HORSLEY DRIVE BUSINESS PARK STAGE 2

SSD 7664 MOD
Noise Assessment

Prepared for:

PROJECT STRATEGY NSW PTY LIMITED p.p CHARTER HALL
PO Box 271, Sutherland NSW 1499

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with PROJECT STRATEGY NSW PTY LIMITED p.p CHARTER HALL (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.

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DOCUMENT CONTROL

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1 Introduction

SLR Consulting has been engaged by Project Strategy NSW Pty Limited on behalf of Charter Hall to prepare this noise assessment to support the modifications proposed to the Horsley Drive Business Park (HDBP) Stage 2 (SSD 7664). HPBD is a business park with a range of uses, including general industrial, light industrial, warehouse and distribution and ancillary office uses.

1.1 Background

Horsley Drive Business Park is a cluster of regional business hubs located in Western Sydney Parkland (WSP) situated around 1.5 km to the east of the M7 Motorway and immediately west of Wetherill Park Industrial Precinct. HDBP Stage 2 (the site) is situated to the north of the recently constructed HDBP Stage 1, with frontages along Cowpasture Road to the east and Trivet Street to the north-east.

Operation and construction noise and vibration impacts from the project were previously assessed as part of the *Horsley Park Business Park – Stage 2, DA Acoustic Assessment* prepared by Acoustic Logic in 2016 (the approved noise assessment).

The Concept Proposal for HDBP Stage 2 obtained Development Consent (SSD 7664), on 9 November 2017 from the Department of Planning and Environment.

The site is located within Lots 17-22 DP 13961 and Lot 2 DP 1212087 within the HDBP. The site is within the Fairfield local government area.

1.2 Proposed modifications

The proposed modifications includes:

- Consolidation of two southern lots (Former Lot 1 & 2) into one single lot (Lot 1).
- Provision of a Customer Fulfilment Centre (CFC) on the consolidated southern lot (Lot 1).
- Renaming of Lot 3 & Lot 4 into Lot 2 & 3.
- Modifications to the proposed layout of Warehouse 1 (on lot 2) and Warehouse 2 (on lot 3) including Gross Floor Area (GFA), carparks and internal traffic routes.

1.3 Purpose of this Report

SLR Consulting has been engaged by Project Strategy NSW Pty Limited on behalf of Charter Hall an Operational and Construction Noise Impact Assessment for the Modification Proposal (MOD).

The aims of this assessment are to:

- compare the operational and construction noise impacts of the proposed modifications to the original design, which was previously assessed in the approved noise assessment.
- identify feasible and reasonable noise mitigation and management measures to be incorporated in the detailed design and construction planning stage of the Proposal as accordance to relevant legislation.

This assessment forms part of the input to the MOD Application.

1.4 Terminology

Specific acoustic terminology is used in this report. An explanation of common acoustic terms is provided in **Appendix A**.

2 Assessment Requirements

2.1 Secretary's Environmental Assessment Requirements – SSD 7664

The NSW Department of Planning Industry and Environment (DPE) have issued a list of Secretary's Environmental Assessment Requirements (SEARs) which inform the assessment. The SEARs which are specific to the noise impact assessment for the original proposal are shown in **Table 1**. This assessment will adopt the requirements this SEARS to be consistent with the previously approved assessment.

Table 1 Secretary's Environmental Assessment Requirements, SSD 7664, June 2016

4. Noise and Vibration
Requirement:
- a description of all potential noise and vibration sources during the construction and operational phases of the development, including on and off-site traffic noise; and
- a noise impact assessment, including a cumulative noise impact assessment in accordance with relevant Environment Protection Authority guidelines; and
- details of noise mitigation, management and monitoring measures.

2.2 HDBP Stage 2 Development Consent - SDD 7664

Conditions for the consent of State Significant Development (SDD) application 7664 are shown below.

B12. For all future development at the site, noise generated during operations must not exceed the noise limits outlined in Table 3 when measured at the property located at 28 Trivet Street, Wetherill Park.

Table 3: Noise Limits dB(A)

Location	Day $L_{Aeq(15\ minute)}$	Evening $L_{Aeq(15\ minute)}$	Night $L_{Aeq(15\ minute)}$	Night $L_{A1(1\ minute)}$
28 Trivet Street, Wetherill Park	52	49	47	57

***Note**: Noise is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy.*

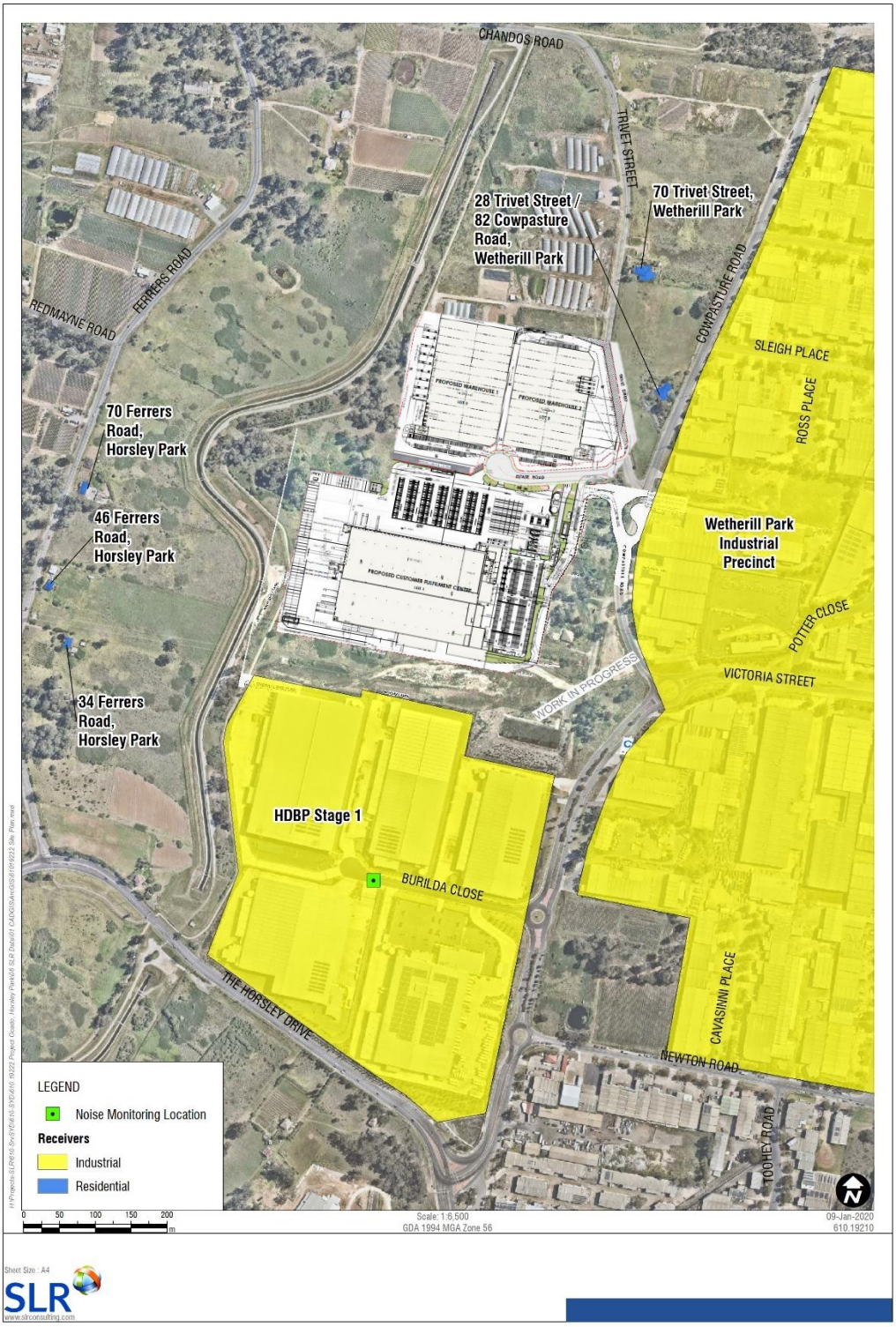
B13. If the construction of an acoustic barrier is required to achieve the noise limits in Condition B12 above, the barrier must be maintained as required and comprise a density of at least 10-15 kg/m².

The assessment property (residential receiver at 28 Trivet Street) is located to the east of the site and identified in **Section 3.1**.

3 Development Description

3.1 Site Location

Figure 1 Site location showing previous noise monitoring site and receivers (Siteplan plotted 24/02/2020)



3.2 Site Activities and Hours of Operation

The site is proposed to operate on a 24 hour basis. The operational hours of specific activities proposed with potential to contribute to overall site noise emissions are outlined in **Table 2**.

Table 2 Activities Proposed during Operation

Item	Operating Time	Location
Warehouse 1 & 2		
Warehouse Operations	24 hours[1]	TBA[2]
Delivery	24 hours[1]	On internal routes
Other operations	24 hours[1]	TBA[2]
Customer Fulfillment Centre		
Warehouse Operations	4.00am – 12.00am[3]	Contained within the building
Compactors	4.00am – 12.00am	To the west of the main building
Van Wash Bays	5.00am- 5.00pm	To the north of the main building
Mechanical Plant	24 hours	On the main building rooftop and on the plantroom deck
Delivery	24 hours	On internal routes

Note 1: Operation hours of warehouse 1 and 2 is assumed to be 24 hours for the worst-case scenario

Note 2: Assumed to operate over the footprint of the corresponding Lot.

Note 3: 12.00am to 4.00am is a maintenance period

3.3 Onsite Vehicle Movements

Estimated onsite vehicle movements were provided by the Ason Group in their report *Transport Assessment - Horsley Drive Business Park Stage 2, Horsley Park* dated 27/02/2020. The traffic volume included in this assessment are shown in **Table 3**.

Table 3 Onsite vehicle movements

Land Use	AM Peak	PM Peak	Daily
Warehouse (Lot 2 & 3)	49	50	663
CFC Staff	49	49	1,182
CFC Deliveries	78	118	1,380
Total	176	217	3,225

Heavy vehicles of warehouses (Lot 2 & 3) make up approximately 20% of total vehicle movements. The types of vehicles for CFC delivery are shown in **Table 4**.

Table 4 Vehicle type for CFC delivery

Period	Inbound Vans	Outbound Vans	Inbound Heavy Vehicles	Outbound Heavy Vehicles	Total
AM Peak	36	36	3	3	78
PM Peak	57	57	2	2	118
Site Peak (Prior to 2:00pm Shift Change)	57	57	4	4	122
Daily	589	589	101	101	1,380

3.4 Identification of Sensitive Receivers

The nearest potentially noise and vibration sensitive receivers to the project were identified in the DA Acoustic Assessment for the HDBP. The location and type of the nearest receivers are shown in **Figure 1** and **Table 5**.

Table 5 Surrounding Sensitive Receivers

Address	Type	Distance (m) from Site Boundary
28 Trivet Street, Wetherill Park (82 Cowpasture Road, Wetherill Park)	Residential	180 m northeast of HDBP Stage 2
34 Ferrers Road, Horsley Park	Residential	250 m west of HDBP Stage 2
46 Ferrers Road, Horsley Park	Residential	300 m west of HDBP Stage 2
70 Ferrers Road, Horsley Park	Residential	230 m west of HDBP Stage 2
HDBP Stage 1	Industrial / Commercial	60 m south of HDBP Stage 2
Wetherill Park Industrial Precinct	Industrial / Commercial	90 m east of HDBP Stage 2

4 Operational Noise Impact Assessment

4.1 Operational Noise Assessment Criteria

4.1.1 SDD7664 Conditions of Consent

The consent conditions for the HDBP Stage 2 (as stated in SSD7764 – refer to **Section 2.1**), are shown in **Table 6**.

Table 6 Controlling Noise Assessment Criteria

Location	Day	Evening	Night	Night
	LAeq(15minute)	LAeq(15minute)	LAeq(15minute)	LA1(1minute)
28 Trivet Street, Wetherill Park	52	49	47	57

4.1.2 Noise from Facility Operations

The SDD 7664 SEARS specified that the assessment should be in accordance with 'relevant Environment Protection Authority guidelines'. The original assessment referenced the now superseded EPA guideline, the *NSW Industrial Noise Policy* (INP).

The *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the NSW *Environment Protection Authority's* (EPA's) requirements for the assessment and management of noise from industry in NSW.

The NPfI describes 'trigger levels' which indicate the noise level at which feasible and reasonable noise management measures should be considered. Two forms of noise criteria are provided – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses.

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

4.1.2.1 Area Classification

The amenity assessment is based on amenity noise levels specific to the land use and associated activities. The project noise levels relate only to industrial-type noise and do not include road, rail or community-related noise. Based on the NPfI land use descriptions residences surrounding the development have been classified for the purposes of this noise assessment as 'urban'.

For this assessment, the area surrounding the proposal is considered to be 'urban'. The NPfI specifies an 'urban' area as one which:

- is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources

- has through-traffic with characteristically heavy and continuous flows during peak periods
- is near commercial districts or industrial districts
- has any combination of the above.

4.1.2.2 Cumulative Noise Impacts

It has been requested by SEARs SSD 7664 that the assessment also consider the cumulative noise impacts from the operation of the approved developments at the Horsley Drive Business Park Stage 2. Existing industrial noise from nearby industrial activities is accounted for in the determination of the amenity criterion as outlined above. This allows the amenity criterion derived for the Horsley Drive Business Park Stage 2 to take into account the cumulative noise impacts.

Table 2.2 of the NPfI outlines modifications to the Acceptable Noise Level (ANL) to account for existing levels of industrial noise. The caculated acceptable noise levels have been summarised in **Table 7** below.

Table 7 Acceptable noise level (ANL) to account for existing level of industrial noise

Receiver	Period	Amenity Noise Levels	Project Amenity Noise Levels for The Proposed Development
		$L_{Aeq, period}$	$L_{Aeq, 15\ minute}$
Residential	Day	60	58[2,3]
	Night	50	48[2,3]
	Evening	45	43[2,3]
Commercial	When in use	65	63[2,3]
Industrial	When in use	70	68[2,3]

Note 1: The recommended amenity noise levels have been reduced by 5 dB to give the project amenity noise levels representing the objective for noise from a single industrial development at a receiver location, as outlined in the NPfI.

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

4.1.2.3 Sleep Disturbance

The NPfI provides guidance in relation to the assessment of sleep disturbance. Specifically, the NPfI states:

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

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

a detailed maximum noise level assessment should be undertaken.

Notwithstanding the uncertainty regarding definitive noise levels and sleep disturbance, this assessment considers sleep disturbance screening criteria, as well as the frequency of exposure to the intermittent noise.

4.1.2.4 Project Trigger Noise Goals

Background noise levels were measured at the centre of Horsley Park Business Park Stage 1, prior to its construction, as part of the DA Acoustic Assessment as shown in **Figure 1**. It is considered that measurements undertaken prior to the construction commencing in the area are reasonable to inform the assessment as ongoing works would likely influence current noise levels in the area.

PTNLs for all noise sensitive receiver areas surrounding the Proposal have been established with reference to the prior measurements and are contained in **Table 8**.

Table 8 Project Trigger Noise Levels

Type of receiver	Noise amenity area	Time of day	RBL[1]	Project Intrusive[2] LAeq(15minute) **dBA**	Project Amenity[3] LAeq(15minute) **dBA**	Resulting PTNL[4] LAeq(15minute) **dBA**
Residential	Urban	Day	51	56	58	**56**
		Evening	49	54	48	**48**
		Night	46	51	43	**43**
Commercial	All	When in use	n/a	n/a	63	**63**
Industrial	All	When in use	n/a	n/a	68	**68**

Note 1: Rating Background Level (RBL) as stated in *Horsley Park Business Park – Stage 2, DA Acoustic Assessment* prepared by Acoustic Logic in 2016

Note 2: Project Intrusive is the RBL plus 5 dB

Note 3: As discussed in **Section 4.1.2.2**

Note 4: Resulting PTNL is the lower of the project intrusive and the project amenity (15 minute) noise levels

The relevant sleep disturbance noise goals for the Project are provided in **Table 9**

Table 9 Sleep Disturbance Noise Goals

Receiver	Period	RBL	SDNL LAmax
Residential	Night	46	61

4.1.3 Road Traffic Noise on Public Roads

When traffic related to the proposed operation of the facility is on the public road network, vehicle movements are regarded as 'additional road traffic' (rather than as part of the site operations) and are assessed under the NSW *Road Noise Policy* (RNP).

Recognising that fewer opportunities generally exist to reduce the noise impacts from new land use developments generating additional traffic on existing roads, the RNP suggests that any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

In assessing feasible and reasonable mitigation measures, the RNP suggests that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

The RNP criteria applicable to the Proposal is reproduced below in **Table 10**.

Table 10 Road Noise Policy Criteria

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	3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15\ hour)}$ 60 (external)	$L_{Aeq(9\ hour)}$ 55 (external)
Local roads	9. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq(1\ hour)}$ 55 (external)	$L_{Aeq(1\ hour)}$ 50 (external)

4.2 Prediction Methodology

A computer model was used to predict noise emissions from the operation of the Project. The operational noise modelling was undertaken using the ISO9613 algorithms within SoundPLAN v8.1 software. A three-dimensional digital terrain map providing relevant topographic information was used in the modelling process, together with noise source data, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. The model includes an indicative barrier which is detailed in Section **4.6.2.**

To assess against the intrusive noise criteria for the daytime, evening and night-time periods, peak 15 minute vehicles movements for the daytime, evening and night-time periods have been modelled throughout the development. In addition, the total vehicle movements during the night-time period have been modelled to assess against the amenity criteria for the night-time period. This assessment assumes that the $L_{Aeq,15min}$ will be taken to be equal to the $L_{Aeq,\ period}$ + 3 decibels (dB).

Sound power levels and speed assumptions for the modelled vehicle movements are outlined in **Table 11**.

Table 11 Sound Power Levels for Onsite Vehicle Movements

Noise Source	Sound Power Level (SWL)	Average Speed
Heavy Vehicles	103 dBA[1]	25 km/h
Light Vehicles	96 dBA	40 km/h
Gas-powered Forklifts[2]	93 dBA	n/a

Note 1: Based on SLR's noise measurement database, this sound power level is typical of trucks travelling at low speeds, such as within industrial estates.

Note 2: If electric forklifts are proposed for the development, noise emissions from forklifts would be considerably lower than gas-powered forklifts.

This assessment incorporates the latest design of the Customer Fulfillment Centre as it is proposed to be built on Lot 1 of HDBP Stage 2. Acoustic data for the fixed plant of the Customer Fulfillment Centre are outlined in **Table 12.**

Table 12 Sound Power Levels for Onsite Noise Sources of the Customer Fulfillment Centre

Noise Source	Sound Power Level (SWL) dBA	Quantity	Source
Data Room roof AC unit	91	4 per room (2 rooms total)	CRAC outdoor units, as specified in Paramount Airconditioning email
Compactor	70[1]	4	S1500 BLADE compactor datasheet
Office HVAC unit	84	3	PURY-P800, as specified in Paramount Airconditioning email
Refrigeration Condenser	95	3	As specified in Oomiak email
Warehouse roof HVAC	89	8	As specified in Paramount Airconditioning email
Wash Bay	85	4	Kärcher Model: TB50 See Note 2

Note 1: Assuming compactors are running concurrently for 1 minute in a 15-minutes period

Note 2: Based on attended measurements conducted by SLR on 05/02/2020 of a similar Karcher wash bay with the same configuration of the proposed wash bays of this project. The proposed wash bays are not equipped with high-pressure manual cleaning option and are not operating concurrently with the undertray spray option. The noise model assumed the washers orientated east-west entry/exit (ie the residence at 28 Trivet Street only looks at the sidewalls of the washers)

In term of the proposed warehouses in Lot 2 & 3, fixed noise sources such as mechanical plant have been modelled throughout the development. As details of specific items of plant and exact locations are not yet known, a conservative approach to modelling has been conducted.

The adopted approach assumes fixed noise sources with a cumulative sound power level of 90 dBA per warehouse have been modelled at rooftop locations around the development to indicate potential noise impacts on the surrounding sensitive receivers. Fixed plant has been assumed to operate continuously, 24 hours a day.

When specific plant is selected during the detailed design phase of the project, compliance against the criteria should be checked using the actual sound power level data for the equipment to be installed and the final locations of the various items of plant.

In addition to the above noise sources, heavy vehicle brake releases and reverse alarms (non-tonal) may occur within the hardstand areas of the development and along the heavy vehicle route. A maximum sound power level (SWL) of 115 dBA has been used to screen for potential sleep disturbance from L_{Amax} noise events on site.

4.3 Predicted Operational Noise Impacts

The predicted $L_{Aeq(15minute)}$ noise levels at the nearest residential receiver locations are presented in **Table 13**, **Table 14** and **Table 15** for the daytime, evening and night-time periods respectively.

All predicted noise levels include the baseline mitigation which consists of:

- Noise barrier assumed to the east of the proposal at 2 m height as shown in **Figure 2**.
- Proposed site elevation was provided in drawing *CO11492.17-DA20-C* plotted on 28/02/2020.

Table 13 Predicted Operating Noise Levels – Daytime with Baseline Mitigation

Receiver	Type	Previous Assessment Predicted Noise Level[1]		This Assessment Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)	Previous Assessment Project Trigger Noise Levels[1]		This Assessment Project Trigger Noise Goals $L_{Aeq(15minute)}$ (dBA)	SSD7664 Criteria $L_{Aeq(15minute)}$
		Intrusiveness $L_{Aeq,15min}$	Amenity $L_{Aeq,period}$		Intrusiveness $L_{Aeq,15min}$	Amenity $L_{Aeq,period}$		
28 Trivet Street, Wetherill Park	Residential	52	51	45	56	60	56	52
34 Ferrers Road, Horsley Park	Residential	<42	<42	<42	56	60	56	-
46 Ferrers Road, Horsley Park	Residential	<42	<42	<42	56	60	56	-
70 Ferrers Road, Horsley Park	Residential	<42	<42	<42	56	60	56	-
HDBP Stage 1	Industrial / Commercial	Not reported	Not reported	46	Not reported	Not reported	68/63	-
Wetherill Park Industrial Precinct	Industrial / Commercial	Not reported	Not reported	48	Not reported	Not reported	68/63	-

Note 1: Predicted noise levels and project trigger noise levels of the original masterplan are extracted from *Horsley Park Business Park – Stage 2, DA Acoustic Assessment* in 2016.

Table 14 Predicted Operating Noise Levels – Evening with Baseline Mitigation

Receiver	Type	Previous Assessment Predicted Noise Level[1]		This Assessment Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)	Previous Assessment Project Trigger Noise Levels[1]		This Assessment Project Trigger Noise Goals $L_{Aeq(15minute)}$ (dBA)	SSD7664 Criteria $L_{Aeq(15minute)}$
		Intrusiveness $L_{Aeq,15min}$	Amenity $L_{Aeq,period}$		Intrusiveness $L_{Aeq,15min}$	Amenity $L_{Aeq,period}$		
28 Trivet Street, Wetherill Park	Residential	48	<48	45	54	50	48	49
34 Ferrers Road, Horsley Park	Residential	<42	<42	<42	54	50	48	-
46 Ferrers Road, Horsley Park	Residential	<42	<42	<42	54	50	48	-
70 Ferrers Road, Horsley Park	Residential	<42	<42	<42	54	50	48	-
HDBP Stage 1	Industrial / Commercial	Not reported	Not reported	47	Not reported	Not reported	68/63	-
Wetherill Park Industrial Precinct	Industrial / Commercial	Not reported	Not reported	48	Not reported	Not reported	68/63	-

Note 1: Predicted noise levels and project trigger noise levels of the original masterplan are extracted from *Horsley Park Business Park – Stage 2, DA Acoustic Assessment* in 2016.

Table 15 Predicted Operating Noise Levels – Night-time with Baseline Mitigation

Receiver	Type	Previous Assessment Predicted Noise Level[1]		This Assessment Predicted Noise Level $LA_{eq(15minute)}$ (dBA)	Previous Assessment Project Trigger Noise Levels[1]		This Assessment Project Trigger Noise Goals $LA_{eq(15minute)}$ (dBA)	SSD7664 Criteria $LA_{eq(15minute)}$
		LAeq,15min	LAeq,period		Intrusiveness LAeq,15min	Amenity LAeq,period		
28 Trivet Street, Wetherill Park	Residential	48	45	**44**	51	45	43	47
34 Ferrers Road, Horsley Park	Residential	<42	<42	<42	51	45	43	-
46 Ferrers Road, Horsley Park	Residential	<42	<42	<42	51	45	43	-
70 Ferrers Road, Horsley Park	Residential	<42	<42	<42	51	45	43	-
HDBP Stage 1	Industrial / Commercial	Not reported	Not reported	47	Not reported	Not reported	68/63	-
Wetherill Park Industrial Precinct	Industrial / Commercial	Not reported	Not reported	46	Not reported	Not reported	68/63	-

Note 1: Predicted noise levels and project trigger noise levels of the original masterplan are extracted from *Horsley Park Business Park – Stage 2, DA Acoustic Assessment* in 2016.

Since the masterplan has been changed by consolidating former Lot 1 & 2 into the Customer Fulfillment Centre and realignments of fomer Lot 3 & 4 (now is 2 & 3), noise levels from the new masterplan are predicted to be lower than previously predicted in the acoustic assessment of the original masterplan.

The above results indicate that with the inclusion of the indicative noise barrier detailed in **Section 4.6.2**, noise emissions from the operation of the HDBP Stage 2 are predicted to be below the noise criteria SSD7664 consent condition at all periods and below the PTNL during day and evening periods.

During night-time period, a negligible residual noise impact of up to 1 dB is predicted at the residences at 28 Trivet Street. This is primarily due to the recessed loading docks, which are proposed to be in operation in the eastern site of the Proposed Warehouse 2 adjacent to the receiver.

Consideration of feasible and reasonable noise mitigation measures (including a noise barrier) is discussed in **Section 4.6**.

4.4 Sleep Disturbance

The predicted $L_{A1(1minute)}$ noise levels at the nearest residential receiver locations are presented in **Table 16** for the daytime, evening and night-time periods respectively.

Table 16 Predicted Operating Noise Levels – Sleep Disturbance

Receiver	Type	Previous Asessment Predicted Noise Level[1] L_{Amax} (dBA)	This Asessment Predicted Noise Level L_{Amax} (dBA)	SSD7664 Criteria $L_{A1(1minute)}$ (dBA)	Criteria PTNL L_{Amax} (dBA)
28 Trivet Street, Wetherill Park (82 Cowpasture Road, Wetherill Park)	Residential	<59	63	57	61
34 Ferrers Road, Horsley Park	Residential	Not reported	57	-	61
46 Ferrers Road, Horsley Park	Residential	Not reported	56	-	61
70 Ferrers Road, Horsley Park	Residential	Not reported	58	-	61
HDBP Stage 1	Industrial / Commercial	N/A	N/A	N/A	N/A
Wetherill Park Industrial Precinct	Industrial / Commercial	N/A	N/A	N/A	N/A

Note 1: Predicted noise levels of the original masterplan are extracted from *Horsley Park Business Park – Stage 2, DA Acoustic Assessment* in 2016.

The results of the sleep disturbance assessment indicate a potential exceedance of the screening criteria which indicates a requirement for a detailed assessment.

It is considered unlikely that the maximum noise events would be at this worst-case location often as the predicted $L_{A1(1minute)}$ noise levels are conservatively based on the 115 dBA L_{Amax} of a heavy vehicle brake release at the closest possible location between site boundary and the receiver (90m). The noise model has factored in the proposed typical truck route which most part will be shielded by the indicative noise barrier and effectively antennuate the L_{Amax} levels from the trucks. The predicted L_{Amax} levels at 28 Trivet Street is slightly higher (up to 4 dBA) than previously predicted due to the changes of the truck route from original masterplan design and assumed SWL.

Where those trigger levels are not met, it is appropriate to consider any effect of the noise with regard to:

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

A review of research on sleep disturbance in the NSW *Road Noise Policy* indicates that in some circumstances, higher noise levels may occur without significant sleep disturbance. Based on studies into sleep disturbance, the RNP concludes that:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions; and that
- One or two noise events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly.

Internal noise levels in a dwelling, with the windows open, are commonly 10 dB lower than external noise levels. Therefore, the first conclusion above suggests that short-term external noises of 60 dBA to 65 dBA are unlikely to cause awakening reactions. The second conclusion suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly.

As the worst-case maximum noise level (ie truck brake located at the closest extent of the site boundary towards the receiver) is predicted in the region of 63 dBA external to the receiver, the internal noise level of the predicted worst-case is below the level where maximum noise level events are considered likely to cause awakening reactions.

4.5 Traffic on Public Roads

The main access route to the development site is proposed via Cowpasture Road and Trivet Street. A comparison of existing traffic and future traffic generated by the proposed development is outlined in **Table 17.**

Table 17 Forecast Traffic Volumes on Public Roads

Road	Existing Traffic[1]				Site Generated Traffic[2,3]			
	Daytime (7 am - 10 pm)		Night-time (10 pm - 7 am)		Daytime (7 am - 10 pm)		Night-time (10 pm - 7 am)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Trivet Street / Cowpasture Road (north of HDBP Stage 2)	4544	140	1515	47	299	32	96	23
Cowpasture Road (south of HDBP Stage 2)	6134	526	2045	175	1688	184	544	133

Note 1: Based on Austraffic survey dated 05/12/2019 for the daytime period. Night-time period traffic was assumed to be 25% of the daily total.

Note 2: The internal traffic assignment is assumed to be 85%/15% distribution between Cowpasture Road and Trivet Street as per Ason report Horsley Drive Business Park Stage 2, dated 02/12/2016 (reference: 0300r01v2)

Note 3: Site generated traffic volumes were supplied by the project team . The site traffic includes the Customer Fulfillment Centre and potential warehouses on Lot 2 & 3.

While light and heavy vehicle movements within the proposed development are classified as part of the operational site noise, once they move off the site and onto public roads they are assessed under the *NSW Road Noise Policy (RNP).*

The RNP requires noise mitigation to be considered where new land use developments increase road traffic noise by more than 2.0 dB. The traffic data in **Table 17** was used to calculate the traffic noise impacts using the procedure detailed in the *Calculation of Road Traffic Noise* (CoRTN) which was issued by the Department of Transport in 1988. Noise levels of the original masterplan at 70 Trivet Street were previously predicted to be less than 58dBA $L_{Aeq,15hour}$ and 55dBA $L_{Aeq,9hour}$ from *Horsley Park Business Park Stage 2 - DA Acoustic Assessment* in 2016.

A summary of the potential noise impacts of road traffic on public roads for the modified masterplan is outlined in **Table 18**.

Table 18 Predicted Traffic Noise Levels on Public Road

Road	Speed (km/h)	Existing L_{Aeq} (dBA)		Combined L_{Aeq} (dBA)		Increase L_{Aeq} (dBA)	
		Day 15hr	Night 9hr	Day 15hr	Night 9hr	Day 15hr	Night 9hr
Trivet Street / Cowpasture Road (north of HDBP Stage 2)	60	64	61	64	62	0.4	0.7
Cowpasture Road (south of HDBP Stage 2)	60	66	64	67	65	1.2	1.7

Note 1: Noise levels are predicted at a nominal distance to understand the relative increase of the total noise contributed by the existing and site-generated traffic.

The predicted increase in road traffic noise due to the proposed facility is predicted to be not greater than 2.0 dB. A requirement to consider further mitigation is therefore not indicated by the assessment.

4.6 Recommended Mitigation

4.6.1 General

It is recommended that the following noise mitigation measures be put in place with a view to minimise noise levels from the Project:

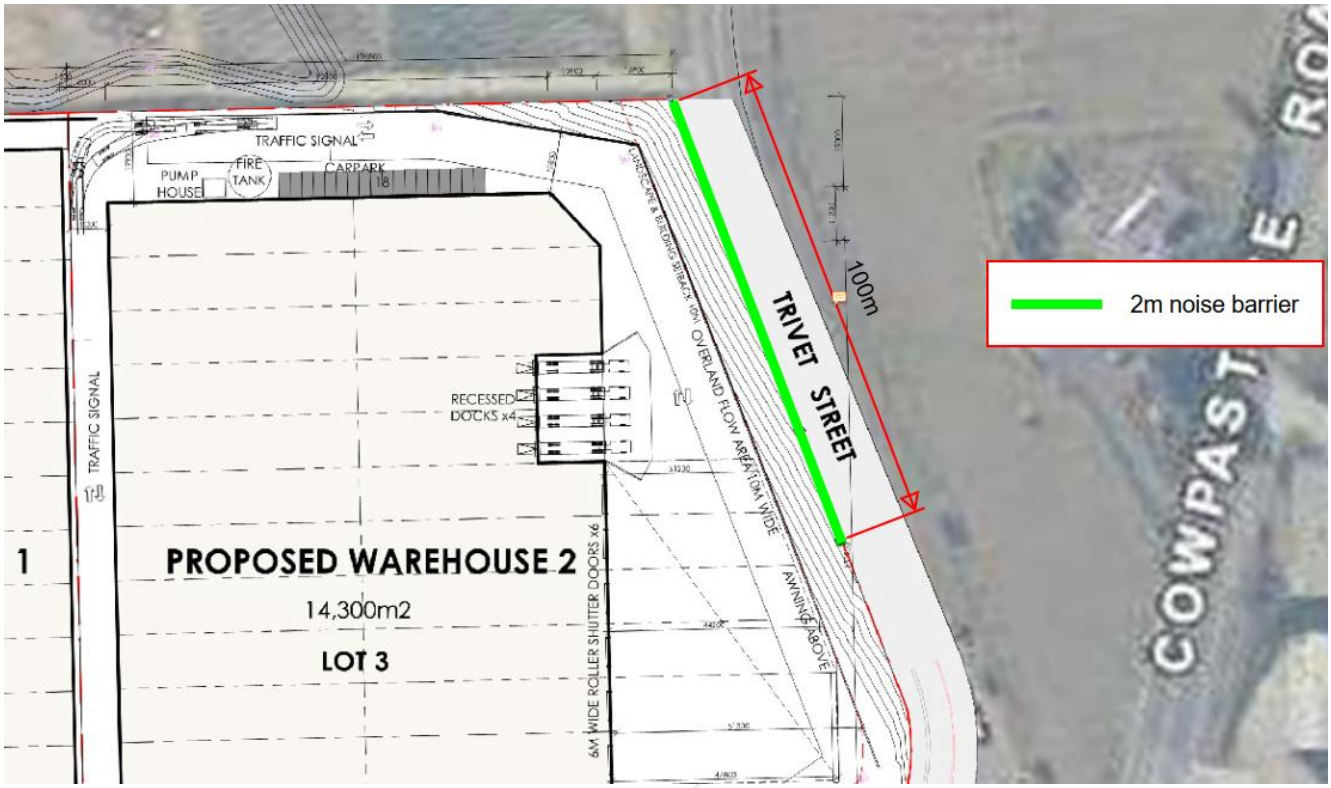
- Briefing the work team and contractors to create awareness of the proximity of noise-sensitive residential receivers and the importance of minimising noise emissions.
- Using 'quiet' work practices to minimise noise, where possible.
- Use of less noise-intensive equipment, where feasible and reasonable.
- Adjusting reversing alarm volume on heavy equipment to make them 'smarter', by limiting the acoustic range to immediate danger area, where acceptable under the relevant safety procedures.
- Enclosure of outdoor fixed plant (such as mechanical plant) where practicable
- For equipment with enclosures, ensure door and seals are well maintained and kept closed when not in use.

Noise management and mitigation measures would be confirmed in an Operational Noise Management Plan (ONMP) – refer to **Section 4.8**.

4.6.2 Indicative Noise Barrier

Feasible and reasonable noise mitigation measures have been investigated to reduce the minor predicted noise impact on the most-affected receiver. Indicative noise barrier with height of 2m, located near the most affected receiver at 28 Trivet Street, Wetherill Park (refer to **Figure 3** for indicative height and location) has been included to reduce impacts as far as reasonably practicable and is subject to review at a later design stage with consideration of aspects such as visual impact, community preference, ect. The recommendation that *"the barrier must be maintained as required and comprise a density of at least 10-15 kg/m2"* according to SSD 7664 consent condition B13 requirements is also considered to apply to this assessment.

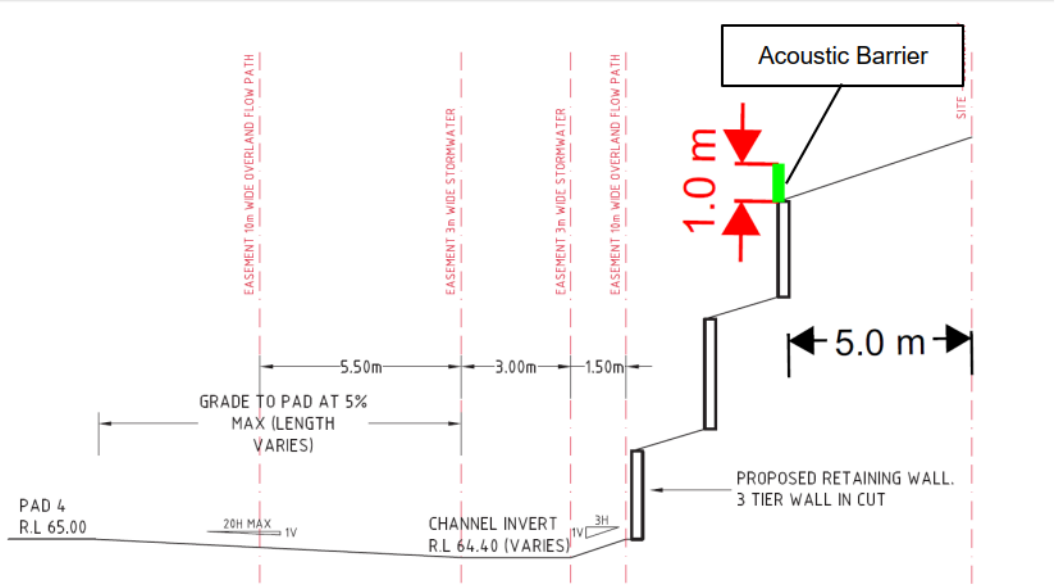
Figure 2 Indicative noise barrier location



This is consistent with the recommendation from the Department of Planning in their report for SSD 7664 (NSW Government Department of Planning and Environment's *HDBP Stage 2 SSD 7664 - Environmental Assessment Report* in November 2017).

> *"The Department recommends the installation of the acoustic barrier as a mitigating noise measure to enable the Applicant to achieve noise limits. The acoustic barrier is considered acceptable due to the following:*
>
> - *it will be wholly contained within the site and will be maintained by the developer/tenant;*
> - *it will not be visible from Trivet Street due to the low height of the barrier and slope of the land; and*
> - *it will provide an additional level of safety to the retaining walls on Lot 4. "*

Figure 3 Deparment of Planning recommendation (extracted from *SSD 7664 - Environmental Assessment Report)*



Noise modelling of the revised layout indicates that the noise barrier of 2m height in the same location (adjacient to the site boundary) is required to effectively block the line of sight from 28 Trivet Street to the truck route and the recessed docks of Proposed Warehouse 2.

It is noted that the warehouse designs on potential Lot 2 & 3 of this modification proposal are not finalised at this stage. The noise impacts should therefore be reassessed in the detailed design stage to confirm the finalised extent of mitigation measures required including this indicative noise barrier.

During compliance assessment, the NPfI considers the significance of any residual noise impacts less than 2 dB(A) to be “Negligible”. Notwithstanding, consideration should be given at the detailed design stage to minimise noise impacts as far as reasonably practicable while balancing other contraints on the mitigation options.

4.7 Recommended requirements for the ONMP

The Operational Noise Management Plan (ONMP) would consider the finalised operations and confirm the appropriateness of the mitigation and management measures recommended in this assessment.

The ONMP would outline the management and control measures to manage noise impacts from the Proposal through a combination of following:

- Requiring best management practices to be implemented onsite by all staff and contractors.
- Implementing noise controls to reduce noise from the source and attenuate noise transmission.

The ONMP would include the following key components:

- Relevant Development Consent Conditions
- Details of the nearest noise sensitive receivers

- A list of major noise generating activities
- Details of the noise management measures, including noise monitoring requirements where necessary
- Details of how a complaints register and contingency plan would be implemented
- Details of internal audits
- Details regarding how review and improvement of Noise Management Plan would occur.

Attended noise monitoring would be undertaken by a suitably trained and qualified acoustic consultant. All attended noise monitoring will be conducted in accordance with the NSW *Noise Policy for Industry*.

5 Construction Noise and Vibration Impact Assessment

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

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

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

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

5.1 Proposed Construction Activities

5.1.1 Proposed Works

This report provides an assessment of the potential noise and vibration impacts associated with the proposed activities required to construct the proposal.

To be consistent with the previous assessment of the original masterplan and facilitate the comparison assessment, the construction noise and vibration assessment has considered the same scenarios including earthwork excavation activities and construction activities of warehouse and office structures.

5.1.2 Construction Hours

Where possible, works would be completed during the standard daytime construction hours of Monday to Friday 7.00 am to 6.00 pm and Saturday 8.00 am to 1.00 pm.

Where Out-of-Hours Works (OOHWs) are required (for emergency works, oversized equipment delivery, etc) it is likely that they would require separate approval on a case by case basis.

5.2 Construction Noise Criteria

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

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

5.2.1 Residential Receivers

The ICNG provides an approach for determining $L_{Aeq(15minute)}$ NMLs at residential receivers surrounding the development site by applying the measured $L_{A90(15minute)}$ background noise levels, as described in **Table 19**.

Table 19 Determination of NMLs for Residential Receivers

Time of Day	NML LAeq(15minute)	How to Apply
Standard 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	RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise management level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

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

Adopting the measured background noise levels in the operational assessment, the NMLs derived for the project are detailed in **Table 20**.

Table 20 Construction NMLs for Residential Receivers - Daytime

Time of Day	$L_{Aeq(15minute)}$ Construction NMLs (dB)[1]		
	Standard Hours	Out-of-Hours	Highly Noise Affected
Daytime	61	56	75 (Standard hours)

5.2.2 Other Sensitive Receivers

Other sensitive land uses have not been identified near HDBP Stage 2 site.

5.2.3 Commercial and industrial premises

The ICNG provides NMLs for commercial and industrial premises. The NMLs applicable to this project are shown in **Table 21**.

Table 21 Constructions NMLs for Other Sensitive Receivers

Land Use	NML $L_{Aeq(15minute)}$ (Applicable when the property is in use)
Industrial premises	External 75 dB(A)
Offices, retail outlets	External 70 dB(A)

5.3 Construction Noise Modelling

Noise modelling of the development site was undertaken using SoundPLAN V8.1 modelling software.

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

Maximum sound power levels (SWLs) for the typical operation of construction equipment applied in the modelling are listed in **Table 22**.

Table 22 Sound Power Levels for Construction Equipment

Construction Activity	Equipment	Operating minutes in 15-min period	No of items in same location	Sound Power Level (dB)		
				Maximum L_{Aeq}		L_{Amax}
				Item	Activity	Activity
Excavation Activities	Excavators with Hammers[1]	7.5	1	115	118	117
	Excavators without hammers	7.5	1	105		
	Bobcat	15	1	105		
	Trucks	15	1	108		
	Scissor Lift	15	1	100		
	Excavators	15	1	105		
Construction Activities	Drilling	15	2	94	114	117
	Hammering[1]	7.5	1	110		
	Concrete Vibrator	15	1	100		
	Cement Mixing Truck	15	1	105		
	Concrete Pumps	15	1	107		

Note 1: In accordance with the ICNG, for activities identified as particularly annoying (such as jackhammering, rock breaking and power saw operations), a 5 dB 'penalty' is added to the source sound power level when predicting noise using the quantitative method.

5.4 Assessment Methodology

Consistent with the requirements of the ICNG, and to inform prioritisation of mitigation and management measures during the detailed design phase, this assessment provides a worst-case noise impact assessment for construction scenarios. The ICNG recommends that the realistic worst-case noise levels from the source should be predicted for assessment locations representing the most noise-exposed residences or other sensitive land uses. For each receiver area, the noise levels are predicted at the most noise-exposed location, which would usually be the closest receiver.

In reality, at any particular location, the potential construction noise impacts can vary greatly depending on factors such as the position of the construction works within the site and distance to the nearest sensitive receiver, the overall duration of the construction works, the intensity of the noise levels, the time at which the construction works are undertaken, and the character of the noise or vibration emissions. Furthermore, other receivers within each receiver area would generally experience lower noise levels compared to the most noise-exposed location as construction work is undertaken at greater separation distance from receivers.

5.5 Predicted Construction Noise Impacts

In the area surrounding the development site, the noise impacts have been quantitatively assessed for several construction activities. The activities considered are described in **Table 22**.

The typical maximum and typical minimum $L_{Aeq(15minute)}$ noise levels at the most-affected sensitive receiver in each of the areas surrounding the OWE are provided in **Table 23** for the construction activities and are representative of the 'noisiest' construction periods allowing for the simultaneous operation of noise intensive construction plant in close proximity.

Table 23 Predicted construction noise levels at nearest receivers

Works Scenario	Type[1]	Noise Level – LAeq(15minute) (dBA)				
		Previous Assessment Predicted Noise Level[1]	This Assessment Predicted Noise Level[2]	RBL - Daytime	NML – Standard Daytime	This Assessment Exceedance
Excavation Activities	28 Trivet Street	55 to 69	72	51	61	11
	34 Ferrers Road, Horsley Park	53 to 58	55	51	61	-
	46 Ferrers Road, Horsley Park	53 to 58	54	51	61	-
	70 Ferrers Road, Horsley Park	53 to 58	57	51	61	-
	HDBP Stage 1	Up to 71	72	51	70/75	2
	Wetherill Park Industrial Precinct	Up to 71	68	51	70/75	-
Construction Activities	28 Trivet Street	40 to 64	68	51	61	7
	34 Ferrers Road, Horsley Park	38 to 53	51	51	61	-
	46 Ferrers Road, Horsley Park	38 to 53	50	51	61	-
	70 Ferrers Road, Horsley Park	38 to 53	53	51	61	-
	HDBP Stage 1	Up to 68	67	51	70/75	-
	Wetherill Park Industrial Precinct	Up to 68	64	51	70/75	-

Note 1: Predicted noise levels and project trigger noise levels of the original masterplan are extracted from *Horsley Park Business Park – Stage 2, DA Acoustic Assessment* in 2016.

Note 2: Worst-case predicted noise levels are representative of the 'noisiest' construction periods allowing for the simultaneous operation of noise intensive construction plant in close proximity.

While the NML exceedances are relatively minor overall, the predicted noise levels in this assessment are slightly higher (up to 4 dB) than previously predicted for the original masterplan. This is likely to be caused by different modelling and/or input assumptions which typically vary for construction scenarios.

During standard construction hours, exceedances of the NMLs of up to 11 dBA is predicted at 28 Trivet Street during excavation and construction works in Lot 3. Exceedance of the NMLs is also predicted at the nearest commercial receivers at HDBP Stage 1 estate during excavation works in Lot 1.

During both during excavation and construction scenarios, no highly affected receivers are identified.

5.6 Construction Noise Mitigation

It is important to note that the above exceedances are based on a worst-case assessment of all equipment for each activity operating simultaneously at the closest point of the site to the most-affected receiver. These worst-case exceedances would not be expected to occur often, as the majority of works would be at a greater distance relative to the most-affected receivers, and the occurrence of all plant operating simultaneously would be low.

Where exceedances of the NMLs are predicted, construction noise mitigation should be considered to reduce the potential noise impacts on the surrounding sensitive receivers. The ICNG describes strategies for construction noise mitigation and control that are applicable to this proposal. The strategies are designed to minimise, to the fullest extent practicable, noise during construction. Furthermore, the SSD 7664 consent condition C5 requires a Construction Noise Management Plan as part of the CEMP for the development. The plan must:

(a) be prepared by a suitably qualified and experienced noise expert;

(b) describe procedures for achieving the noise management levels in the EPA's Interim Construction Noise Guideline 2009;

(c) describe the measures to be implemented to manage high noise generating works such as piling and excavation in close proximity to sensitive receivers;

{d) include strategies that have been developed with the community for managing high noise generating works;

(e) describe the community consultation undertaken to develop the strategies in d) above; and

(f) include a complaints management system.

Where reasonable and feasible, preference should be given to scheduling construction works within the standard construction hours of:

- Monday to Friday 7.00 am to 6.00 pm.
- Saturday 8.00 am to 1.00 pm

Typically any OOHWs would be subject to separate approval on a case-by-case basis.

Where construction noise levels are predicted to exceed the NMLs it is recommended that construction noise mitigation measures should be considered, where reasonable and feasible. Typical construction noise mitigation measures include the following:

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

- Where practicable, temporary acoustic hoarding should be installed as close to the noise source as feasible aiming to block direct line of sight between the receiver position and the noise source. This measure typically suits dominant single items of plant such as rockbreakers, concrete saws and jackhammers where the source of noise is typically near the ground.

5.7 Construction Traffic Noise

5.7.1 Construction Road Traffic Noise Goals

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

One of the objectives of the RNP is to apply relevant permissible noise increase criteria to protect sensitive receivers against excessive decreases in amenity as the result of a proposal. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

On this basis, construction traffic NMLs set at 2 dB above the existing road traffic noise levels during the daytime and night-time periods are considered appropriate to identify the onset of potential noise impacts. Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consideration would be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures where the relevant noise increase is greater than 2 dB, consideration would also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:

- 60 dBA $L_{Aeq(15hour)}$ day and 55 dBA $L_{Aeq(9hour)}$ night for existing freeway / arterial / sub-arterial roads.

5.7.2 Construction Traffic Noise Assessment

The main construction traffic access route to the HDBP Stage 2 site during the stages of construction would be along Cowpasture Road. A comparison of existing traffic and future traffic generated by the proposed development is outlined in **Table 24**.

Table 24 Forecast Construction Traffic Volumes on Public Roads

Road	Existing Traffic[1]				Site Generated Traffic[2,3]			
	Daytime (7 am - 10 pm)		Night-time (10 pm - 7 am)		Daytime (7 am - 10 pm)		Night-time (10 pm - 7 am)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Cowpasture Road (south of HDBP Stage 2)	6134	526	2045	175	75	150	45	90

Note 1: Based on Austraffic survey dated 05/12/2019 for the daytime period. Night-time period traffic was assumed to be 25% of the daily total.

Note 2: The internal traffic assignment is assumed to be 85%/15% distribution between Cowpasture Road and Trivet Street as per Ason report Horsley Drive Business Park Stage 2, dated 02/12/2016 (reference: 0300r01v2)

Note 3: Since this is a concept design assessment, construction-related traffic hasn't been finalised and therefore is assumed to be 10 truck movement every hour, extracted from the previous assessment in 2016. It is also assumed that the construction generates 5 light vehicle movements per hour.

While light and heavy vehicle movements within the proposed development are classified as part of the operational site noise, once they move off the site and onto public roads they are assessed under the *NSW Road Noise Policy (RNP).*

Construction traffic on Cowpasture Road to/from site is predicted to increase daytime and night-time road traffic noise levels by 0.7 dBA and 0.8 dBA respectively.

In both of these situations, construction traffic is not predicted to increase road traffic noise levels by more than 2 dBA. Therefore, construction road traffic noise mitigation or management measures are not considered to be required.

5.8 Construction-related vibration assessment

The effects of vibration in buildings can be divided into three main categories – those in which the occupants or users of the building are inconvenienced or possibly disturbed, those where the building contents may be affected and those in which the integrity of the building or the structure itself may be prejudiced.

5.8.1 Vibration Criteria

5.8.1.1 Human comfort vibration

The EPA's *Assessing Vibration: a technical guideline* provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV) rather than a continuous vibration level. The VDV is dependent upon the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The VDVs recommended in the document for vibration of an intermittent nature (ie construction works where more than three distinct vibration events occur) are presented in **Table 25**.

Table 25 Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$) (*Assessing Vibration: a technical guideline)*

Location	Daytime[1]		Night-time[1]	
	Prefered Value	Maximum Value	Prefered Value	Maximum Value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note 1: Daytime is 7:00 AM to 10:00 PM and night-time is 10:00 PM to 7:00 AM.

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas (Source: BS 6472-1992).

5.8.1.2 Effects on building contents

People can perceive floor vibration at levels well below those likely to cause damage to building contents or affect the operation of typical equipment. For most receivers, the controlling vibration criterion will be the human comfort criterion, and it is therefore not normally required to set separate criteria in relation to the effect of construction vibration on most building contents. Where appropriate, objectives for the satisfactory operation of critical instruments or manufacturing processes should be sourced from manufacturer's data and/or other published objectives.

5.8.1.3 Structural damage vibration

Structural damage vibration limits are based on Australian Standard AS 2187: Part 2-2006 Explosives - Storage and Use - Part 2: Use of Explosives and British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2. These standards provide frequency-dependent vibration limits related to cosmetic damage, noting that cosmetic damage is very minor in nature, is readily repairable and does not affect the structural integrity of the building. The recommended vibration limits from BS 7385 for transient vibration for minimal risk of cosmetic damage to residential and industrial buildings are shown in Table 26.

Table 26 Transient vibration guide values for minimal risk of cosmetic damage (BS 7385)

Line	Type of building	Peak component particle velocity in the 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

5.8.1.4 Minimum working distances

As a guide, minimum working distances for the proposed items of vibration intensive plant are provided in the Transport for NSW *Construction Noise and Vibration Strategy* (CNVS) (2018) and are reproduced below in **Table 27**.

Table 27 Recommended minimum working distances for vibration intensive plant

Plant item	Rating/description	Minimum working distance	
		Cosmetic damage (BS 7385)	Human response (NSW EPA Vibration Guideline)
Vibratory roller	< 50 kN (Typically 1-2t)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4t)	6 m	20 m
	< 200 kN (Typically 4-6t)	12 m	40 m
	< 300 kN (Typically 7-13t)	15 m	100 m
	> 300 kN (Typically 13-18t)	20 m	100 m
	> 300 kN (Typically > 18t)	25 m	100 m
Small hydraulic hammer	300 kg - 5 to 12t excavator	2 m	7 m

Plant item	Rating/description	Minimum working distance	
		Cosmetic damage (BS 7385)	Human response (NSW EPA Vibration Guideline)
Medium hydraulic hammer	900 kg - 12 to 18t excavator	7 m	23 m
Large hydraulic hammer	1600 kg - 18 to 34t excavator	22 m	73 m
Jackhammer	Handheld	1 m (nominal)	Avoid contact with structure
Bored piling	< 800 mm	2 m	n/a

Note 1: More stringent conditions may apply to heritage or other sensitive structures.

The minimum working distances presented in **Table 27** are quoted for both cosmetic damage (refer to BS 7385:2 *Evaluation and Measurement for Vibration in Buildings Part 2: Guide to Damage Levels from Ground-borne Vibration*, 1993) and human comfort (refer to NSW EPA *Assessing Vibration: a technical guideline*, 2006).

The minimum working distances for building damage should be complied with at all times. The distances are noted as being indicative and would vary depending on the particular item of plant and local geotechnical conditions. They apply to address the risk of cosmetic (minor – easily reparable) damage of typical buildings under typical geotechnical conditions.

Where vibration intensive works are required to be undertaken within the specified safe working distances, vibration monitoring should be undertaken to ensure acceptable levels of vibration are satisfied.

In relation to human comfort, minimum working distances relate to continuous vibration. For most construction activities, vibration emissions are intermittent Construction Vibration Criteria

5.8.2 Predicted Construction Vibration Impacts

Vibration intensive items of plant proposed for use during the construction of the development would include plate compactors and vibratory rollers. These items of equipment are proposed to be used during pad and hardstand works and construction of roadways.

During construction works, the nearest vibration-sensitive receiver at 28 Trivet Street which is approximately 90 m from the eastern boundary in HDBP Stage 2.

5.8.2.1 Cosmetic Damage Assessment

Vibratory rollers and plate compactors are proposed to be operated outside the recommended minimum working distances to 28 Trivet Street for cosmetic damage. Vibration at this receiver is unlikely to be above the vibration criteria.

5.8.2.2 Human Comfort Vibration Assessment

In relation to human comfort (response), the minimum working distances relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are permitted, as discussed in BS 6472-1.

Based on the general work zones, some items of proposed construction equipment have the potential to be operated within the recommended minimum working distances (90m). There is potential for ground vibration levels to exceed the human comfort criteria depending on the duration and nature of the construction activity. The required locations for vibration intensive equipment should therefore be reviewed during the preparation of the site-specific CNVMPs for construction works adjacent to the most affected receiver at 28 Trivet Street.

5.8.3 Construction Vibration Mitigation

Where vibration intensive construction activities are proposed within the minimum working distances, these works should be confined to less sensitive periods where practicable. In general, mitigation measures that should be considered are summarised as follows:

- Relocate vibration generating plant and equipment to other areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of plant and equipment where possible e.g. smaller capacity vibratory rollers.
- If vibration intensive works are required within the safe working distances, vibration monitoring or attended vibration trials would be undertaken to ensure that levels remain below the cosmetic damage criterion.
- Where buildings are located within the minimum working distances for cosmetic damage, building condition surveys would be completed both before and after the works to identify existing damage and any damage due to the works.

6 Summary

It should be noted that the recommendation made in this report are based on 24-hour operation of warehouse and the Customer Fulfilment Centre in the estate site. As such, this is considered a worst-case assessment of potential impacts. Typical impacts are likely to be lower than the worst-case predicted impacts.

6.1 Operational Noise Impacts

An operational noise impact assessment has been conducted for the HDBP Stage 2's modified masterplan design as part of SSD 7664. Operational noise criteria have been determined in accordance with the processes outlined in the NSW *Noise Policy for Industry* and SSD 7664 consent. Predicted noise levels of the modified masterplan have been assessed against the previously predicted noise levels from the original masterplan and relevant noise criteria including cumulative-corrected amenity criteria. The key findings are summarised as below:

- The SSD 7664 consent conditions have been considered.
- The original assessment referenced the now superseded EPA guideline, the *NSW Industrial Noise Policy* (INP) (2000). The *Noise Policy for Industry* (NPfI) (2017) has been considered for the modified assessment.
- To account for potential cumulative noise imact of other industrial noise in the area, amenity noise criteria levels have been reduced as per NPfI in Section **4.1.2.2**.
- Noise sources have been modelled according to the updated estate masterplan including the Customer Fulfillment Centre with new layouts.
- Latest estimated onsite vehicle movements provided by the Ason Group in their report Transport Assessment - Horsley Drive Business Park Stage 2, Horsley Park dated 27/02/2020 have been taken into account.
- Feasible and reasonable noise mitigation measures have been investigated to reduce the noise impacts on the most-affected receivers. An indicative noise barrier with height of 2 m located adjacent to the 28 Trivet Street boundary is recommended as detailed in Section **4.6.2.**
- Inclusion of the indicative noise barriers was found to result in no exceedance of the consent condition during all periods and the PTNL during daytime and evening periods, and a marginal exceedance of up to 1 dB(A) of the PTNL during night-time periods.
- During night-time period, a residual noise impact of up to 1 dB(A) is predicted at the residences at 28 Trivet Street with the 2m barrier option. As this is higher than previously specified, consideration should be given at the detailed design stage when the final operational plan is confirmed to minimise noise impacts as far as reasonably practicable while balancing other contraints on the mitigation options such as visual impact.
- The increase in traffic noise on public roads due to additional HDBP Stage 2 traffic is not considered likely to result in a perceptible increase in noise levels at the nearest sensitive receivers. No mitigation is therefore likely to be required for road traffic noise.

6.2 Construction Noise and Vibration Impacts

A construction noise and vibration impact assessment has been conducted for the HDBP Stage 2's modified masterplan design as part of SSD 7664. Construction noise and vibration criteria have been determined in accordance with the relevant guidelines. The key findings are summarised as below:

- Construction noise impacts have been predicted for several construction activities during the excavation scenario and construction scenario of the HDBP Stage 2.
- Exceedance of the NMLs of up to 11 dBA is predicted at 28 Trivet Street during excavation activity in Lot 3 during standard contruction hours. Exceedance of the NMLs is also predicted at the nearest commercial receivers at HDBP Stage 1 estate during excavation works in Lot 1. NML exceedances during other construction activity is predicted to be minor with worst-case exceedance up to 7 dB during worst-case noise intensive activity.
- No receivers are considered to be Highly Noise Affected, ie with predicted noise levels exceeding 75 dB LAeq.
- It is important to note that the above exceedances are based on a worst-case assessment of all equipment for each activity operating simultaneously at the closest point of the site to the most-affected receiver to identify mitigation to be incorporated in the contruction planning stage. Noise impacts during less intensive construction activity and/or at further site locations would be lower than the predicted worst-case.
- Where exceedances of the NMLs are predicted, construction noise mitigation should be considered to reduce the potential noise impacts on the surrounding sensitive receivers. Typical construction noise mitigation measures have been recommended in this report.
- The SSD 7664 consent condition C5 requires a Construction Noise Management Plan (CNMP) as part of the CEMP for the development. A detailed construction methodology and associated management plans including consultation should therefore be developed as part of the CNMP during the detailed design phase of the Proposal to manage impacts.
- Construction traffic is not predicted to increase daytime road traffic noise levels by more than 2 dBA at the nearest sensitive receivers. Construction road traffic noise mitigation or management measures are therefore not considered to be required.
- Vibration levels at the nearest receiver are unlikely to be above the cosmetic damage criteria.
- There is potential for ground vibration levels to exceed the human comfort criteria depending on the duration and nature of the construction activity. The required locations for vibration intensive equipment should be reviewed during the preparation of the site-specific CNVMPs for construction works adjacent to the most affected receivers.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

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

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

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

2. 'A' Weighted Sound Pressure Level

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

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

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

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

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

3. Sound Power Level

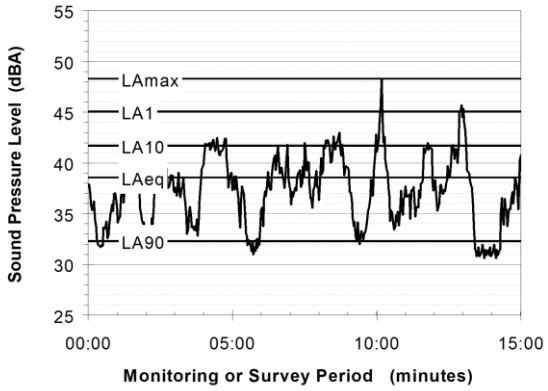
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4. Statistical Noise Levels

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

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



Of particular relevance, are:

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

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

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

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

5. Frequency Analysis

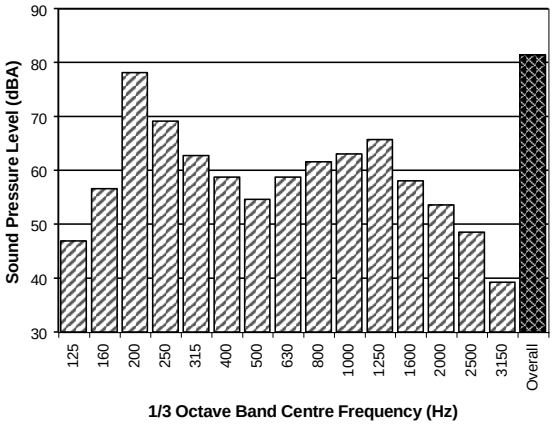
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

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

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



6. Annoying Noise (Special Audible Characteristics)

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

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

7. Vibration

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

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

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

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

8. Human Perception of Vibration

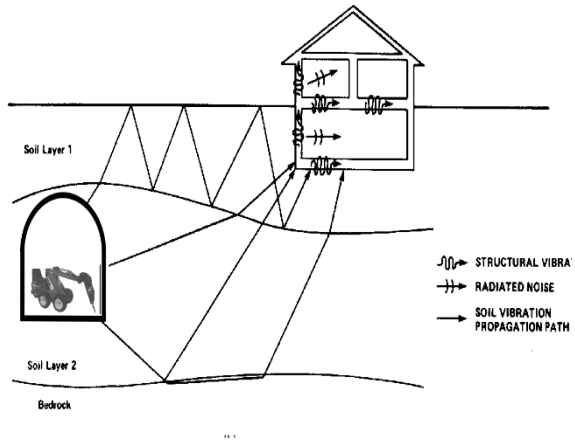
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

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

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

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

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



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

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