DRILL PTY LTD

24-26 RAILWAY PARADE, WESTMEAD

NOISE IMPACT ASSESSMENT

MAY 2018

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24-26 Railway Parade, Westmead
Noise impact assessment

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EXECUTIVE SUMMARY

A proposed development at 24-26 Railway Parade, Westmead, has been assessed by WSP for Development Application. The development will include a three-storey podium and sixteen storey building, with residential and commercial tenancies and associated on-site parking. Access to the site will be via a driveway fronting Ashley Lane.

Acoustic criteria for the development is taken from:

- NSW Environment Protection Authority (EPA) Noise Guideline for Local Government
- NSW Noise Policy for Industry 2017 (NSW NPfI) (Replaces the *NSW Industrial Noise Policy* (2000) effective as of Friday 27 October 2017)
- NSW Department of Environment, Climate Change and Water (DECCW) Road Noise Policy
- Office of Liquor, Gaming and Racing - reducing the risk of noise disturbance: October 2009
- Building Code of Australia Volume One, Part F5
- Australian Standard AS2107:2016 – Recommended Design Sound Levels and Reverberation Times for Building Interiors

Noise from mechanical plant will be controlled to meet noise criteria developed in accordance with the NSW Noise Policy for Industry. Controls such as selection of quiet equipment, physical attenuation controls, carefully selected locations and barriers will be considered for mechanical equipment. Car movements on and off the site at the access points, including delivery vehicles using the loading dock, are expected to comply with NPfI criteria.

Noise ingress to dwellings will be controlled to meet recommended design levels given in AS2107:2016. An indicative façade performance of 34 dB $R_w + C_{tr}$ is recommended for the living areas of apartments, and 32 dB $R_w + C_{tr}$ is recommended for the night-time sleeping areas of the apartments and hotel rooms. Actual façade construction will be reviewed as the design progresses.

Construction of partitions and floors within the development will be designed to meet the sound insulation requirements for Class 2 buildings, in accordance with Volume One, Part F5 of the Building Code of Australia.

1 INTRODUCTION

WSP has been appointed by Drill Pty Ltd to provide acoustic consultancy services for a proposed mixed-use development at 24-26 Railway Parade, Westmead. The purpose of this report is to provide a noise impact assessment in support of a Development Application to be submitted to Parramatta City Council.

The noise impact assessment has been conducted based on the DA architectural package by Sissons Architects.

1.1 SITE AND PROJECT DESCRIPTION

The project site is located at 24-26 Railway Parade, Westmead, legally identified as Lot 1 in DP 972068, Lot 10 in DP 605684 and Lot 1 in DP 952720. The three-storey podium and 16 storey tower on top will include retail/commercial tenancies, a tavern, a medical centre, a hotel and apartments.

Figure 1.1 shows the allocation of floors to the various uses.

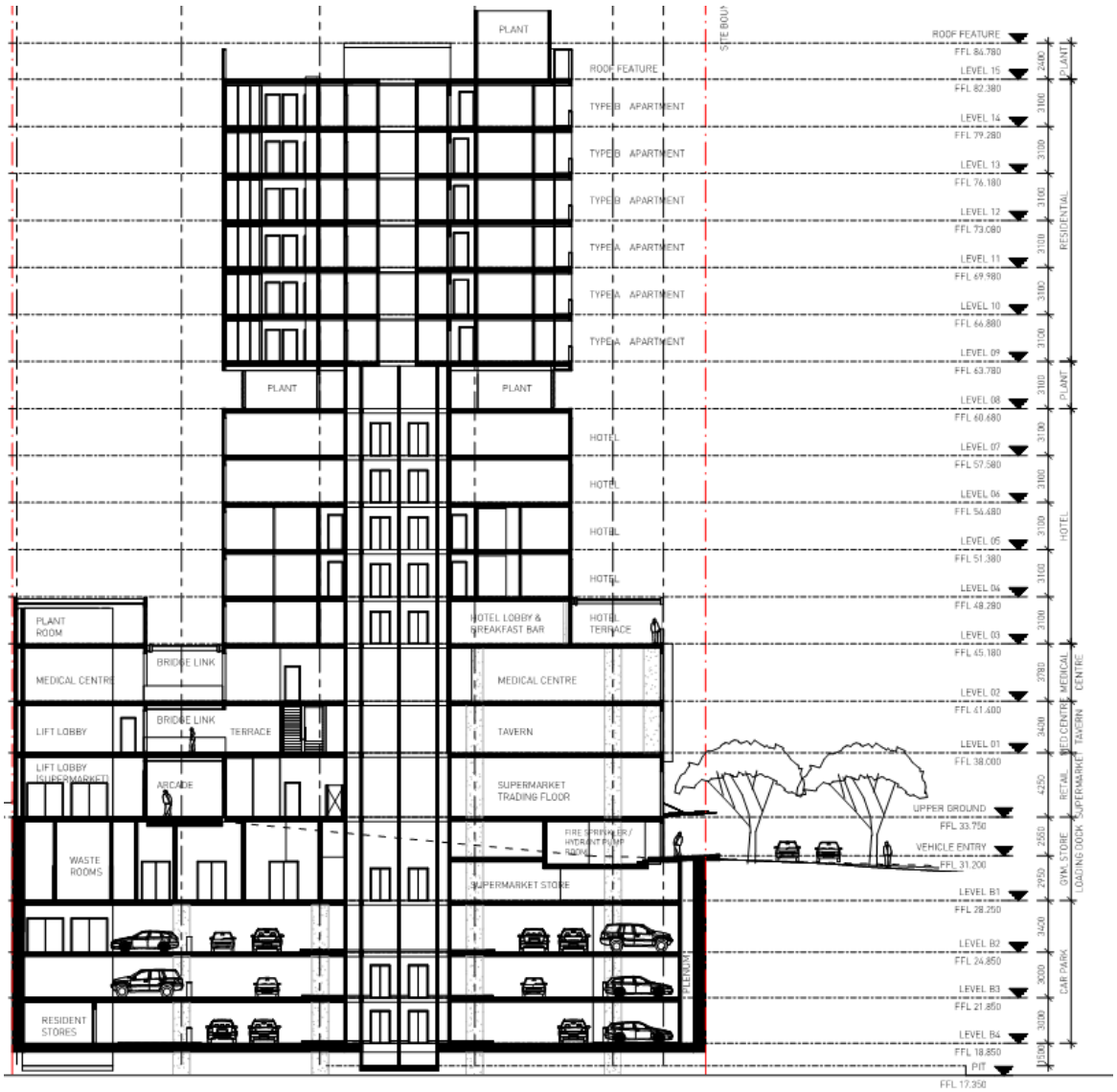


Figure 1.1 Usages within development

The proposed development is adjacent to commercial receivers near Westmead railway station, with residential receivers to the east and south, and Hawkesbury Road to the west. An aerial overview of the site is given in Figure 1.2 with the nearest receivers listed in Table 1.1.

Source: *NSW SIX Maps*

Figure 1.2 Site overview

Table 1.1 Nearest sensitive receivers

RECEIVER ID	ADDRESS	TYPE	APPROXIMATE DISTANCE, METRES
C1	27 Railway Parade	Commercial	5
C2	149 Hawkesbury Road	Commercial	3
R3	16 Central Avenue	Residential	20
R4	21 Railway Parade	Residential	15
R5	139, 143 Hawkesbury Road	Residential	100
R6	20-22, 24, 26, 27 Alexandria Avenue	Residential	95

2 SITE SURVEY

Unattended background monitoring was conducted by WSP from 3 May to 11 May 2017 to assess the existing background noise levels and traffic noise levels in the vicinity of the development. In addition, attended measurements were conducted on 11 May 2017 to determine the noise and vibration generated by passing trains.

2.1 NOISE MEASUREMENTS

Unattended noise logging was conducted on the roof of 27 Railway Parade, Westmead to establish the existing background and ambient noise levels. The noise environment consisted primarily of road traffic noise from Hawkesbury Road and general urban hum. Trains were audible but not dominant when moving through Westmead railway station.

2.1.1 EQUIPMENT AND MEASUREMENT APPROACH

The unattended noise survey was conducted with reference to the NSW Noise Policy for Industry (NPfI), Road Noise Policy (RNP) and AS1055.1 "Acoustics – Description and measurement of environmental noise Part 1: General Procedures."

The microphone was located in a free-field position at least 3.5m away from reflecting walls on the roof of 27 Railway Parade.

The sound level meter was field-calibrated using a Pulsar Model 105 acoustic calibrator both before and after noise measurements to monitor drifts in calibration. No drifts in excess of 1 dBA were noted throughout the monitoring exercise. The sound level meter and calibrator were in current National Association of Testing Authorities (NATA) calibration at the time of use. Serial numbers and laboratory calibration due dates are shown below in Table 2.1.

Table 2.1 Equipment details

EQUIPMENT DESCRIPTION	MANUFACTURER AND TYPE NO.	SERIAL NO.	CALIBRATION DUE DATE
Sound level meter	Norsonic Nor140	1404791	25/09/2017
Preamplifier	Norsonic 1209	14105	25/09/2017
Microphone	Gras 40AF	150762	25/09/2015
Calibrator	Pulsar - Model 105	55041	11/11/2017

2.1.2 RESULTS

Results from the unattended noise monitoring are given in Table 2.2 in accordance with NPfI time periods.

Table 2.2 Noise logger results

	RATING BACKGROUND LEVEL dBA			AMBIENT NOISE LEVEL dBA $L_{eq\ period}$		
	Day 7:00am-6:00pm	Evening 6:00pm-10:00pm	Night 10:00pm-7:00am	Day 7:00am-6:00pm	Evening 6:00pm-10:00pm	Night 10:00pm-7:00am
27 Railway Pde	53	51	44	60	58	56

Table 2.3 Measurement results, ambient noise levels (RNP time periods)

	AMBIENT NOISE LEVEL dBA $L_{eq\ period}$	
	DAY 7:00AM-10:00PM	NIGHT 10:00PM-7:00AM
27 Railway Pde	60	56

Note: free-field levels

The noise logger was set to record octave band noise levels. Table 2.4 presents the L_{90} octave band levels recorded during the monitoring period, and Table 2.5 gives the recorded $L_{eq\ period}$.

Table 2.4 Measured L_{90}, octave band centre frequencies

	L_{90} dB OCTAVE BAND FREQUENCY, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
Day 7:00am-12:00am	48	48	47	43	43	42	34	23	10
Night 12:00am-7:00am	40	44	42	38	36	33	20	11	10
7:00am-6:00pm	50	48	48	44	43	42	36	30	23

Table 2.5 Measured L_{eq}, octave band centre frequencies

	L_{eq} dB OCTAVE BAND FREQUENCY, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
Day 7:00am-12:00am	48	48	47	43	43	42	34	23	10
Night 12:00am-7:00am	40	44	42	38	36	33	20	11	10
7:00am-6:00pm	64	63	60	56	54	55	51	44	35

2.2 TRAIN PASSBY MEASUREMENTS

Operator-attended measurements were conducted on 11 May 2017 to determine noise and vibration emissions from train passby events on the nearby rail corridor.

2.2.1 EQUIPMENT AND MEASUREMENT APPROACH

Vibration measurements were conducted at the nearest site boundary to the rail corridor. The transducer was located at ground level at the boundary of 26 Railway Parade, approximately 25 m from the nearest rail line.

A summary of the equipment used for the measurements, and the calibration details, is given in Table 2.6.

Table 2.6 – Equipment details

EQUIPMENT DESCRIPTION	MANUFACTURER AND TYPE NO.	SERIAL NO.	CALIBRATION DUE DATE
Vibration Meter	Svan 958	36693	13/01/2018
Transducer	Svan SV84	D5995	13/01/2018

2.2.2 RESULTS

A summary of the observed train passbys and the resulting vibration level is given in Table 2.7.

Table 2.7 Measured train vibration levels

TIME	TRAIN	MEASURED VIBRATION DOSE VDV, $m/s^{1.75}$	MEASUREMENT DURATION s
12:03pm	Waratah	0.05	21
12:11pm	C Set	0.02	52
12:15pm	Waratah	0.04	35
12:24pm	OSCAR	0.07	40
12:26pm	Freight	0.04	50
12:32pm	Waratah	0.04	31

3 ACOUSTIC CRITERIA

Development approval criteria are determined by local council requirements, state policies and guideline documents. This section presents the noise criteria applicable to the proposed redevelopment. Relevant policies and guidelines for this development site are summarised in Table 3.1.

Table 3.1 Applicable policies and guidelines

ASSESSMENT	APPLICABLE POLICIES AND GUIDELINES	RELEVANT ASPECTS OF DEVELOPMENT
Industrial noise emissions	NSW EPA Noise Policy for Industry	Noise from sources (such as mechanical plant) associated with the development Loading dock activities which may produce noise Noise emissions from vehicular movements on the site, including car parking
Entertainment noise emissions	NSW — Office of Liquor, Gaming and Racing - reducing the risk of noise disturbance: October 2009	Amplified music from entertainment venues
Road traffic noise emissions	NSW DECCW Road Noise Policy	Noise from additional traffic on public road generated by the development
Noise ingress	NSW DoP Development Near Rail Corridors and Busy Main Roads Interim Guideline Parramatta DCP Australian Standard AS2107:2016	Internal noise level within apartment Internal noise level within hotel rooms
Vibration	NSW DoP Development Near Rail Corridors and Busy Main Roads Interim Guideline NSW EPA Assessing Vibration: a technical guideline	Vibration impacts on the development due to trains
Construction noise and vibration	NSW EPA Interim Construction Noise Guideline NSW EPA Assessing Vibration: a technical guideline	Noise and vibration during construction
Sound insulation	Building Code of Australia, Part F5	Construction of inter-tenancy partitions within the development Sound insulation between sole occupancy units Sound insulation between hotel rooms

3.1 INDUSTRIAL NOISE EMISSIONS

The proposed development has the potential to contribute to the existing external noise environment near the proposed site. Noise assessed under the NSW Noise Policy for Industry (NPfI) includes:

- Noise from sources (such as mechanical plant) associated with the development
- Loading dock activities which may produce noise
- Noise emissions from vehicular movements on the site, including car parking

Noise will be generated from loading dock activities and from fixed mechanical plant (such as condensers and fan units) associated with the buildings. To ensure that nearby noise sensitive receivers are not adversely affected by noise, noise emissions from the proposed development must be designed to comply with relevant policy and legislation.

The following section provides an overview of the relevant acoustic criteria applicable to the proposed development based on the requirements of the NSW NPfI.

3.1.1 OVERVIEW

The NSW NPfI prescribes methods for determining the statutory environmental noise limits that apply to noise sensitive receivers (i.e. residences) with regards to noise due to individual noise sources only.

The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences
- Maintaining noise level amenity for particular land uses for residences and other land uses

In assessing the noise impact of industrial sources, both components must be considered for residential receivers. In most cases, only one will become the limiting criterion and form the project-specific noise levels for the industrial source under assessment. The intrusive noise criteria do not apply to commercial receivers, instead an amenity criterion is applicable to these receivers.

In addition to the above, the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered.

3.1.2 TIME PERIODS

Time periods defined by the NSW NPfI are presented in Table 3.2.

Table 3.2 NSW NPfI Time Periods

NSW NPfI TIME PERIOD	TIME
Day	7am to 6pm Monday to Saturday 8am to 6pm Sundays and public holidays
Evening	6pm to 10pm all days
Night	All other times

3.1.3 INTRUSIVENESS CRITERION

With regard to the assessment of intrusive noise due to industrial sources, the NSW NPfI states:

The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise form the source (represented by the ***L_{Aeq} descriptor****), measured over a 15-minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold.*

The intrusiveness criterion for residential receivers prescribed in the NSW NPfI may be summarised as:

$L_{Aeq,\ 15\text{-}minute}$ ≤ Rating Background Level (L_{A90}) + 5 dB(A)

Where the Rating Background Level (RBL) is prescribed as:

Rating Background Level (RBL) – the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). The rating background level is the level used for assessment purposes. ***Where the rating background level is found to be less than 30dB(A) for the evening and night periods, then it is set to 30dB(A); where it is found to be less than 35 dB(A) for the daytime period, then it is set to 35 dB(A).***

Based on the background noise level measured during the day, evening and night periods, the RBL and intrusiveness criterion has been established for the proposed development in accordance with the NSW NPfI.

3.1.4 AMENITY CRITERIA

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels prescribed in the NSW NPfI where feasible and reasonable.

Nearby residential receivers located around the redevelopment is categorised as R3 "Medium Density Residential", therefore it is categorised as a "suburban residential" receiver in accordance with the NPfI. The relevant amenity criteria established in accordance with the NSW NPfI are presented in Table 3.3.

The recommended amenity noise levels represent the objective for **total** industrial noise at a receiver location, whereas the **project amenity noise level** represents the objective for noise from a **single** industrial development at a receiver location.

Project amenity noise level for industrial development = recommended amenity noise level (Table 2.2) minus 5 dB(A)

Table 3.3 Recommended L_{eq} noise levels from industrial noise sources

TYPE OF RECEIVER	INDICATIVE NOISE AMENITY AREA	TIME OF DAY	RECOMMENDED AMENITY NOISE LEVEL, dBA $L_{eq,\ period}$	PROJECT AMENITY NOISE LEVELS, dBA $L_{eq,\ period}$
Residential	Suburban	Day	55	50
		Evening	45	40
		Night	40	35
Commercial	Commercial	When in use	65	60

When the measured existing noise level ($L_{Aeq\ 15\ min}$) at a residential receiver is close to the "Acceptable Noise Level" (ANL) detailed in Table 3.3 due to industrial noise sources, noise from the new source must be controlled to preserve the amenity of the area in accordance with the requirements of the NSW NPfI.

3.1.5 PROJECT NOISE TRIGGER LEVEL

In assessing the noise impact of the proposed development on surrounding residential receivers, both the intrusiveness and amenity criterion must be considered. In most cases, only one criterion will become the limiting criterion and form the project noise trigger levels (PNTL) for the industrial source under assessment. A summary of all relevant criteria, including the project noise trigger level for each time period is presented in Table 3.4.

The criteria presented in Table 3.4 applies to environmental noise emissions from the proposed redevelopment including mechanical plant. Environmental noise criteria are applicable at the property boundary of the nearest residence to the proposed development site.

Table 3.4 Summary of environmental noise criteria

RECEIVER TYPE	PERIOD	RBL dBA	INTRUSIVE CRITERIA dBA $L_{eq,\ 15min}$	PROJECT AMENITY NOISE LEVEL* $L_{Aeq\ 15\text{-}MINUTE}$, dB	PROJECT NOISE TRIGGER LEVEL $L_{Aeq\ 15\text{-}MINUTE}$, dB
Residential	Day	53	58	53	53
	Evening	51	56	43	43
	Night	44	49	38	38
Commercial	When in use	-	-	63	63

* Project amenity noise level (ANL) is suburban ANL (Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level.

3.1.6 MAXIMUM NOISE LEVEL EVENT ASSESSMENT

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed the following, a detailed maximum noise level event assessment should be undertaken.

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

3.2 ENTERTAINMENT NOISE EMISSIONS

Parramatta City Council does not include specific requirements for entertainment noise emissions. Therefore, the typical OLGR requirement is adopted for the proposed development to control entertainment noise associated with any licensed premises on site.

A typical OLGR requirement is provided within the document *Office of Liquor, Gaming and Racing - reducing the risk of noise disturbance: October 2009.*

a) *The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) by more than 5 dB between 07:00 am and 12:00 midnight at the boundary of any affected residence.*

b) *The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) between 12:00 midnight and 07:00 am at the boundary of any affected residence.*

c) *Notwithstanding compliance with (a) and (b) above, noise from the use is not to cause the existing established $L_{A90, 15\ minute}$ which enters a separate residential premise, in the absence of noise from the use, to increase in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed within a habitable room between the hours of 7am and 12 midnight.*

d) *Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 am.*

e) *The $L_{A10, 15minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90, 15\ minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 3dB when assessed indoors at any affected commercial premises.*

Based on the measured octave band noise levels at the receivers presented in Table 2.4, the above conditions have been translated into noise limits to be complied with at the boundary of the surrounding receivers and applying the corrections detailed in the above OLGR criteria 'a' and 'b'. Internal noise criteria as noted in 'd' and 'e' also apply.

Table 3.5 – Octave band criteria at various noise sensitive receivers

		dB L_{10} AT 1/1 OCTAVE BAND CENTRE FREQUENCY (HZ)								
		31.5	63	125	250	500	1K	2K	4K	8K
Residential receiver	Daytime Criterion	53	53	52	48	48	47	39	28	15
	Night-time Criterion	40	44	42	38	36	33	20	11	10
Commercial receiver (external)[1]	When in use[2]	53	51	51	47	46	45	39	33	26

(1) Internal criteria may be equally applied externally at the receiver since the façade of receivers are likely to remain unchanged. Therefore, if noise emissions are compliant with the criteria outside of the receivers, compliance with the internal criteria will also be achieved.

(2) Typical operation hours for commercial receivers has been assumed as 7am to 6pm.

3.3 ROAD TRAFFIC NOISE

The *Road Noise Policy* (RNP) is used to assess noise from additional traffic on public road generated by the development. For traffic generating developments, the RNP states:

> *For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option.'*

In addition, the RNP provides an assessment noise level applicable to traffic generating developments. Table 3.6 presents the relevant criteria relevant to residences affected by arterial roads. Note that the criteria applies to façade-corrected noise levels.

Table 3.6 Excerpt from RNP Table 3, road traffic noise assessment criteria for residential land uses

ROAD CATEGORY	TYPE OF PROJECT/LAND USE	ASSESSMENT CRITERIA	
		DAY (7.00AM-10.00PM)	NIGHT (10.00PM-7.00AM)
Freeway/arterial/sub-arterial roads	Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{eq\ 15\ hour}$ 60 dBA (external)	$L_{eq\ 9\ hour}$ 55 dBA (external)
Local roads	Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{eq\ 1\ hour}$ 55 dBA (external)	$L_{eq\ 1\ hour}$ 50 dBA (external)

In summary, the site specific assessment criteria are where the development causes an increase in road traffic noise of more than 2 dBA and the noise levels in Table 3.6 are exceeded.

3.4 NOISE INGRESS

The *Development Near Rail Corridors and Busy Main Roads Interim Guideline* provides advice for addressing noise from railways and roads with 40,000 or more vehicle movements per day (average annual daily traffic flow, or AADT).

The development is located near an existing heavy rail corridor, with the nearest operational railway track approximately 32m from the development site. Hawkesbury Road is situated to the north of the development and has an AADT of 30,873 measured at RMS traffic station 7119-PR (approximately 1.2km southwest of the development).

Due to the development's proximity to the rail corridor, criteria in the guideline must be met. In addition, the guidelines states that "if internal noise levels with windows and doors open exceed the criteria by more than 10 dBA, the design of the ventilation for these rooms should be such that the occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia."

Table 3.7 provides the internal noise criteria given in the guideline, which are applicable to the apartments.

Table 3.7 Internal noise criteria

TYPE OF OCCUPANCY	NOISE LEVEL, dBA $L_{EQ\ PERIOD}$	APPLICABLE TIME PERIOD
Residential – sleeping areas (bedrooms)	35	Night 10:00pm-7:00am
Residential – other habitable rooms (excluding kitchens, garages, bathrooms and hallways)	40	Any time

Australian Standard AS2107:2016 provides internal noise levels which can be used as a target for spaces such as living and sleeping areas within dwellings. Table 3.8 provides a summary of the relevant internal noise levels.

Table 3.8 AS 2107 internal noise levels

TYPE OF OCCUPANCY/ACTIVITY	RECOMMENDED DESIGN SOUND LEVEL, dBA $L_{eq\ 15min}$	
	SATISFACTORY	MAXIMUM
Houses and apartments near major roads – Living areas	35	45
Houses and apartments near major roads – Sleeping areas (night time) Hotels and motels near major roads	35	40
Hotel foyers and recreation areas	45	50
Small retail stores, supermarkets, shopping malls	< 55	-

The noise goal for residences within the development is summarised below in Table 3.9, and is based on the 'satisfactory' recommended design sound levels outlined in AS 2107.

Table 3.9 Internal noise goals

LAND USAGE	APPLICABLE TIME PERIOD	INTERNAL NOISE CRITERIA dBA $L_{eq\ 15min}$
Apartments – living areas	Day, Night	40
Apartments – sleeping areas	Night	35
Hotel rooms – sleeping areas	Night	35
Hotel foyer, recreation areas	When in use	45
Retail	When in use	55

3.5 RAIL VIBRATION

Vibration from train passbys is considered 'intermittent' vibration according to the NSW EPA *Assessing Vibration: A Technical Guide*.

Table 3.10 Acceptable vibration dose values for intermittent vibration

LOCATION	ASSESSMENT PERIOD	PREFERRED VALUES $m/s^{1.75}$	MAXIMUM VALUES $m/s^{1.75}$
Residences	Daytime (7:00am-10:00pm)	0.20	0.40
	Night time (10:00pm-7:00am)	0.13	0.26
Offices	Day or night time	0.40	0.80

3.6 SOUND INSULATION CRITERIA

The Building Code of Australia, Volume One Part F5 (BCA) provides performance requirements for partitions separating sole occupancy units. Apartments are classified as Class 2, while hotel rooms are Class 3.

A summary of the sound insulation requirements for inter-tenancy partitions and floors for the project are derived from BCA section 3.8.6 are presented in Table 3.11.

Table 3.11 Inter-tenancy acoustic requirements, Class 2 and 3 buildings

BUILDING ELEMENT	DESCRIPTION	SOUND INSULATION REQUIREMENTS	
		IMPACT	AIRBORNE
Walls	Separating sole occupancy units	—	$R_w + C_{tr} \geq 50$
	Separating a habitable room of a sole occupancy unit from a bathroom, sanitary compartment, laundry or kitchen in an adjacent sole occupancy unit	Discontinuous construction	$R_w + C_{tr} \geq 50$
	Separating a sole occupancy unit and a stairway, public corridor, public lobby or the like	—	$R_w \geq 50$
	Separating a sole occupancy unit and a plant room and lift shaft	Discontinuous construction	$R_w \geq 50$
	A door between a sole occupancy unit and a stairway, public corridor, lobby or the like.	—	$R_w \geq 30$
Floors	Separating sole-occupancy units and separating sole-occupancy units and a plant room, lift shaft, stairway, public corridor, public lobby or the like.	$L_{n,w} \leq 62$	$R_w + C_{tr} \geq 50$
Services	A duct, soil, waste, water supply pipe and stormwater pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a habitable room (other than a kitchen)	—	$R_w + C_{tr} \geq 40$
	A duct, soil, waste, water supply pipe and stormwater pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a kitchen or any other non-habitable room.	—	$R_w + C_{tr} \geq 25$

BUILDING ELEMENT	DESCRIPTION	SOUND INSULATION REQUIREMENTS	
		IMPACT	AIRBORNE
Pumps	The point of connection between the service pipes in a building and any circulating or other pump.	A flexible coupling at the connection	—

4 ASSESSMENT

This section outlines the assessment of the proposed redevelopment and relevant recommendations where required, and considers the existing noise environment. Assessment of the impacts of the proposed Parramatta Light Rail on the development are addressed in Section 5.

4.1 NOISE EMISSIONS

Noise egress will be controlled to meet the relevant criteria as outlined in Section 3. This section details the assessment of industrial and entertainment noise sources.

4.1.1 VEHICLE MOVEMENTS

Loading docks and car parking are located within the basement floors of the development. Access is via Ashley Lane, which is approximately 15m away from residences at 21 Railway Parade. As the loading dock and car park are enclosed, associated noise from these usages will be due to vehicle movements in and out of the development.

Based on the transport impact statement provided by GTA Consultants, the anticipated traffic generation during the PM peak period is 169-192 vehicles. A typical weekday PM peak hour period is 5:00pm-6:00pm. The following assumptions have been adopted to determine the noise generated by car movements

- 192 car movements per hour, equating to 48 vehicles in a 15 minute period
- Each car movement generates noise during movement (90 dBA SWL for 3.5 seconds) and during acceleration (98 dBA SWL for 1.5 seconds)
- Car door slams and cars starting will be contained within the building and do not contribute significantly to external noise emissions

Based on the assumed number of movements, the predicted level from car park usage at 21 Railway Parade is **51 dBA $L_{eq\ 15min}$**. This meets the NPfI day criteria level.

Loading dock activities will depend on the needs of the commercial tenants. As the loading dock is situated within the building, the main source of delivery vehicle noise is expected to be movements at the access points into and out of the development. The following assumptions have been adopted to provide an indicative noise level from loading dock usage:

- One truck (100 dBA SWL) conducting one delivery takes 15 seconds to enter the development, and 15 seconds to leave the development (therefore, 100 dBA SWL for 30 seconds)
- Two roller door events per delivery (94 dBA SWL for total of 10 seconds)

Assuming that one delivery is conducted in a 15 minute period, the predicted noise level from the loading dock operations is 36 dBA $L_{eq\ 15min}$. This meets the NPfI day, evening and night criteria levels.

Based on this indicative level, a maximum of one delivery could take place within a 15 minute period and remain under the NPfI night criteria level (36 dBA $L_{eq\ 15min}$, below criteria of 38 dBA $L_{eq\ 15min}$).

4.1.2 MECHANICAL PLANT

Mechanical plant is proposed to be located on level 8 and the rooftop. Noise emissions associated with the operations of the mechanical equipment are to be determined under guidance contained in the NSW NPfI. Mechanical services noise will be designed to not exceed noise criteria outlined in Section 3.1 of this report.

During the design process, the following typical noise control treatments may be applied to the mechanical design to ensure compliance with the established NPfI criteria;

- Attenuators
- Quiet unit selections
- Consideration to location of units
- Timed systems
- Acoustic barriers and/or acoustic louvres

4.1.3 ENTERTAINMENT

Entertainment noise comprises of amplified music or speech and patron noise from the tavern licenced premises on the site. At this stage of the design, it is uncertain what loudspeakers will be used within the tavern. Amplified music and patron noise will be controlled to meet the criteria given in Section 3.2.

Patron noise has been assessed based on the following assumptions, agreed upon with the client in email correspondence dated 11 April 2018:

- Level 1 tavern terrace: 25 patrons talking with a raised voice, closed between midnight and 7am.
- Hotel terrace: 10 patrons talking with a normal voice, closed between midnight and 7am.
- Food and beverage area: 40 patrons talking with a normal voice during peak times (such as lunch), closed between midnight and 7am.

Sound power levels for patrons have been sourced from ANSI S3.5-1997 *Methods for Calculation of the Speech Intelligibility Index*, and are summarised in Table 4.1.

Table 4.1 Patron sound power levels sourced from ANSI S3.5-1997

	SOUND POWER LEVEL, dB OCTAVE BAND FREQUENCY, Hz					
	250	500	1000	2000	4000	8000
Normal voice	43	43	42	34	23	10
Raised voice	38	36	33	20	11	10

Note: ANSI S3.5-1997 does not define values for octave band centre frequencies below 250 Hz

To model the noise emissions from the tavern terrace, which will have both patrons and gaming machines, source levels were obtained from previous WSP measurements inside an unenclosed gaming area for other projects in Sydney. These levels are considered representative of a typical unenclosed gaming space. The internal sound pressure level used for the calculation is given in Table 4.2.

Table 4.2 Internal noise level, source levels

	dB L_{10} AT 1/1 OCTAVE BAND CENTRE FREQUENCY (HZ)									
	31.5	63	125	250	500	1K	2K	4K	8K	dBA
Internal sound pressure level	69	68	71	69	64	66	62	52	43	70

Distance attenuation between source and receiver, and shielding between the tavern terrace and residences along Ashley Lane were accounted for in calculating patron noise emissions. No significant barriers between the food and

beverage area and hotel terrace were identified. As a result, barrier attenuation was not included in calculations for 27 Railway Parade.

Predicted patron noise levels at nearby sensitive receivers are presented in Table 4.3.

Table 4.3 Predicted noise levels from patrons

LOCATION		SOUND PRESSURE LEVEL, dB OCTAVE BAND FREQUENCY, Hz								
		31.5	63	125	250	500	1000	2000	4000	8000
21 Railway Pde Residential Day	Predicted	43	42	40	38	33	34	28	16	< 10
	Criteria	53	53	52	48	48	47	39	28	15
	Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
21 Railway Pde Residential Night[2]	Predicted	40	38	36	35	29	29	22	< 10	< 10
	Criteria	40	44	42	38	36	33	20	11	10
	Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes[1]	Yes	Yes
27 Railway Pde Commercial	Predicted	-	-	-	40	43	37	32	28	22
	Criteria	53	51	51	47	46	45	39	33	26
	Complies?	-[3]	-[3]	-[3]	Yes	Yes	Yes	Yes	Yes	Yes

(1) Marginal compliance is achieved as the predicted level is within 2 dB of the criteria. The average human ear cannot perceive a difference of 2 dB or less.

(2) Results given for during the night are mitigated levels.

(3) ANSI S3.5-1997 does not define sound power levels in octave band centre frequencies below 250 Hz for speech.

At 21 Railway Parade, the nearest residential receiver, entertainment noise emissions meet the day time criteria levels in each octave band frequency with all louvres opened. During the night, entertainment noise targets may not be met with all louvres opened. For this reason, consideration should be given to reducing the terrace's open area on the Railway Parade facade. Predicted levels are given for a situation where a minimum 6 m length of the louvres are closed on the façade line closest to Ashley Lane (as shown in Figure 4.1)

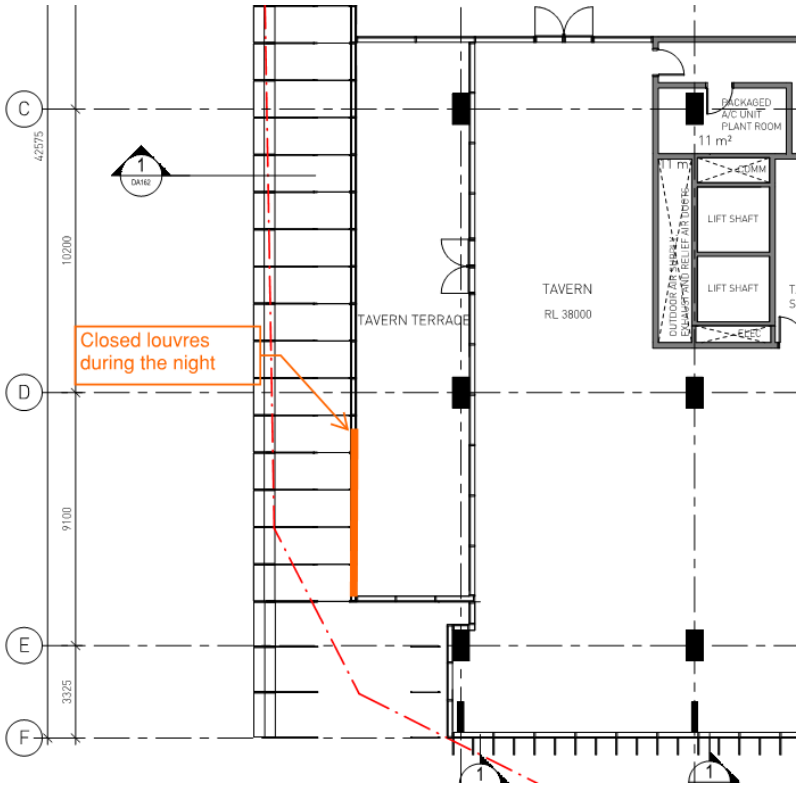


Figure 4.1 Tavern terrace, louvres to close after 12am

For the commercial receiver at 27 Railway Parade, the food and beverage terrace area is expected to be the main contributor of entertainment noise for ground and lower levels, while the hotel terrace is likely to affect higher floors. This is due to shielding offered by the building. The predicted levels are representative of noise breakout from the food and beverage area, assumed to be a 'live' room with large reflective surfaces. Noise breakout from the food and beverage area is expected to meet the commercial criteria levels at 27 Railway Parade.

During the design process, the following typical noise control treatments may be applied to the loudspeaker system design and patron management strategies to ensure compliance with the established entertainment noise criteria:

- Careful placement of loudspeakers to avoid facing nearby sensitive receivers
- Use of directional loudspeakers facing away from sensitive receivers
- Lower music volumes during night periods
- Absorptive finishes within entertainment areas to prevent excessive noise build-up
- Ensuring doors and windows are kept closed during night periods
- Restricting access to external deck or terrace areas during night period
- Provide signage to remind patrons to reduce noise annoyance to neighbours

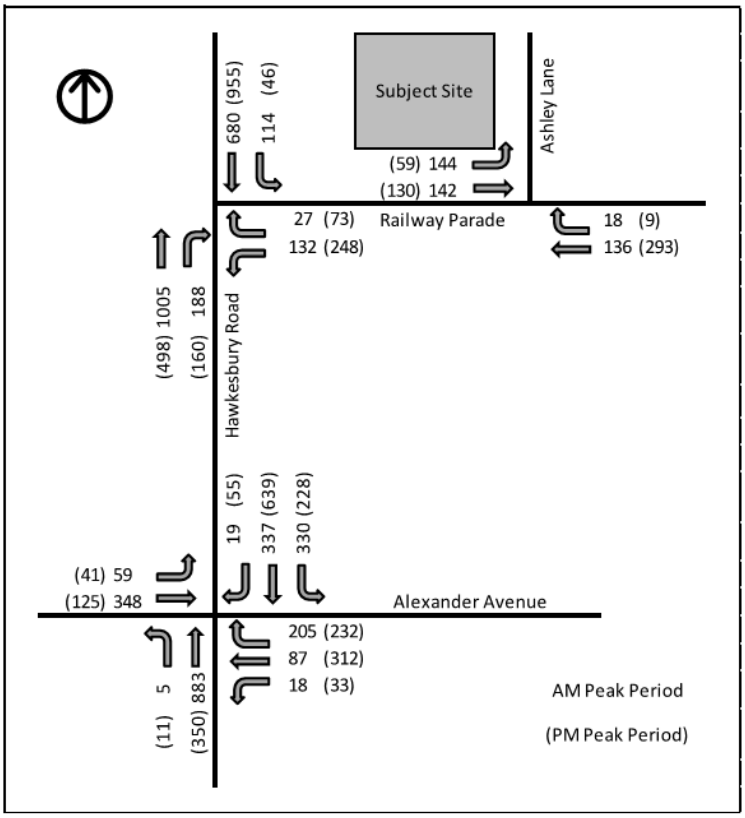
4.2 ROAD TRAFFIC NOISE

In line with the Road Noise Policy (RNP) criteria outlined in Section 3.3, road traffic noise due to the development should not be increased by more than 2 dBA, if the existing noise from the road is above the relevant assessment criteria. An increase in road traffic noise of more than 2 dBA may be determined when the traffic flow increases by 60% or more, assuming the percentage of heavy vehicles, vehicle speed remains constant and the alignment position does not change.

This development does not involve changes to the alignment of Hawkesbury Road, Railway Parade or Ashley Lane, nor a change to posted speed limits.

Due to the existing high volumes, it can be considered that the development is unlikely to increase traffic flow on Hawkesbury Road by more than 60% and is unlikely to increase traffic noise generation by 2 dBA from this road. Therefore, further analysis of road traffic noise from Hawkesbury Road has not been conducted.

Parramatta City Council has provided the existing peak hour traffic flows for Railway Parade and Ashley Lane, which is shown in Figure 4.2.



Source: Parramatta City Council

Figure 4.2 Existing PM peak hour traffic volumes

GTA Consultants have advised that the predicted net increase on Ashley Lane is 106 vehicles during the PM peak period, giving a total of 174 vehicles. As this is a traffic flow increase of more than 60%, it is likely that the existing traffic noise level would increase by 2 dBA. Therefore, a spreadsheet calculation implementing the Calculation of Road Traffic Noise (CoRTN) algorithm has been conducted to determine the resulting noise level during the PM peak period.

Accounting for a distance of 10m between the façade of 27 Railway Parade and the kerb of Ashley Lane, and a total of 174 vehicles on Ashley Lane in the PM peak hour, the predicted road traffic noise level due to Ashley Lane is 55 dBA $L_{eq\ 1hr}$. This meets the daytime criterion for local roads given in the RNP, as summarised in Table 3.6 of this report. No predicted data on the traffic flow during the night-time period was provided at the time of assessment, it is recommended that further study of road traffic noise for the night-time period is conducted to determine compliance with the night-time criterion.

Railway Parade has a higher traffic volume than Ashley Lane during the PM peak period. Assuming a similar net increase as experienced on Ashley Lane, the traffic increase is expected to be less than 60% and therefore is unlikely to increase traffic noise by more than 2 dBA. For this reason, no further modelling of noise emissions from this road has been conducted.

Based on the available traffic data, it is expected that the development will comply with the RNP. Once a detailed traffic analysis has been conducted as part of the detailed design, the impact of road noise will be assessed to confirm if there are additional impacts outside of the PM peak hour period.

4.3 NOISE INGRESS

Key noise sources in the vicinity of the development include the railway line and Hawkesbury Road. The proposed Parramatta Light Rail is also expected to contribute to the noise environment (discussed in Section 5).

Detailed design of the glazing will be conducted during design development and detailed design stages of the project to identify any special requirements for the internal spaces that will be located along the building perimeter.

Acoustic calculations have been performed based on internal room dimensions shown in the current architectural design package and assuming a worst-case scenario of a façade with 100% glazing. The minimum required overall façade sound insulation performance are:

- **34 dB $R_w + C_{tr}$** for apartment living areas
- **32 dB $R_w + C_{tr}$** for hotel and apartment sleeping areas

These performances are the composite performance of both the vision (glazed) and non-vision element.

The following glazing types are provided as examples to meet the nominated performance specification above:

- Living areas: 12.38mm laminated glass, or 6mm float glass/12mm air gap/10.38mm laminated glass
- Sleeping areas: 10.38mm laminated glass, or 6mm float glass/12mm air gap/10.38mm laminated glass

Detailed modelling during detailed design phase can further optimise the glazing requirements and selections based on the elevation of the façade and/or the relative heights of the façade sections to the street level.

Additionally, other factors such as thermal and structural requirements will need to be considered in the final facade glazing design.

4.4 RAIL VIBRATION

An analysis of the current Sydney Trains timetable (20 October 2013 with minor amendments June 2016) was carried out to determine the number of trains passing through Westmead railway station. Freight train movements are not publicly available and could not be obtained. However, based on site observations and the understanding that freight trains do not operate during morning or afternoon peak periods (6am-9am and 3pm-6pm, respectively). It is assumed that 10 freight trains pass through Westmead station during the day period and 10 during the night period. Table 4.4 presents the number of passenger trains.

Table 4.4 Passenger trains passing through Westmead railway station

	TRAINS UP (TOWARDS CENTRAL)	TRAINS DOWN (AWAY FROM CENTRAL)	TOTAL
Weekdays, 7:00am-10:00pm	195	209	404
Weekdays, 10:00pm-7.00am	36	25	61
Weekends, 7:00am-10:00pm	78	77	155
Weekends, 10:00pm-7.00am	24	22	46

From the attended vibration measurements, an average passenger train event results in a VDV of 0.040 mm/s$^{1.75}$ while a freight train produces a VDV of 0.042 mm/s$^{1.75}$. Table 4.5 lists the calculated VDV accounting for the total passenger train movements and 10 freight train passbys in each time period.

Table 4.5 VDV at 24-26 Railway Pde

	DAILY DOSE VDV, mm/s$^{1.75}$	PREFERRED VALUE VDV, mm/s$^{1.75}$	MEETS PREFERRED VALUE
Weekdays, 7:00am-10:00pm	0.18	0.20	Yes
Weekdays, 10:00pm-7.00apm	0.12	0.13	Yes
Weekends, 7:00am-10:00pm	0.14	0.20	Yes
Weekends, 10:00pm-7.00apm	0.11	0.13	Yes

Based on the measurements and the calculated daily dose, intermittent vibration from the rail corridor is expected to comply with the preferred values as outlined in *Assessing Vibration: A Technical Guide*.

4.5 SOUND INSULATION

The Building Code of Australia, Volume One Part F5 (BCA) provides performance requirements for partitions separating sole occupancy units. Apartments are classified as Class 2, while hotel rooms are Class 3.

The residential apartments and hotel guest rooms will be designed to have sound insulation that meets the performance requirements of the BCA for a Class 2 and 3 buildings, as outlined in Section 3.6

These design areas to be developed as part of the detailed design include walls, floors, floor finishes, ceilings and junction detailing.

5 PARRAMATTA LIGHT RAIL

Stage 1 of the Parramatta Light Rail (PLR) involves the construction of 12km of light rail from Westmead to Carlingford via Parramatta CBD and Camellia. 24-26 Railway Parade is located approximately 45m from the light rail alignment and is expected to be situated next to Westmead light rail station.

As the development application for this development is to be submitted after the exhibition of the Stage 1 PLR Environmental Impact Statement (EIS), the proposed high rise building and residential receivers within this development have not been specifically addressed in the PLR EIS noise and vibration impact assessment.

This section discusses the potential noise and vibration impacts of the PLR operations on the proposed development using the publicly available information provided in the project's EIS. Construction noise is not discussed, as these impacts are short-term and are likely to be addressed as part of a construction noise and vibration management plan (CNVMP) for the PLR project.

5.1 NOISE

The following noise sources due to the PLR have been identified:

- Light rail movements
- Westmead light rail station (notably the PA system)
- Substation at 7 Ashley Lane

The development will be located approximately 35m from a straight portion of light rail track and near Westmead light rail station, where light rail vehicles will be traveling slowly.

The following assumptions on light rail noise emissions have been adopted with reference to the PLR EIS:

- Tram on embedded tracks at 60 km/h: 85 dBA SEL. For trams travelling 15km/h or less, apply a -6 dBA correction. Therefore, the SEL for a tram movement is 79 dBA.
- 114 tram passbys during the day period, 24 during the night.

Based on the above assumptions, the predicted noise level from light rail operations is less than 20 dBA during both the day and night periods.

Westmead light rail station is to be located near the intersection of Hawkesbury Road and Railway Parade. The EIS identifies the PA system as a potential noise source associated with the station. The EIS also notes that the PA system will be used intermittently and is unlikely to significantly increase the overall noise level within the area.

A substation is proposed to be located at 7 Ashley Lane. Substation noise is referenced in the EIS, noting that the substation will be required to meet 47 dBA $L_{eq\ 15min}$ during the night. If the substation meets this target, it is not expected to significantly increase the ambient noise levels experienced at the development.

Therefore, based on the available information in the PLR EIS, noise from light rail operations is not expected to significantly alter the required façade noise ingress performance given in Section 4.3.

5.2 VIBRATION

Similar to heavy rail operations, criteria for intermittent vibration (i.e. from light rail operations) is given in *Assessing Vibration: A Technical Guide*.

Based on the values in Table 76 in Technical Paper 13, the maximum predicted VDV in NCA03 (the noise catchment area containing 24-26 Railway Parade) during operation is predicted to be 0.05 $m/s^{1.75}$ during the day and 0.03 $m/s^{1.75}$ during the night. This is a minor increase over the existing measured vibration levels at the site, and would not result in a vibration level over the preferred values given in *Assessing Vibration: A Technical Guide.*

Therefore, it is expected that the PLR project will not significantly increase vibration impact at the proposed development site and is expected to comply with the requirements in the *Development Near Rail Corridors and Busy Main Roads Interim Guideline*.

6 CONCLUSION

WSP has conducted an acoustic assessment of the proposed development at 24-26 Railway Parade, Westmead. The three storey podium and 16 storey building will contain a mixture of residential and commercial uses.

Background noise measurements were conducted between 3 May and 11 May 2017 to determine environmental noise criteria for the development, in accordance with the NSW Noise Policy for Industry. Mechanical services will be designed to meet these criteria levels. Noise from loading dock activities and car park movements are expected to comply with industrial noise criteria. Road traffic is not expected to increase by more than 60% due to the development and as such, road traffic noise criteria will be met.

The façade design will consider target internal noise levels as stipulated in *Development Near Rail Corridors and Busy Main Roads Interim Guideline* and AS2107:2016. Ambient noise levels were measured during the unattended monitoring and were used to determine a required façade noise reduction level.

The BCA Volume One Part F5 specifies the sound insulation requirements of Class 2 and Class 3 buildings. Construction of walls, floors, floor finishes, ceilings and junction detailing for the proposed residential apartments and hotel rooms will be designed to achieve the sound insulation requirements of the BCA.

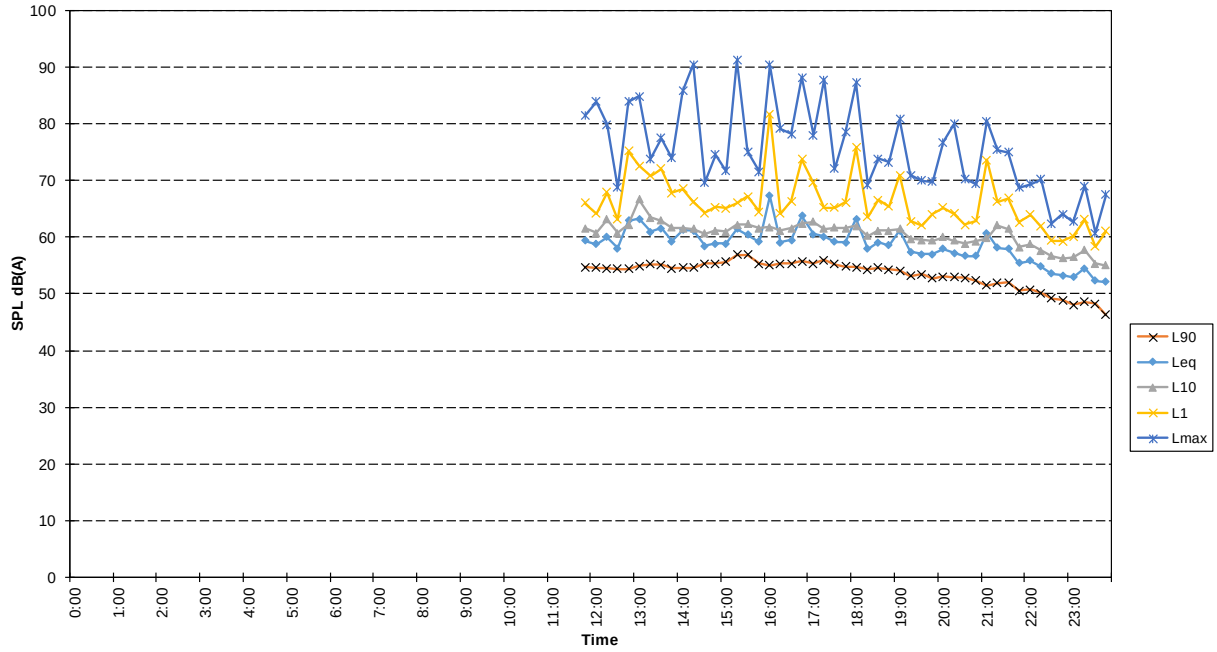
Information given in the Parramatta Light Rail Environment Impact Statement indicates that noise and vibration from light rail operations (tram movements, station PA and electrical substation) is unlikely to require additional mitigation at the development.

Based on the assessments presented in this report, the proposed development is determined to be capable of complying with established development criteria.

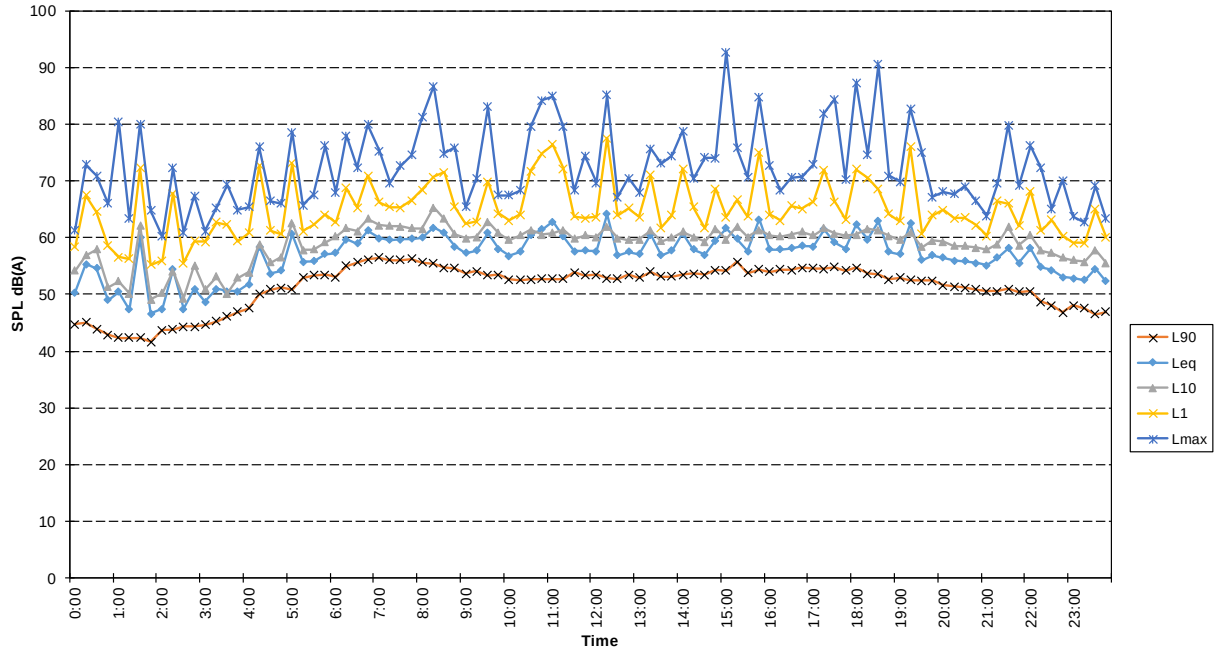
APPENDIX A

NOISE MEASUREMENT RESULTS

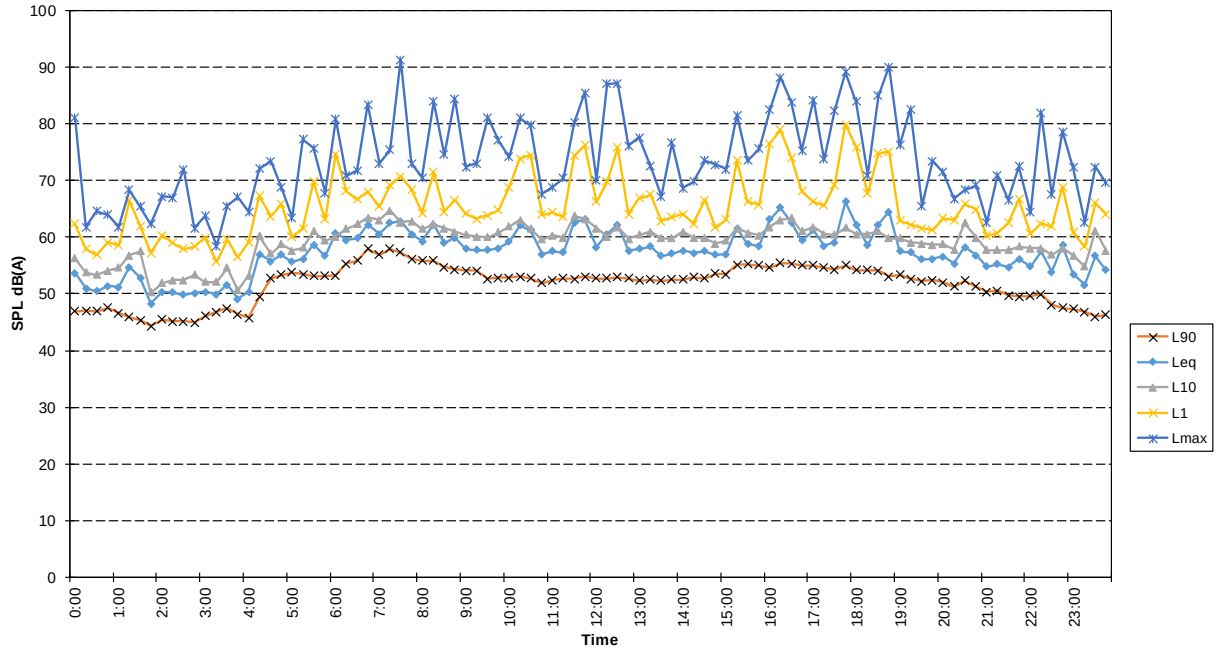
Location - 27 Railway Parade
Measured Noise Levels - Wednesday 03/05/2017



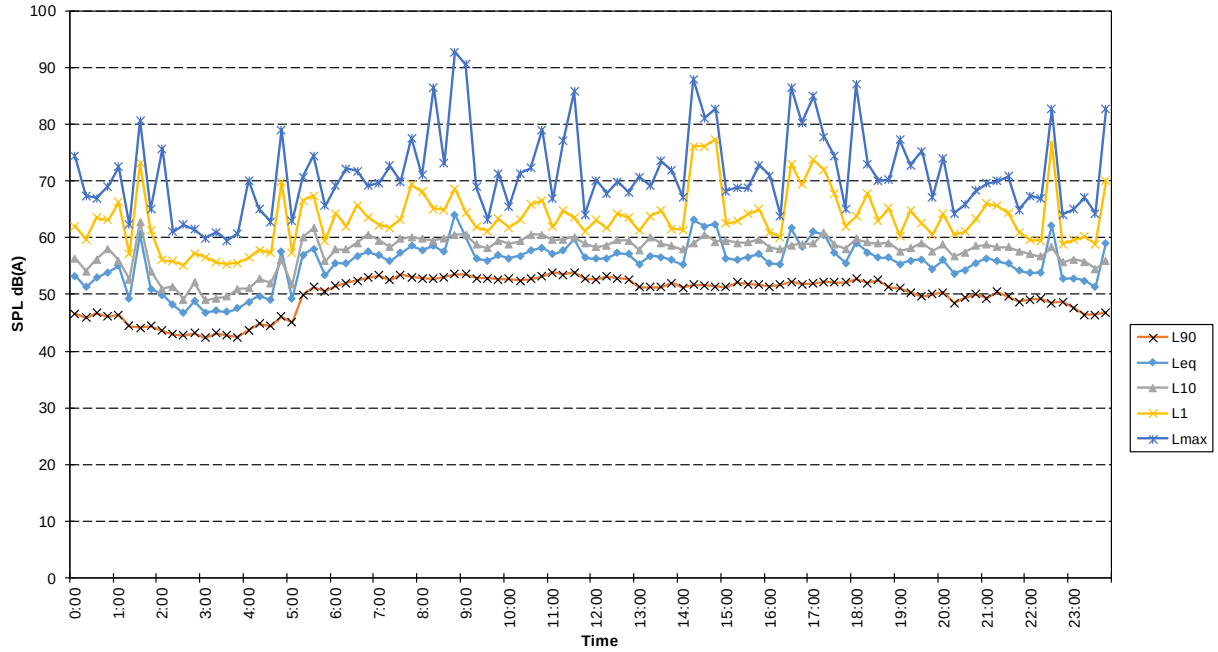
Location - 27 Railway Parade
Measured Noise Levels - Thursday 04/05/2017



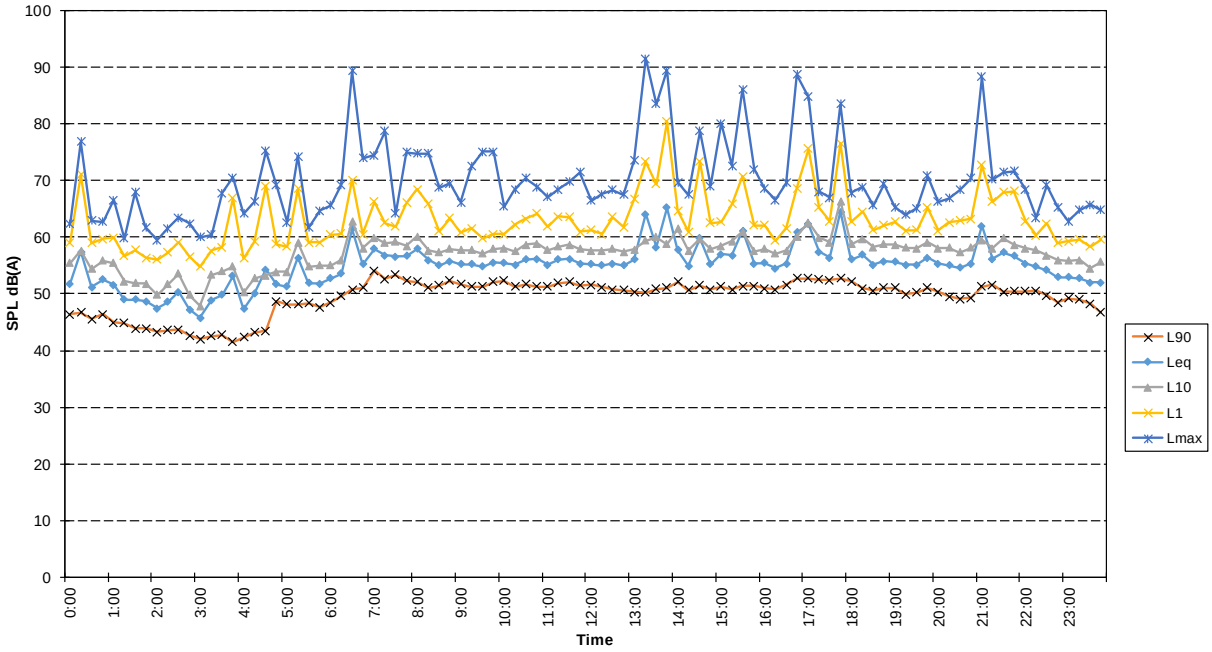
Location - 27 Railway Parade
Measured Noise Levels - Friday 05/05/2017



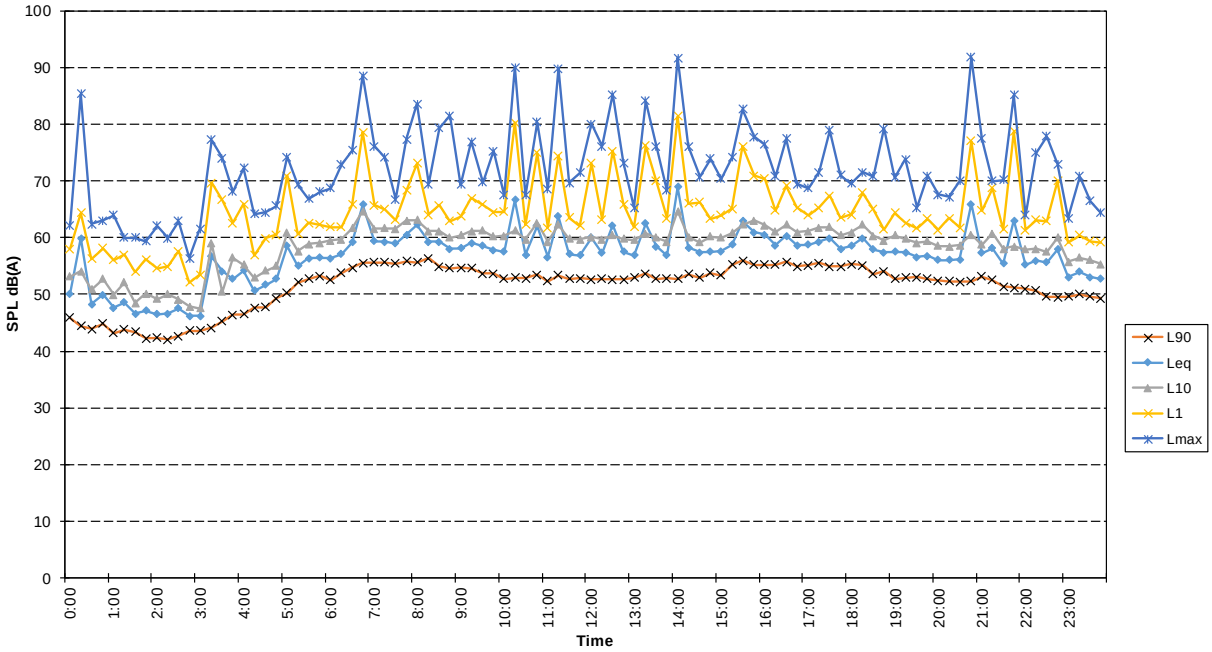
Location - 27 Railway Parade
Measured Noise Levels - Saturday 06/05/2017



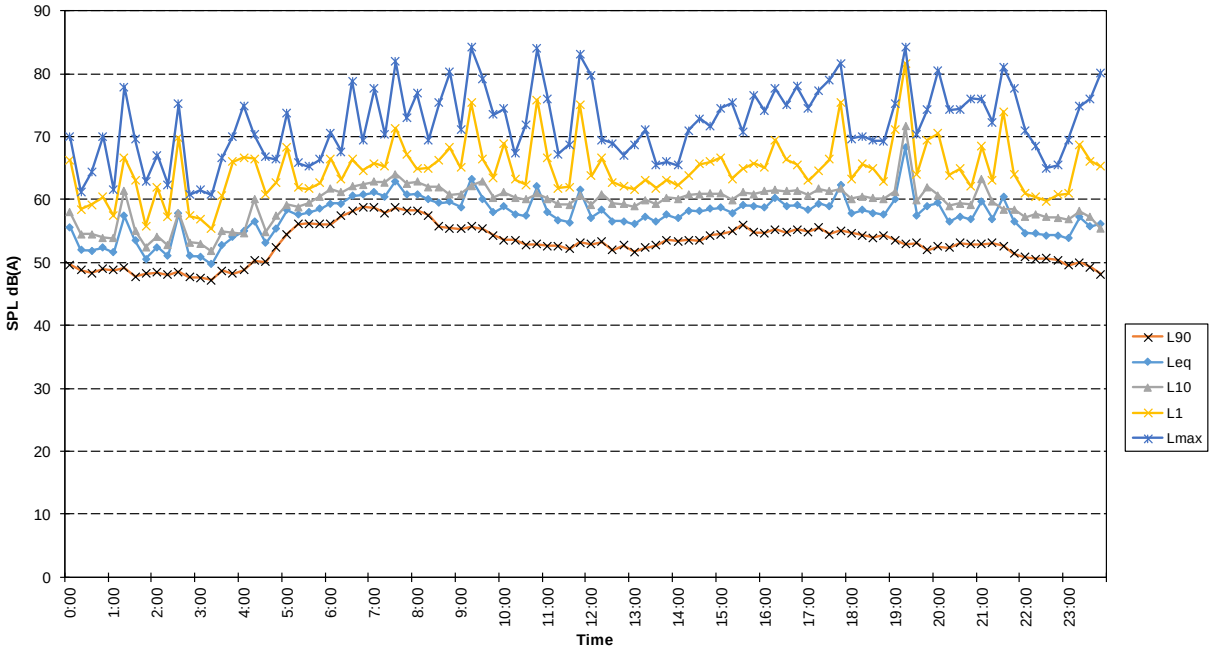
Location - 27 Railway Parade
Measured Noise Levels - Sunday 07/05/2017



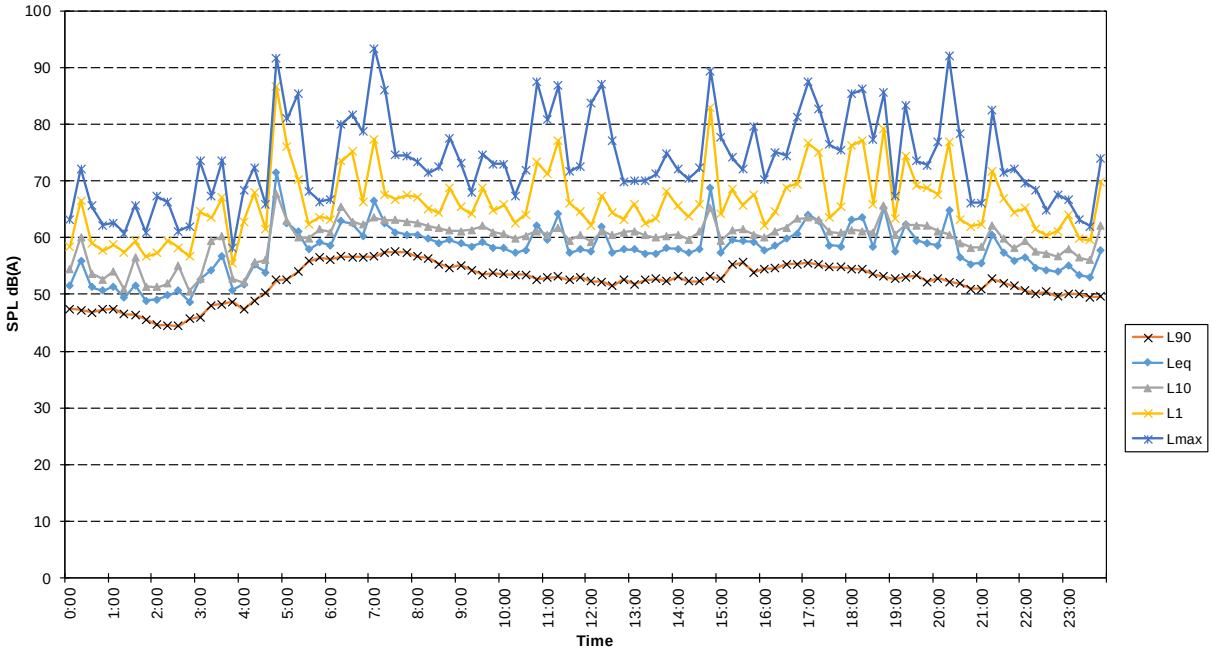
Location - 27 Railway Parade
Measured Noise Levels - Monday 08/05/2017



Location - 27 Railway Parade
Measured Noise Levels - Tuesday 09/05/2017



Location - 27 Railway Parade
Measured Noise Levels - Wednesday 10/05/2017



Location - 27 Railway Parade
Measured Noise Levels - Thursday 11/05/2017