LIGHT HORSE INTERCHANGE WAREHOUSE FACILITY (LOT 7)

SSD-34991713
Noise Impact Assessment

Prepared for:

Charter Hall
Level 20
1 Martin Place
Sydney NSW 2000

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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 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

Reference	Date	Prepared	Checked	Authorised
610.30765-R03-v1.0	2 June 2022	Joshua Ridgway	Mark Irish	Mark Irish

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Charter Hall to assess the potential operational and construction noise impacts of Light Horse Interchange Warehouse Facility (Lot 7) in the Light Horse Business Hub (LHBH), located adjacent to the M4 and M7 Motorways Light Horse Interchange in Eastern Creek.

The Concept Proposal for the LHBH obtained Development Consent under SSD-9667 on 31 August 2020 from the Department of Planning and Environment (DPE) (then Department of Planning, Industry and Environment). A Noise Impact Assessment (SSD-9667 NIA) was prepared as part of the SSD-9667 application (SLR Report *610.18514-R02-v1.0*, dated March 2019). The approved Concept Masterplan is shown in **Figure 1**. A modification to SSD-9667 (MOD 1) is currently being prepared by Charter Hall.

SSD-34991713 seeks to approve the construction and operation of a warehouse and distribution centre development on Lot 7 of the LHBH. This report presents a review of the potential operational and construction noise impacts for Lot 7 and compares the predicted noise levels to the noise criteria for the development, as specified in the Development Consent SSD-9667.

Figure 1 Approved SSD-9667 Concept Masterplan

Note 1: Sourced from Appendix 1 of the SSD-9667 Development Consent.

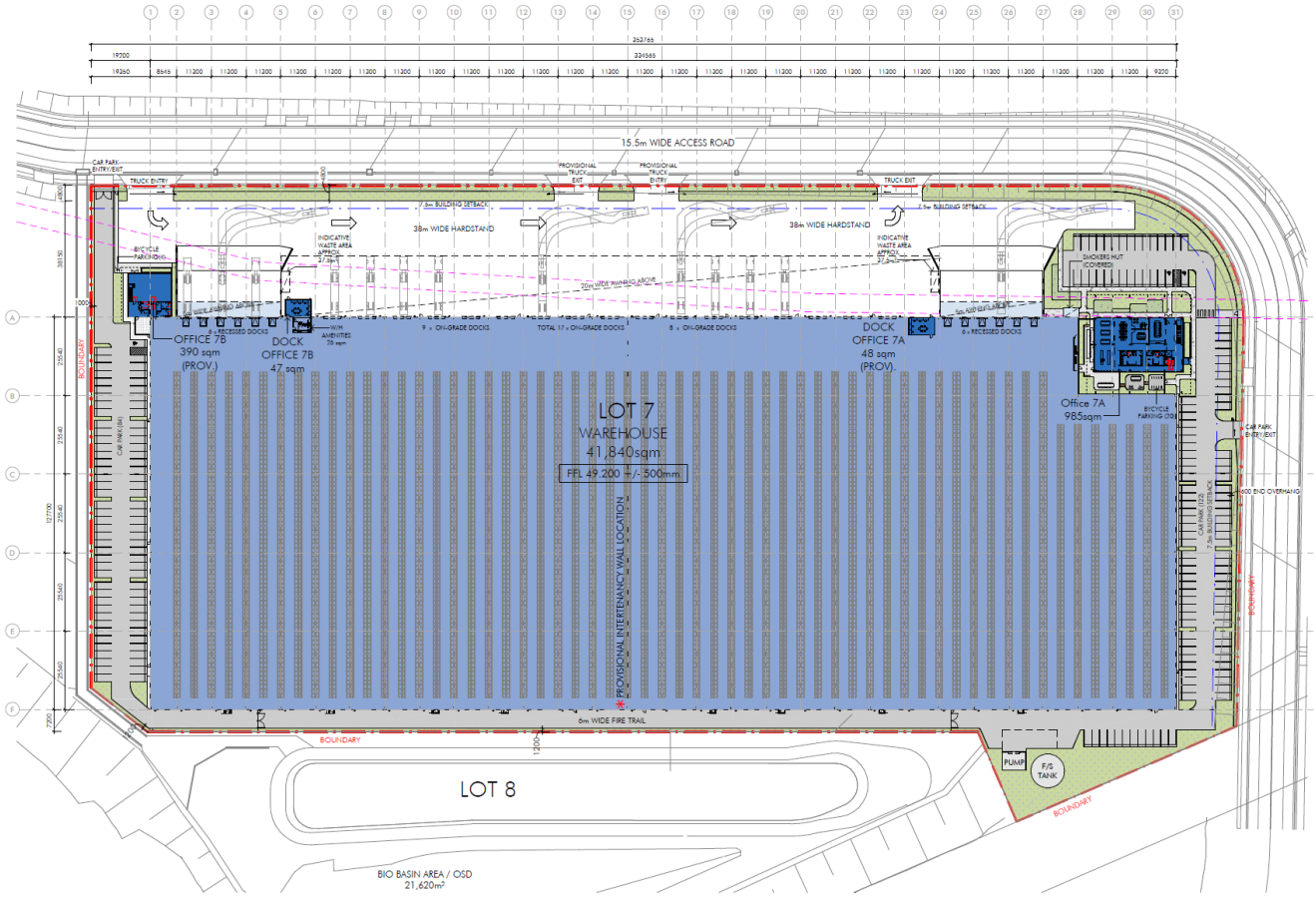
2 Light Horse Interchange Warehouse Facility (Lot 7)

The project comprises the construction of a warehouse or distribution centre development including the following key components:

- Maximum building height of 15 metres
- 41,840 m^2 warehouse
- 985 m^2 ancillary office (2 storey)
- Two dock offices: 48 m^2 and 47 m^2
- Provisional 390 m^2 office (2 storey)
- On-site parking will be provided for 206 vehicles
- 24/7 operations
- No manufacturing as part of the use

The proposed Lot 7 development is shown in **Figure 2**.

Figure 2 Proposed Lot 7 Development Design



Note 1: Provided by Charter Hall, dated 12 May 2022.

3 SEARs, Assessment Criteria and Sensitive Receivers

3.1 Secretary's Environmental Assessment Requirements

Secretary's Environmental Assessment Requirements (SEARs) were issued for SSD-34991713 by DPE. The SEARs relevant to noise and vibration are shown in **Table 1**.

Table 1 Noise and Vibration SEARs – SSD-34991713

Key Issue No. & Description	Issue and Assessment Requirements	How It Is Addressed	Section of This Report
Issue 11. Noise and Vibration	Provide a noise and vibration assessment prepared in accordance with the relevant EPA guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	This noise impact assessment details operational and construction noise and vibration impacts on the relevant nearby sensitive receivers and structures in accordance with the relevant EPA guidelines. Noise and/or vibration mitigation and management measures are proposed, where required.	• Relevant EPA guidelines and nearby sensitive receivers – **Section 3** • Assessment of operational noise impacts and proposed mitigation and management measures (where required) – **Section 4** • Assessment of construction noise and vibration impacts and proposed mitigation and management measures (where required) – **Section 5**

This report addresses the above SEARs.

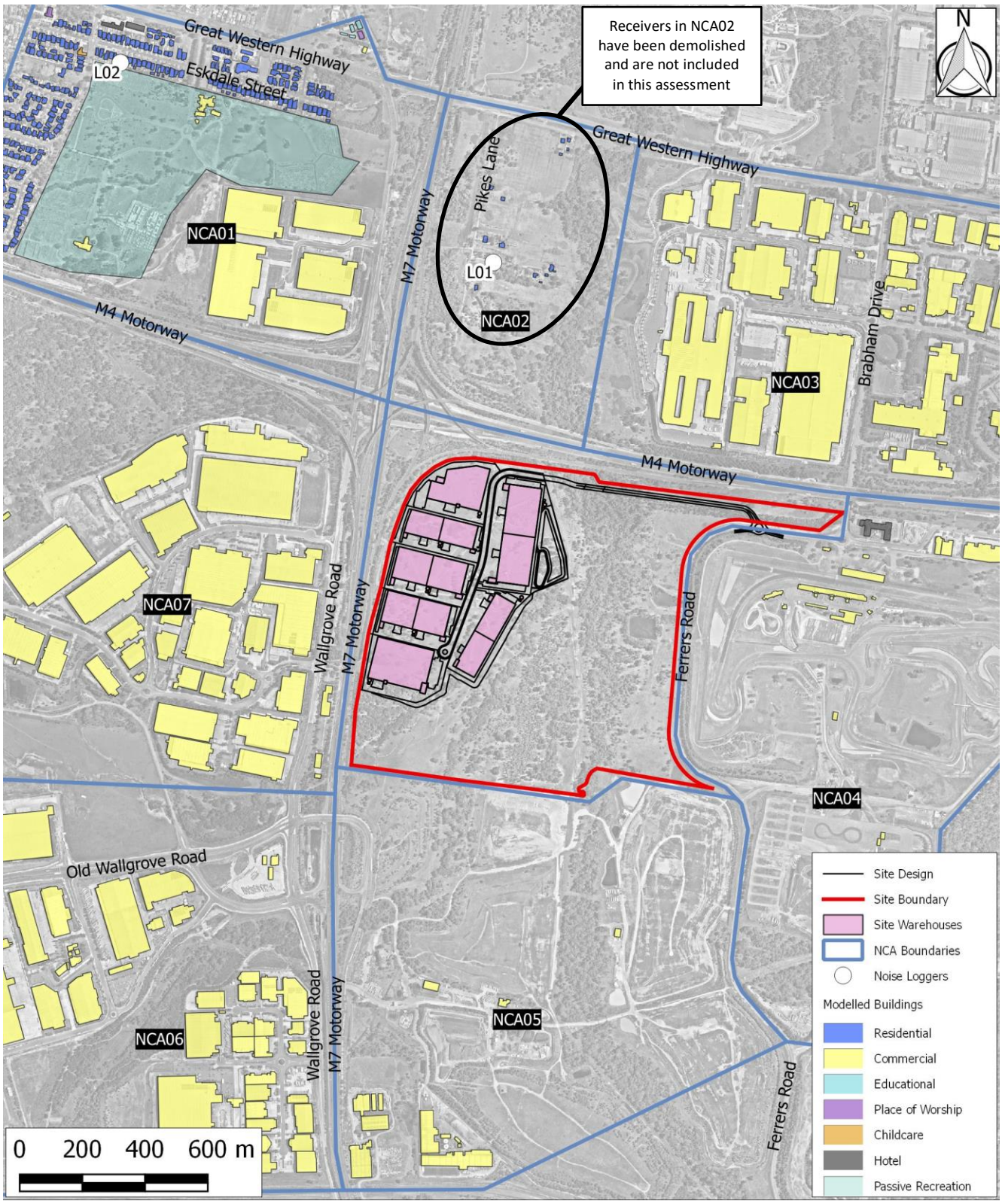
3.2 Receiver Locations

The locations of noise sensitive receivers in the vicinity of the LHBH are shown in **Figure 3**, extracted from Appendix 4 of the SSD-9667 Development Consent.

Sensitive receivers include residences, passive recreation, educational premises, a place of worship and a childcare centre in NCA01, and hotels in NCA01 and NCA04. Commercial premises are located in all NCAs except NCA02.

The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

Figure 3 NCAs and Sensitive Receiver Locations



Note 1: Sourced from Appendix 4 of the SSD-9667 Development Consent.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

3.3 Operational Noise Limits

The operational noise limits for the LHBH are detailed in Condition B12 of the SSD-9667 Development Consent. The noise limits are shown in **Table 2**.

Table 2 Operational Noise Limits

Receiver Type/ Location	Day ($L_{Aeq(15minute)}$)	Evening ($L_{Aeq(15minute)}$)	Night ($L_{Aeq(15minute)}$)	When in Use ($L_{Aeq(15minute)}$)
Residential (NCA01)	46	46	43	-
Residential (NCA02)[2]	52	48	43	-
Childcare	-	-	-	48
Educational	-	-	-	43
Place of Worship	-	-	-	48
Hotel	63	53	48	-
Passive Recreation	-	-	-	48
Commercial	-	-	-	63

Note 1: Noise is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW *Noise Policy for Industry*.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

3.4 Construction Noise Management Levels

Condition B19 of the SSD-9667 Development Consent states the development must be constructed to achieve the construction Noise Management Levels (NMLs) detailed in the *Interim Construction Noise Guideline* (DECC, 2009). The NMLs for the LHBH were detailed in the SSD-9667 NIA. A summary of the NMLs adopted for the development are shown in **Table 3**.

Table 3 Project Specific Noise Management Levels (dBA)

Receiver Type	NML ($L_{Aeq(15minute)}$ – dBA)					Sleep Disturbance Screening Level (RBL+15 dB) (L_{Amax} dBA)
	Standard Construction Hours (RBL+10dB)	Out of Hours[5] (RBL+5dB)			Highly Noise Affected (dBA)	
	Daytime	Daytime[3]	Evening	Night-time	All Periods	Night-time
Residential (NCA01)	51	46	46[1]	43	75	53
Residential (NCA02)[2]	n/a	n/a	n/a	n/a	n/a	n/a
Educational	55	55 (when in use)			-	-
Place of Worship	55	55 (when in use)			-	-
Passive Recreation	60	60 (when in use)				-
Child Care (play areas)	65 (internal 55[4])	65 (when in use)			-	-
Child Care (sleep areas)	50 (internal 40[4])	50 (when in use)			-	-
Hotel (sleep areas)	50 (internal 40[4])	50 (when in use)			-	-

Receiver Type	NML ($L_{Aeq(15minute)}$ – dBA)					Sleep Disturbance Screening Level (RBL+15 dB) (L_{Amax} dBA)
	Standard Construction Hours (RBL+10dB)	Out of Hours[5] (RBL+5dB)			Highly Noise Affected (dBA)	
	Daytime	Daytime[3]	Evening	Night-time	All Periods	Night-time
Commercial	70	70 (when in use)			-	-
Industrial	75	75 (when in use)			-	-

Note 1: Where the evening RBL is higher than the daytime RBL, the daytime RBL has been adopted.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

Note 3: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

Note 4: Internal Noise level. It should be conservatively assumed that these receivers have operable windows, therefore a conservative estimate of the difference between internal and external noise levels of 10 dBA should be adopted.

Note 5: In accordance with Condition B17, works will be undertaken during standard daytime construction hours. Where out of hours works are required and are approved under Condition B18, the out of hours NMLs would apply.

3.5 Construction Vibration Limits

Condition B22 of the SSD-9667 Development Consent states vibration caused by construction at any residence or structure outside the site must be limited to the latest version of *DIN 4130-3* for structural damage, and the acceptable vibration values set out in *Assessing Vibration: A Technical Guideline* for human exposure. The minimum working distances for vibration intensive works based on the guidelines specified in Condition B22 were detailed in the SSD-9667 NIA. These are shown in **Table 4**.

Table 4 Recommended Minimum Working Distances from Vibration Intensive Equipment

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

Note 1: Criteria reference from DIN 4150.

Note 2: Criteria reference from Roads and Maritime CNVG.

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. All general receivers and structures are located well outside the minimum working distances detailed above, and as such, are unlikely to experience vibration related impacts.

The Construction Noise and Vibration Management Plan (CNVMP) for the Stage 1 LHBH works (SLR Report *610.30501-R01-v2.1-20220325*, dated March 2022) details specific vibration criteria for the M4 and M7 Motorway structures, and for the underground Jemena high pressure gas line.

The CNVMP states that for works with large vibratory rollers or hydraulic hammers adjacent to the M4 and M7 Motorway structures a minimum working distance of 25 m shall be applied to meet the vibration criteria detailed in DIN 4150. All M4 and M7 structures are located over 50 m from the Lot 7 construction works, and as such, are unlikely to experience vibration related impacts.

Jemena has specified a ground vibration limit of 20 mm/s Peak Particle Velocity (PPV) for the gas line. Based on this limit, **Table 5** details the minimum working distances for vibration intensive equipment in the vicinity of the Jemena high pressure gas line.

Table 5 Minimum Working Distances from Vibration Intensive Equipment – Jemena Gas Line

Plant Item	Rating/Description	Minimum Horizontal Distance from Jemena High Pressure Gas Line[1]
Vibratory Roller	<100 kN (Typically <4 tonnes)	5 m
	<300 kN (Typically 4-13 tonnes)	10 m
	>300 kN (Typically >13 tonnes)	15 m
Hydraulic Hammer	≤900 kg (≤18 t excavator)	5 m
	>900 kg (>18 t excavator)	10 m
Pile Boring	≤ 800 mm	3 m
Jackhammer	Hand held	3 m

Note 1: Based on BS 7385 with the Jemena PPV limit of 20 mm/s.

There is potential for vibration intensive works in the north-eastern area of the site, adjacent to the high pressure gas easement to be within the minimum working distance of the Jemena high pressure gas line. Where vibration intensive works are proposed within the minimum working distances of the Jemena high pressure gas line (horizontal distance from directly above the gas line), vibration monitoring and management must be undertaken in accordance with the CNVMP.

4 Operational Noise Assessment

4.1 Operational Noise Modelling

The SoundPLAN noise model prepared for the SSD-9667 NIA has been updated for the Lot 7 design and operations.

Consistent with the SSD-9667 NIA, the noise model includes standard weather conditions during the daytime and evening periods, with noise-enhancing weather conditions during the night-time period, using an F-class temperature inversion with a 2 m/s source to receiver drainage flow.

It is noted that standard noise model inputs required by DPE (such as loading dock sources and heavy vehicle sound power levels) have been updated since the approval of the LHBH. As such, the sound power levels for noise model inputs for Lot 7 are typically higher than those modelled in the SSD-9667 NIA. Concept Plan noise sources on other lots within the LHBH are consistent with the SSD-9667 NIA and have not been modified.

4.1.1 Operational Noise Sources

The Lot 7 development is in the early design stages and certain future tenants are currently unknown. Several assumptions have been made by Charter Hall regarding the likely future tenants, uses and sources of noise, based on the likely tenants. The main sources of operational noise at the development include:

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

A summary of the noise sources associated with the operation of the development is provided below.

On-Site Traffic

Vehicles volumes for Lot 7 were provided by Charter Hall, sourced from the Lot 7 Traffic and Parking Assessment (Lot 7 TPA) prepared by Transport and Traffic Planning Associates (*Ref 21077 (C) Rev E*, dated May 2022).

The following peak-1hour volumes have been used, based on the above information:

- 108 vehicle movements in the AM peak (daytime), comprising 78 light vehicles and 30 heavy vehicles.
- 86 vehicle movements in the PM peak (evening), comprising 62 light vehicles and 24 heavy vehicles.
- 32 vehicle movements in the night-time peak, comprising 23 light vehicles and 9 heavy vehicles.

The peak 1-hour vehicle volumes above have been assumed to be spread evenly across the 1-hour period, and have been divided by four to model as worst-case 15-minute volumes during the daytime, evening and night-time periods.

Vehicle volumes for the other lots within the LHBH are consistent with those previously modelled for the SSD-9667 NIA.

The relevant sound power levels (SWLs) and modelling assumptions are detailed in **Table 6**.

Table 6 Vehicle Noise Sources

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)
Large Trucks	Estate roads	108[1]	20
	On-lot truck access and hardstands		5
Light Vehicles	Estate roads	96[2]	40
	Car parks and light-vehicle access		20

Note 1: Based on a combined sound power level of 106 dBA for large trucks at slow speed for 80% of the time and 111 dBA for trucks accelerating at slow speed for 20% of the time.

Note 2: 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.

Loading Docks

The modelled loading dock noise sources for Lot 7 are detailed in **Table 7**. Consistent with the SSD-9667 NIA, external forklift movements (ie outside of the warehouses) have been modelled in the at-grade dock areas of the hardstands, operating continuously during any one 15-minute period.

Table 7 Loading Dock Noise Sources

Noise Source	Sound Power Level (dBA)	Typical Duration of Use in Worst-case 15-minute Period	Source Height (m)
Truck reversing alarm[1]	107[2]	30 seconds	1.0
Forklift reversing alarm[1]	102[2]	90 seconds	0.5
Truck air brakes	118	1 second	1.0
Gas forklift	93	900 seconds	1.0

Note 1: The operation of this equipment is typically intermittent and a +5 dB modifying correction factor has been added to the night-time noise level in accordance with the NPfI.

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

Mechanical Plant

Consistent with the SSD-9667 NIA, external mechanical plant on Lot 7 has been conservatively modelled on the warehouse rooftop (6 units) with an assumed SWL of 90 dBA per unit.

4.2 Predicted Operational Noise Levels

The predicted operational noise levels at the most-affected receivers in each NCA are summarised in **Table 8**. The predicted levels are the Lot 7 development cumulatively with the other lots of the LHBH as the criteria applies to the whole estate.

The cumulative noise level predictions for this assessment and corresponding exceedance of the noise limits are shown in the table, where appropriate. The SSD-9667 NIA noise levels and predicted change from the SSD-9667 NIA noise levels are also shown for comparison.

Table 8 Predicted Operational Noise Levels Lot 7 SSD and SSD-9667 NIA – Most-affected Receiver – Cumulative Masterplan Development

NCA	Receiver Type	Period (weather)	LAeq(15 minutes) Noise Level (dBA)					Compliance
			Noise Limit	Lot 7 SSD Predicted	Exceedance	SSD-9667 NIA Predicted	Change	
NCA01	Residential	Daytime (standard)	46	33	-	32	+1	Yes
		Evening (standard)	46	32	-	32	0	Yes
		Night-time (standard)	43	30	-	30	0	Yes
		Night-time (noise-enhancing)	43	36	-	33	+3	Yes
	Childcare	When in use (all)	48	<30	-	<30	0	Yes
	Educational	When in use (all)	43	<30	-	<30	0	Yes
	Place of Worship	When in use (all)	48	<30	-	<30	0	Yes
	Hotel	Daytime (standard)	63	<30	-	<30	0	Yes
		Evening (standard)	53	<30	-	<30	0	Yes
		Night-time (standard)	48	<30	-	<30	0	Yes
		Night-time (noise-enhancing)	48	<30	-	<30	0	Yes
	Passive Recreation	When in use (all)	48	33	-	30	+3	Yes
	Commercial	When in use (all)	63	39	-	37	+2	Yes
NCA02	Residential[2]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NCA03	Commercial	When in use (all)	63	49	-	46	+3	Yes
NCA04	Hotel	Daytime (standard)	63	44	-	42	+2	Yes
		Evening (standard)	53	43	-	41	+2	Yes
		Night-time (standard)	48	39	-	37	+2	Yes
		Night-time (noise-enhancing)	48	44	-	42	+2	Yes
	Commercial	When in use (all)	63	45	-	41	+4	Yes
NCA05	Commercial	When in use (all)	63	33	-	31	+2	Yes
NCA06	Commercial	When in use (all)	63	36	-	34	+2	Yes
NCA07	Commercial	When in use (all)	63	46	-	47	-1	Yes

Note 1: **Bold** text indicates an exceedance of the project noise trigger level.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

The above shows that cumulative operational noise levels the Lot 7 development and the other lots of the LHBH Masterplan are predicted to be compliant with the relevant noise limits at all receivers during all periods and weather conditions.

The Lot 7 development updates, along with the revised source sound power levels, result in minor increases in noise levels at some locations compared to the SSD-9667 NIA.

The Lot 7 development is compliant with all relevant operational noise limits detailed in SSD-9667, and as such, no operational noise mitigation measures are required to be implemented.

5 Construction Noise and Vibration Assessment

Exact details on the construction of the development are not currently known at this stage of the project. As such, it has been necessary to make certain assumptions as to the type and location of equipment together with details regarding construction activities. These assumptions are defined in the following sections and are generally consistent with the SSD-9667 NIA.

5.1 Construction Works

5.1.1 Working Hours

Conditions B17 and B18 of the SSD-9667 Development Consent outline the allowable construction hours for the development. Earthworks and construction must be undertaken during the standard ICNG daytime working hours of:

- 7:00 am to 6:00 pm Monday to Friday
- 8:00 am to 1:00 pm on Saturdays.

Works outside the hours above may be undertaken in the following circumstances:

- Works that are inaudible at the nearest sensitive receivers;
- Works agreed to in writing by the Planning Secretary;
- For the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or
- Where is it required in an emergency to avoid the loss of lives, property or to prevent environmental harm.

5.1.2 Construction Activity Source Noise Levels

Site clearing and bulk earthworks on the Lot 7 site are being undertaken as part of the Stage 1 LHBH development and have not been included in this assessment. General construction activities required to be undertaken in order to construct the Lot 7 development are listed in **Table 9**. Sound power levels for the typical operation of construction equipment used in the modelling have been taken from verified test data and global standards that form part of SLR's noise database, consistent with the SSD-9667 NIA.

Table 9 Sound Power Levels for Construction Equipment

ID	Construction Activity	Equipment	Operating minutes in 15-min period[2]	No of items in same location	Sound Power Level LWA (dB)	
					Item	Activity
W.001	Construction of Roadways	Bitumen Spray Truck	15	1	100	111
		Line Marking Plant	15	1	98	
		Paving Machine	15	1	104	
		Roller – Vibratory (12 tonne)[1]	15	1	109	
W.002	Paving Works including Concrete Pours	Concrete Mixer Truck	7.5	1	106	112
		Concrete Pump	7.5	1	106	
		Concrete Vibrator	15	1	102	
		Paving Machine	15	1	104	
		Roller – Vibratory (12 tonne)[1]	15	1	109	
W.003	Construction of Warehouse and Office Buildings	Elevated Working Platform	15	2	97	107
		Flatbed Truck	15	1	100	
		Hand Tools (Electric)	15	4	96	
		Mobile Crane (100 tonne)	15	1	101	
W.004	Landscaping and Finishing Works	Hydromulching Equipment	15	1	97	102
		Skidsteer Loaders (approx 0.5 tonne)	15	1	97	
		Light Vehicle (Ute/4WD)	15	1	98	

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.

Note 2: This refers to the amount of time in minutes that individual items of equipment would be in use for during the worst-case 15 minute assessment period, based on site observations. Some items of plant, such as Concrete Pumps, are not typically used in a continuous manner.

5.2 Construction Noise Assessment

SoundPLAN has been used for modelling the noise emissions from construction of the development using the ISO 9613 noise prediction algorithms. The three-dimensional model includes ground topography, buildings and representative noise sources.

5.2.1 Predicted Construction Airborne Noise Levels

A summary of the predicted noise levels (without additional mitigation) for each of the most-affected receivers in each NCA for the various work activities is presented in **Table 10**.

A qualitative description of the NML exceedance bands is given below, noting that the impact of these potential exceedances would depend on the period in which they were to occur:

- Noise levels 1 to 10 dB above NML – impact would typically be marginal to minor
- Noise levels 11 dB to 20 dB above NML – impact would typically be moderate
- Noise levels >20 dB above NML – impact would typically be high

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted at the most-exposed receiver, as the noise levels presented in this report are based on each scenario occurring at the site boundary.

Table 10 Predicted Worst-Case Construction Airborne Noise Levels

NCA	Receiver Type	Period	NML	Predicted Noise Level - $L_{Aeq(15\ minutes)}$ (dBA)			
				W.001	W.002	W.003	W.004
NCA01	Residential	Daytime – Standard Hours	51	34	35	30	<30
		Daytime – OOH	46	34	35	30	<30
		Evening	46	34	35	30	<30
		Night-time	43	34	35	30	<30
	Childcare	When in use	50	34	35	30	<30
	Educational	When in use	55	31	32	<30	<30
	Place of Worship	When in use	55	31	32	<30	<30
	Hotel	When in use	50	30	31	<30	<30
	Passive Recreation	When in use	60	35	36	31	<30
	Commercial	When in use	70	39	40	35	35
NCA02	Residential[2]	n/a	n/a	n/a	n/a	n/a	n/a
NCA03	Commercial	When in use	70	44	45	40	35
NCA04	Hotel	When in use	50	37	38	33	<30
	Commercial	When in use	70	42	43	38	33
NCA05	Commercial	When in use	70	35	36	31	<30
NCA06	Commercial	When in use	70	36	37	32	<30
NCA07	Commercial	When in use	70	43	44	39	34

Note 1: Green cell colour indicates noise levels 1 to 10 dB above NML; Yellow cell colour indicates noise levels 11 to 20 dB above NML; Red cell colour indicates noise levels >20 dB above NML.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

Construction airborne noise levels up to 44 dBA are predicted at the nearest sensitive receivers.

No exceedances of the NMLs are predicted at any of the surrounding receivers during any of the works. No receivers are predicted to be Highly Noise Affected (>75 dBA). As such, no specific construction noise mitigation measures are required to be undertaken. Best practice measures to minimise construction noise should be implemented in accordance with the CNVMP for the development once prepared.

5.3 Construction Vibration Assessment

As detailed in **Section 3.5**, all general receivers and structures are located well outside the minimum working distances detailed in **Table 4**, and as such, are unlikely to experience vibration related impacts.

All M4 and M7 structures are located over 50 m from the Lot 7 construction works, and as such, are unlikely to experience vibration related impacts.

There is potential for vibration intensive works in the north-eastern area of the site, adjacent to the high pressure gas easement to be within the minimum working distance of the Jemena high pressure gas line (refer to **Table 5**). Where vibration intensive works are proposed within the minimum working distances of the Jemena high pressure gas line (horizontal distance from directly above the gas line), vibration monitoring and management must be undertaken in accordance with the LHBH CNVMP (SLR Report *610.30501-R01-v2.1-20220325*, dated March 2022). Should a CNVMP specific to the Lot 7 development works be prepared the measures relating to vibration intensive works near the Jemena pipelines must be implemented in that document.

6 Conclusion

An operational and construction noise and vibration impact assessment was undertaken for the Light Horse Interchange Warehouse Facility (Lot 7) development at the LHBH in accordance with the SSD-34991713 SEARs and the SSD-9667 Development Consent.

Summary of Operational Noise Impacts

Predicted cumulative operational noise levels from the Lot 7 development and the other lots of the LHBH Masterplan are predicted to be compliant with the relevant noise limits at all receivers during all periods and weather conditions. The Lot 7 development updates, along with the revised source sound power levels, result in minor increases in noise levels at some locations compared to the SSD-9667 NIA. The Lot 7 development is compliant with all relevant operational noise limits detailed in SSD-9667, and as such, no operational noise mitigation measures are required to be implemented.

Summary of Construction Noise Impacts

Construction airborne noise levels up to 44 dBA are predicted at the nearest sensitive receivers. No exceedances of the NMLs are predicted at any of the surrounding receivers during any of the works. No receivers are predicted to be Highly Noise Affected. As such, no specific construction noise mitigation measures are required to be undertaken. Best practice measures to minimise construction noise should be implemented in accordance with the CNVMP for the development once prepared.

Summary of Construction Vibration Impacts

All general receivers and structures are located outside the minimum working distances, and as such, are unlikely to experience vibration related impacts. All M4 and M7 structures are located over 50 m from the Lot 7 construction works, and as such, are unlikely to experience vibration related impacts. Where vibration intensive works in the north-eastern area of the site are proposed within the minimum working distances of the Jemena high pressure gas line (horizontal distance from directly above the gas line), vibration monitoring and management must be undertaken in accordance with the LHBH CNVMP (SLR Report *610.30501-R01-v2.1-20220325*, dated March 2022). Should a CNVMP specific to the Lot 7 development works be prepared the measures relating to vibration intensive works near the Jemena pipelines must be implemented in that document.

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 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

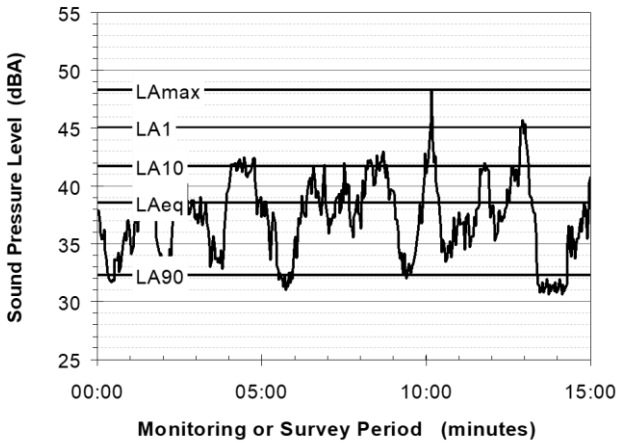
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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 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

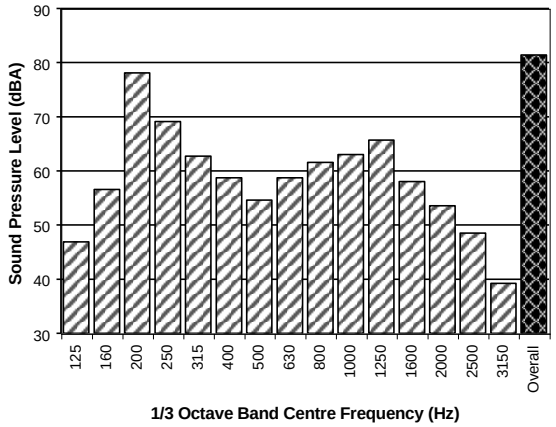
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

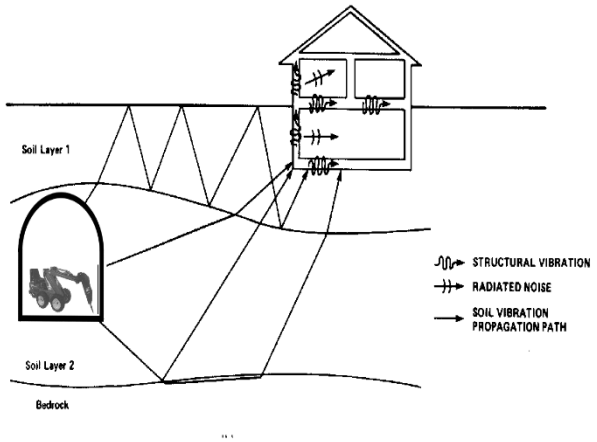
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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