be noted that the cosmetic damage buffer shown above assumes light frame structures which may not be applicable in this circumstance due to the typical construction of warehouses and other industrial buildings.

The minimum working distance from reinforced/industrial structures would be 12 m for large vibratory rollers (>18t).

Where structures are shown within the cosmetic damage buffer above, this would only be when vibration intensive equipment is being used at the site boundary, near to adjacent sensitive receivers. Work in other more distant areas of the site would be outside the minimum working distances.

No residential buildings have been identified within the cosmetic damage buffer.

Offset distances from specific vibration intensive plant to the nearest receivers and receiver structure type should be confirmed before commencing vibration intensive works during construction.

The above figures show that COM_9 and the Stage 2 DHL warehouses are likely within the human comfort minimum working distance and occupants of these buildings may be able to perceive vibration impacts at times when vibration intensive equipment are in use nearby. Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration intensive equipment is in use.

Feasible and reasonable construction vibration mitigation measures should be applied where vibration intensive works are required within the minimum working distances. Construction vibration mitigation and management measures are discussed in **Section 5.1**.

4.3 Operational Noise

Operational noise levels have been assessed for the following scenarios:

- DHL Stage 1 (ie operation of Warehouse 3 and 4)

4.3.1 Predicted Operational Noise Levels – DHL Stage 1

A summary of the worst-case DHL Stage 1 operational noise assessment at the consent receivers using the allowance system including all commercial receivers and north-eastern residential receivers (RES_1 – RES_7) and isolated temporary residential receivers (RES_8 – RES_18) are detailed in **Table 28**.

The predicted worst-case levels are compared to the consent criteria to determine the potential impact from the proposal. Noise contours of the predicted worst-case operational noise impacts are in **Appendix D**.

A detailed assessment of all potential feasible and reasonable mitigation measures that could be applied to the development to minimise the impacts has been completed and is summarised in **Section 5.2**. The following predictions include the recommended mitigation measures, where appropriate.

Table 28 Operational Noise Assessment – DHL Stage 1 Operation

Receiver ID	Period	Criteria	Predicted	Exceedance	Compliance
Consent Receiver Locations (COM_1 – COM_11, RES_1 – RES_7)					
COM_1	When in use	54	30	-	Yes
COM_2		54	33	-	Yes
COM_3		54	34	-	Yes
COM_4		54	35	-	Yes
COM_5		54	34	-	Yes
COM_6		54	32	-	Yes
COM_7		54	32	-	Yes
COM_8		54	40	-	Yes
COM_9		54	53	-	Yes
COM_10		54	49	-	Yes
COM_11		54	27	-	Yes
RES_1	Day	39	24	-	Yes
	Evening	34	19	-	Yes
	Night	29	21	-	Yes
RES_2	Day	39	29	-	Yes
	Evening	34	24	-	Yes
	Night	29	26	-	Yes
RES_3	Day	39	28	-	Yes
	Evening	34	24	-	Yes

Receiver ID	Period	Criteria	Predicted	Exceedance	Compliance
	Night	29	25	-	Yes
RES_4	Day	39	28	-	Yes
	Evening	34	23	-	Yes
	Night	29	25	-	Yes
RES_5	Day	39	26	-	Yes
	Evening	34	22	-	Yes
	Night	29	23	-	Yes
RES_6	Day	39	25	-	Yes
	Evening	34	21	-	Yes
	Night	29	22	-	Yes
RES_7	Day	39	24	-	Yes
	Evening	34	20	-	Yes
	Night	29	22	-	Yes
Isolated Receivers within Rezoned Land (RES_8 – RES_18)					
RES_8	Day	53	29	-	Yes
	Evening	48	26	-	Yes
	Night	43	27	-	Yes
RES_9	Day	53	32	-	Yes
	Evening	48	30	-	Yes
	Night	43	30	-	Yes
RES_10	Day	53	32	-	Yes
	Evening	48	29	-	Yes
	Night	43	29	-	Yes
RES_11	Day	53	29	-	Yes
	Evening	48	26	-	Yes
	Night	43	26	-	Yes
RES_12	Day	53	31	-	Yes
	Evening	48	29	-	Yes
	Night	43	29	-	Yes
RES_13	Day	53	33	-	Yes
	Evening	48	30	-	Yes
	Night	43	30	-	Yes
RES_14	Day	53	34	-	Yes
	Evening	48	31	-	Yes
	Night	43	32	-	Yes

Receiver ID	Period	Criteria	Predicted	Exceedance	Compliance
RES_15	Day	53	31	-	Yes
	Evening	48	28	-	Yes
	Night	43	29	-	Yes
RES_16	Day	53	33	-	Yes
	Evening	48	30	-	Yes
	Night	43	30	-	Yes
RES_17	Day	53	33	-	Yes
	Evening	48	29	-	Yes
	Night	43	30	-	Yes
RES_18	Day	53	33	-	Yes
	Evening	48	29	-	Yes
	Night	43	30	-	Yes

DHL Stage 1

The above assessment indicates the following:

- Noise from the proposal is predicted to comply with the noise allowance at all consent receiver locations (COM_1 – COM_11 and RES_1 – RES_7).
- Noise from the proposal is predicted to comply with the rural amenity criteria at all isolated rural residential receivers (RES_8 – RES_18).

4.3.2 Sleep Disturbance

The predicted night time maximum noise levels at the nearest residential receivers are shown in **Table 29**. These include the mitigation measures specified in **Section 5.2**, where appropriate.

Table 29 Sleep Disturbance Assessment – DHL Stage 1

Receiver ID	Maximum Noise Level LAmax (dBA)		Exceedance	Below Screening Level
	Sleep Dist. Screening Level	Predicted Maximum Noise Level		
DHL Stage 1				
RES_1	52	35	-	Yes
RES_2	52	38	-	Yes
RES_3	52	37	-	Yes
RES_4	52	35	-	Yes
RES_5	52	34	-	Yes
RES_6	52	33	-	Yes
RES_7	52	32	-	Yes

Receiver ID	Maximum Noise Level LAmax (dBA)		Exceedance	Below Screening Level
	Sleep Dist. Screening Level	Predicted Maximum Noise Level		
RES_8	52	35	-	Yes
RES_9	52	36	-	Yes
RES_10	52	41	-	Yes
RES_11	52	38	-	Yes
RES_12	52	36	-	Yes
RES_13	52	41	-	Yes
RES_14	52	43	-	Yes
RES_15	52	40	-	Yes
RES_16	52	42	-	Yes
RES_17	52	41	-	Yes
RES_18	52	40	-	Yes

The above shows that maximum noise levels are expected to comply with the sleep disturbance screening level at all residential receivers.

4.3.3 Off-site Traffic Assessment

Traffic associated with the development would enter and exit the site from the south via Elizabeth Drive, with the majority of traffic travelling directly to the Northern Road or the M7 Motorway. Development related heavy vehicles are anticipated to be via a range of vehicle types, include large and medium trucks.

It is expected that traffic noise levels in the area would increase as the Northern Gateway Precinct and surrounding areas, including Western Sydney Airport and M12 Motorway, are developed and the various estates/projects become operational. Impacts from increased traffic noise are likely to occur at certain receivers as traffic volumes in the area increase. These impacts should, however, be considered as temporary as the potentially affected receivers within the precinct are zoned ENT enterprise and will be redeveloped and replaced with a variety of future industrial and business enterprises.

4.4 Aircraft Noise Impacts

The potential aircraft noise impacts on the site from Western Sydney Airport are summarised in **Table 30**.

Table 30 Western Sydney Airport – Building Site Acceptability Based on ANEF Zones

Assessment Scenario	Building Site Acceptability Based on ANEF Zones
Year 2030 Prefer 05 Direction (majority of departures to the north-east and arrivals from the south-west)	The site buildings are less than 30 ANEC, which is considered ‘acceptable’ for light industrial uses.

Assessment Scenario	Building Site Acceptability Based on ANEF Zones
Year 2030 Prefer 23 Direction (majority of departures to the south-west and arrivals from the north-east)	The site buildings are less than 30 ANEC, which is considered ‘acceptable’ for light industrial uses.
Year 2050 Prefer 05 Direction (majority of departures to the north-east and arrivals from the south-west)	The site buildings are less than 30 ANEC, which is considered ‘acceptable’ for light industrial uses.
Year 2050 Prefer 23 Direction (majority of departures to the south-west and arrivals from the north-east)	The site buildings are less than 30 ANEC, which is considered ‘acceptable’ for light industrial uses.

The potential impacts from Western Sydney Airport and requirements for building envelope mitigation should be reviewed as the project progresses.

5.0 Mitigation and Management Measures

5.1 Construction Impacts

The impacts during construction of the project are predicted to be typical of major construction works near to sensitive receivers. No works outside of standard construction hours are currently proposed.

The use of standard mitigation measures to minimise the impacts is considered sufficient to control the majority of the impacts. Examples of measures which could be applied to the work are provided in the Roads and Maritime (now Transport for NSW) Construction Noise and Vibration Guideline (see **Appendix E**).

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared before any work begins. This would identify all potentially impacted receivers, assess the potential noise and vibration impacts from the project and provide details regarding how the impacts would be minimised through the use of all feasible and reasonable mitigation measures. The CNVMP would also contain procedures for handling complaints, should they occur, and detail any compliance monitoring requirements.

5.2 Operational Noise Impacts

Where operational noise impacts from the site are predicted to exceed the relevant noise criteria, feasible and reasonable operational noise mitigation and management measures should be considered, with the aim of reducing noise emissions to the relevant criteria.

The typical hierarchy for mitigation and management of industrial noise sources is as follows:

- Reducing noise emissions at the source (ie noise source control)
- Reducing noise in transmission to the receiver (ie noise path control)
- Reducing noise at the receiver (ie at-receiver control).

A detailed assessment of all potential feasible and reasonable mitigation measures that could be applied to the development to minimise the impacts has been completed and is summarised in **Table 31**.

Table 31 Operational Noise Mitigation Options

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
Source Control			
S1	Optimised site layout to minimise noise emissions from the site	Where possible, the site layout has been designed so that the warehouse buildings screen the noisier areas of the development (ie hardstands and truck routes) from the nearest receivers.	Yes – applied during design of the concept masterplan
S2	Limit vehicle movements	A reduction in concurrent vehicle movements across the site by staggering delivery/pickup times and/or employee shift change times could reduce noise emissions. In practice, this would occur naturally across the estate due to operational requirements of the different tenants.	No – vehicle volumes used in this assessment are likely needed to meet tenant's requirements. Placing restrictions on allowable vehicle movements across the different tenancies is

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
			unlikely to be feasible and reasonable.
S3	Hardstand/external equipment use	Minimising the concurrent use of forklifts or other mobile plant outside the warehouses and/or limiting their use to the less sensitive day and evening periods. In practice, this would occur naturally across the estate due to operational requirements of the different tenants.	No – placing restrictions on allowable external use of forklifts and equipment across the different tenancies is unlikely to be feasible and reasonable.
S4	Quieter mobile plant and equipment	Use of quieter mobile plant and equipment options, such as electric forklifts instead of gas forklifts.	Yes – the development proposes to use quieter equipment such as electric forklifts instead of gas forklifts.
S5	Use broadband and/or ambient sensing alarms on trucks and forklifts where they are required to reverse during the night-time.	Reduce potential for annoying noise emissions during the night-time from forklifts and trucks.	Yes – use broadband and/or ambient sensing alarms on forklifts and trucks where they are required to reverse during the night-time.
S6	Appropriate specification and location of mechanical plant during detailed design.	If noise impacts from mechanical plant are identified during detailed design, quieter plant could be selected, or the plant could be relocated to a location screened from view of the nearest receivers, where appropriate.	Noise impacts from preliminary mechanical plant selections were identified during this assessment. Where selected equipment is expected to result in higher noise levels during later stages of design, potential impacts should be reassessed.
S7	Appropriate design of warehouses during detailed design.	Appropriate warehouse materials to minimise noise break-out from internal activities would be selected during detailed design. Where it is identified that noisier equipment is required to be used within the warehouse buildings than currently assumed (eg manufacturing equipment instead of standard warehousing and distribution equipment), facade and roof construction can use materials that provide a greater acoustic benefit.	Potentially – noise impacts from internal equipment would be investigated further during construction certificate stages if tenants require manufacturing plant or other noisy equipment.
S8	Roller doors kept closed when loading/unloading is not occurring to minimise noise breakout.	Use of roller doors to minimise internal noise breakout.	Yes – roller doors should be kept closed when not in use for loading/unloading trucks.

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
S9	Appropriate design of site layout to minimise the need for trucks to stop or brake outside of loading docks with line of sight to residential receivers.	Minimise noise emissions, particularly from truck airbrakes.	Yes – applied during design of the concept masterplan
S10	Production of an Operational Noise Management Plan.	This would detail the measures that could be used by the various tenants to minimise general noise emissions from the site. Reference can be made to the Best Management Practice (BMP) and Best Available Technology Economically Available (BATEA) measures listed in the NPfI (see **Appendix F**).	Yes
Path Control			
P1	Noise barriers	Construction of noise barriers along boundary fence locations or other strategic locations could be used to reduce noise levels where plant or equipment are in line of sight of the nearest receivers.	No – compliance with the surrounding consent locations and isolated residential receivers is not expected to require barrier mitigation.
Receiver Control			
R1	At-property treatments	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.	No – compliance with the surrounding consent locations and isolated residential receivers is not expected to at-property treatments.
Verification Monitoring			
V1	Noise monitoring	Verify post-construction operational noise levels are in-line with predictions and the mitigation is working as intended.	Yes

Compliance during DHL Stage 1 with the noise allowance detailed in the Burrah Park NIA – which subsequently complies with consent condition A12 and B13 within the Burrah Park CoA – is predicted to occur at all commercial receivers and north-eastern residential receivers (RES_1 – RES_7). Isolated temporary residential receivers (RES_8 – RES_18) are expected to comply with the rural amenity criteria.

6.0 Conclusion

SLR has been engaged to assess the potential construction and operational noise emissions from the proposed Badgerys Creek DHL Development Stage 1 project, which is a warehouse and distribution development located on Elizabeth Drive, Luddenham.

Construction noise levels are predicted to comply with the noise management levels. Work would be limited to daytime hours only, and standard mitigation measures have been recommended to address the potential construction impacts.

Operational noise levels from DHL Stage 1 are expected to comply with the noise allowance detailed in the Burrah Park NIA for all consent receiver locations (COM_1 – COM_11 and RES_1 – RES_7).

Therefore, the site is expected to comply with conditions A13 and B12 from the Burrah Park CoA and is considered appropriate from an acoustic standpoint.

Appendix A Acoustic Terminology

Badgerys Creek DHL Development Stage 1

Noise Impact Assessment

DHL Supply Chain (Australia) Pty Ltd

SLR Project No.: 610.30951.00000

5 August 2026

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 x 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

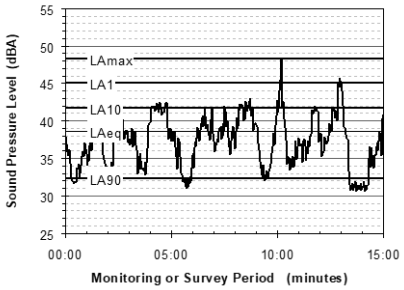
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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 L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} 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:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} 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.

L_{Aeq} 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

5. Frequency Analysis

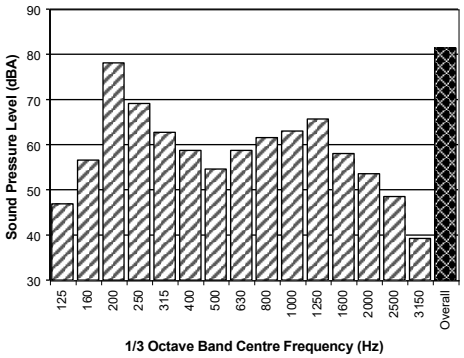
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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.

energy as the corresponding time-varying sound.

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.

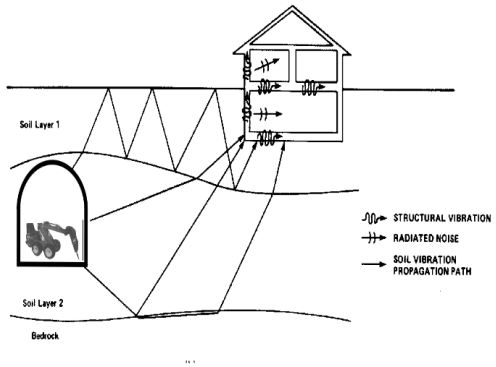
9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

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

- 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.

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.

(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-

Appendix B Construction Noise Sources

Badgerys Creek DHL Development Stage 1

Noise Impact Assessment

DHL Supply Chain (Australia) Pty Ltd

SLR Project No.: 610.30951.00000

5 August 2026

Scenario	Total SWL	Circular Saw[1]	Concrete Mixer Truck	Concrete Pump	Concrete Vibrator	Elevated Working Platform	Excavator - Breaker[1]	Excavator (14 tonne)	Excavator (22 tonne)	Front End Loader	Generator	Grader	Hand Tools	Mobile Crane - Franna	Mobile Crane (400 tonne)	Road Profiler	Roller - Smooth Drum	Roller - Vibratory (12 tonne)[1]	Semi Trailer	Tipper Truck	Truck
Sound Power Level[2]		106	103	106	102	97	121	97	99	104	102	108	94	98	106	107	107	109	106	97	107
Estimated on-time in 15 minutes		15	7.5	7.5	15	15	5	7.5	7.5	7.5	15	15	15	7.5	15	15	15	15	5	15	5
Scenario																					
W.01 Site establishment	105										X		X								X
W.02 Demolition	117						X		X	X	X										X
W.03 Earth works	111								X		X							X			X
W.04 Concreting works	109		X	X	X						X										X
W.05 Structure works	110		X	X				X								X					X
W.06 Stormwater & Pavements	117		X				X	X				X		X			X	X		X	X
W.07 Finishing works	106					X					X		X	X							X

Note 1: Equipment classed as ‘annoying’ in the ICNG and requires a 5 dB correction.

Note 2: Sound power level data is taken from the DEFRA Noise Database, RMS Construction and Vibration Guideline and TfNSW Construction Noise and Vibration Strategy.

Appendix C Operational Noise Contours

Badgerys Creek DHL Development Stage 1

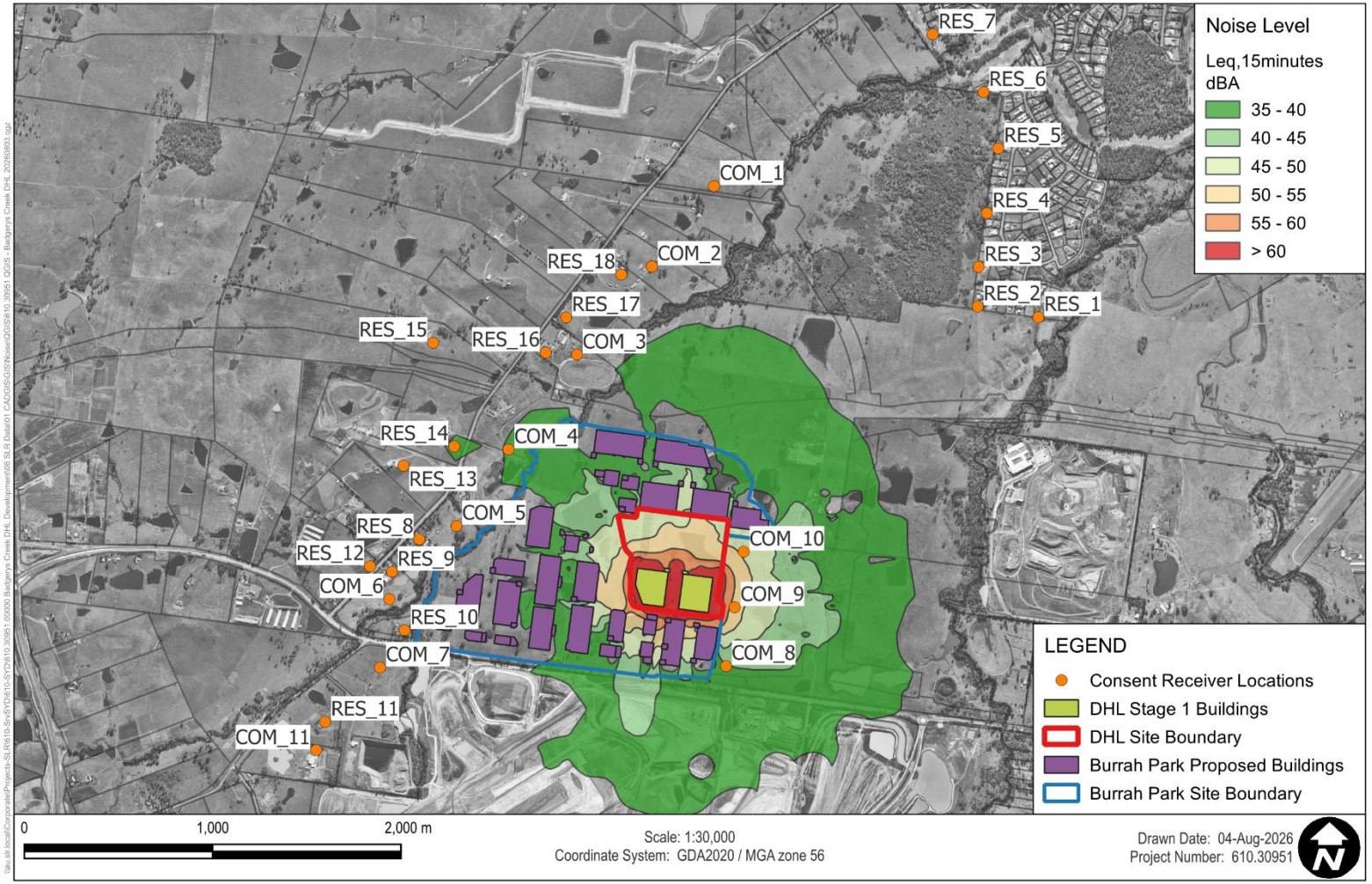
Noise Impact Assessment

DHL Supply Chain (Australia) Pty Ltd

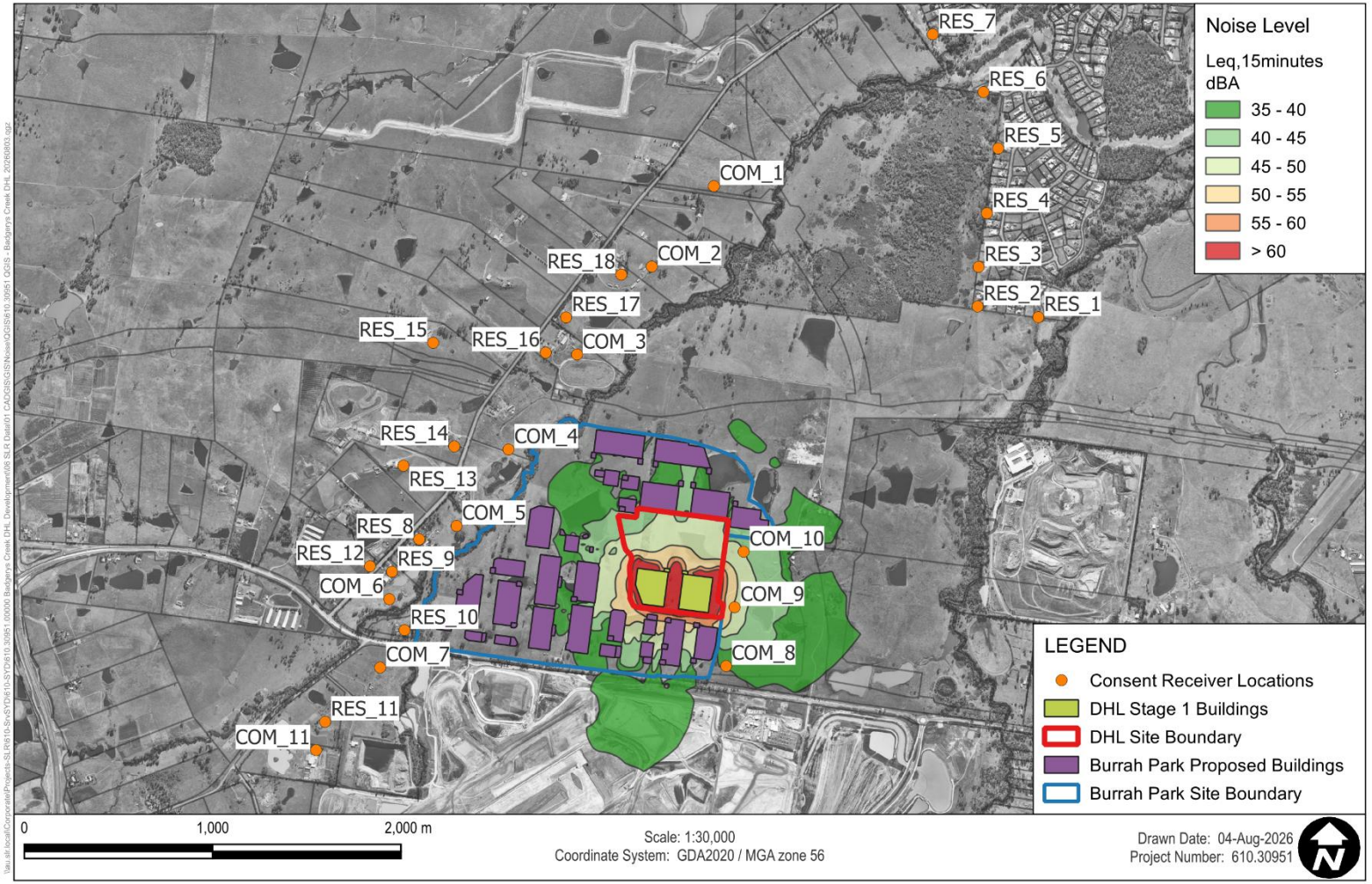
SLR Project No.: 610.30951.00000

5 August 2026

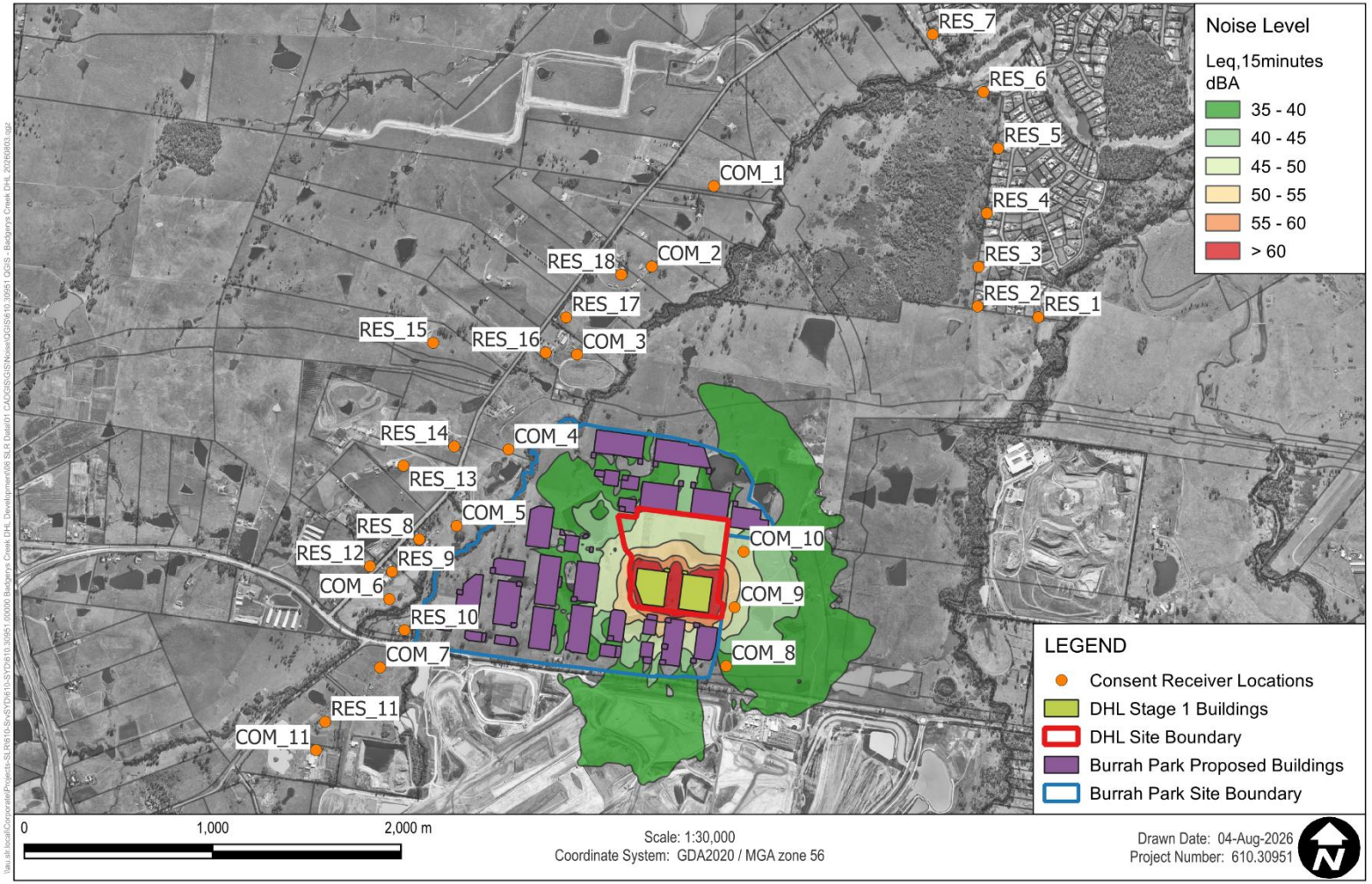
C.1 Day Operational Noise Contour Map (Stage 1)



C.2 Evening Operational Noise Contour Map (Stage 1)



C.3 Night Operational Noise Contour Map (Stage 1)



Appendix D CNVG Mitigation Measures

Badgerys Creek DHL Development Stage 1

Noise Impact Assessment

DHL Supply Chain (Australia) Pty Ltd

SLR Project No.: 610.30951.00000

5 August 2026

CNVG Standard Mitigation and Management Measures

Action Required	Applies To	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures.	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop-in session (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioral practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under **Appendix C** of the CNVG a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.

Action Required	Applies To	Details
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage
Source controls		
Construction hours and scheduling	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration Airborne noise	See **Appendix C** of the CNVG for more details on the following respite measures: • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturer's specifications or Appendix H of the CNVG.
Rental plant and equipment.	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne-noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Airborne noise Ground-borne vibration	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noise activities should be scheduled for normal working hours. If the work can not be undertaken during the day, it should be completed before 11:00pm. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.

Action Required	Applies To	Details
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power.
Non-tonal and ambient sensitive reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. **Appendix D** of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor control		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See **Appendix C** of the CNVG for additional measures	Airborne noise Ground-borne vibration	In some instances, additional mitigation measures may be required.

Appendix E NPfl Mitigation Measures

Badgerys Creek DHL Development Stage 1

Noise Impact Assessment

DHL Supply Chain (Australia) Pty Ltd

SLR Project No.: 610.30951.00000

5 August 2026

Best Management Practice (BMP)

Best management practice (BMP) is the application of particular operational procedures that minimise noise while retaining productive efficiency.

Where applied, these measures and practices are often documented in a noise management plan so that operational practices and undertakings are clearly understood and applied at all levels of an industrial operation. Application of BMP can include the following types of practice:

- Using the quietest plant that can do the job
- Scheduling the use of noisy equipment at the least-sensitive time of day
- Not operating, or reducing operations at night
- Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise
- Where there are several noisy pieces of equipment, scheduling operations so they are used separately rather than concurrently
- Keeping equipment well-maintained and operating it in a proper and efficient manner
- Using ‘quiet’ practices when operating equipment, for example, positioning idling trucks in appropriate areas
- Running staff-education programs and regular tool box talks on the effects of noise and the use of quiet work practices.

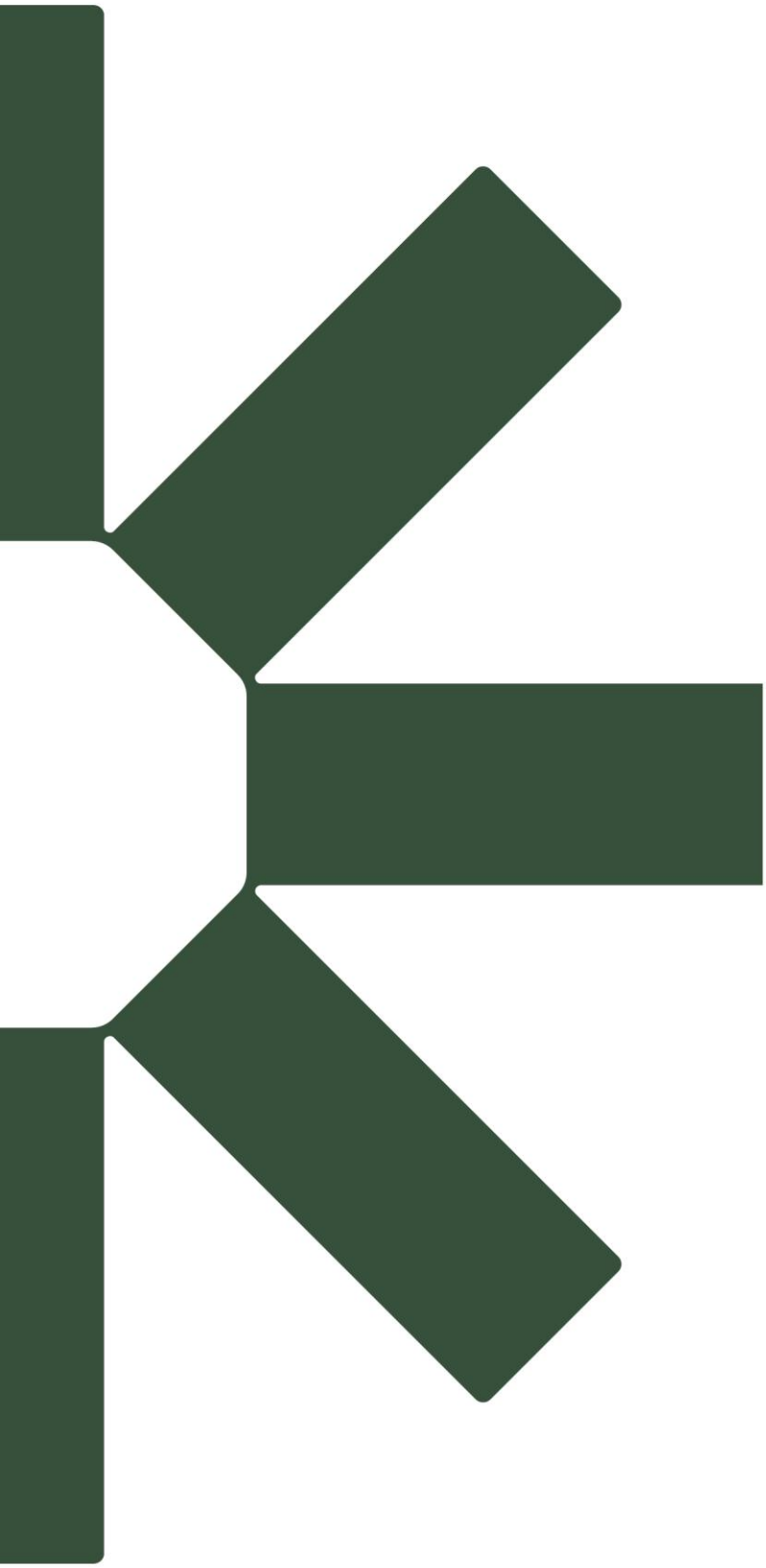
Best Available Technology Economically Achievable (BATEA)

With ‘Best available technology economically achievable’ (BATEA), equipment, plant and machinery that produce noise incorporate the most advanced and affordable technology to minimise noise output. Affordability is not necessarily determined by the price of the technology alone. Increased productivity may also result from using more advanced equipment, offsetting the initial outlay, for example, using ‘quieter’ equipment that can be operated over extended hours. Old or badly-designed equipment can often be a major source of noise.

Where BMP fails to achieve the required noise reduction by itself, the BATEA approach should then be considered. Examples of uses of BATEA include:

- Considering alternatives to tonal reversing alarms (where work health and safety is appropriately considered)
- Using equipment with efficient muffler design
- Using quieter engines, such as electric instead of internal combustion
- Fitting and maintaining noise reduction packages on plant and equipment
- Using efficient enclosures for noise sources
- Damping or lining metal trays or bins
- Active noise control.

For many industries there are a wide range of factors that can restrict the feasibility and reasonableness of applying BMP or BATEA measures on a particular site. Work health and safety considerations must also be taken into account as well as any other regulatory and process requirements.



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