ACOUSTICS AND AIR

240-244 BEECROFT ROAD, EPPING

CONCEPT SUBDIVISION NOISE & VIBRATION ASSESSMENT

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SEPTEMBER 2019

PREPARED FOR

URBAN GROWTH NSW
LEVEL 14, 60 STATION STREET
PARRAMATTA NSW 2150

WILKINSON MURRAY

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GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

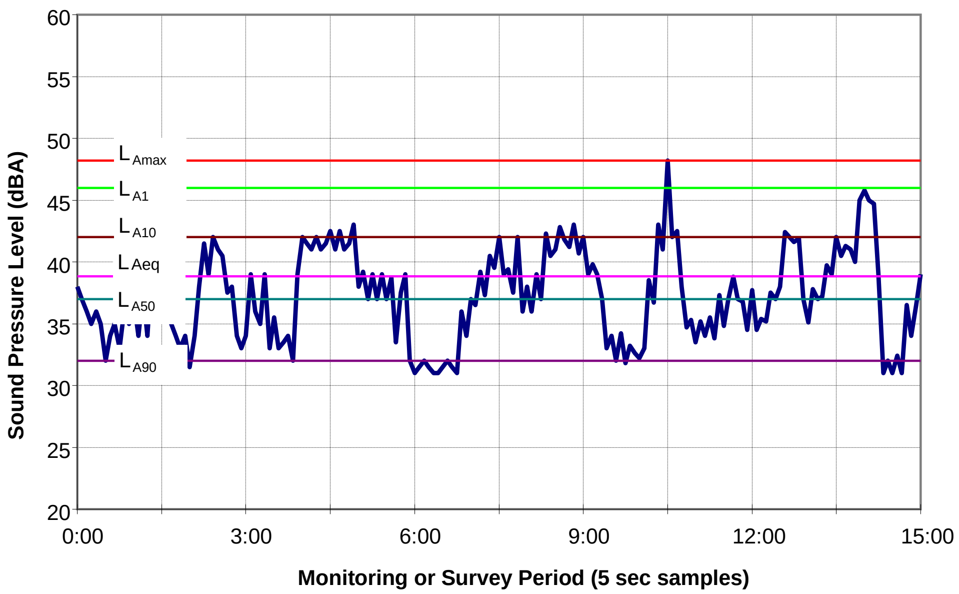
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

It is proposed to develop the land at 240-244 Beecroft Road, Epping primarily for residential use. A concept proposal is currently being developed for the subdivision development application and this report assesses the noise and vibration impact of the development.

It assesses the impact of existing noise levels in the surrounding area upon the proposed residential use and also addresses the noise impact upon the surrounding area as a result of the proposed use. The site is adjacent to Beecroft Road, close to the Northern Line and partly over the Sydney Metro Northwest which is currently under construction and the noise and vibration from this infrastructure may affect the suitability of the site for residential use. This is the main aspect addressed in this report.

2 PROPOSED DEVELOPMENT

The proposed development is a set of six multi-storey apartment buildings between Ray road and Beecroft Road, Epping. The development overlooks Beecroft Road and the existing Northern rail line, approximately 300m north of Epping station.

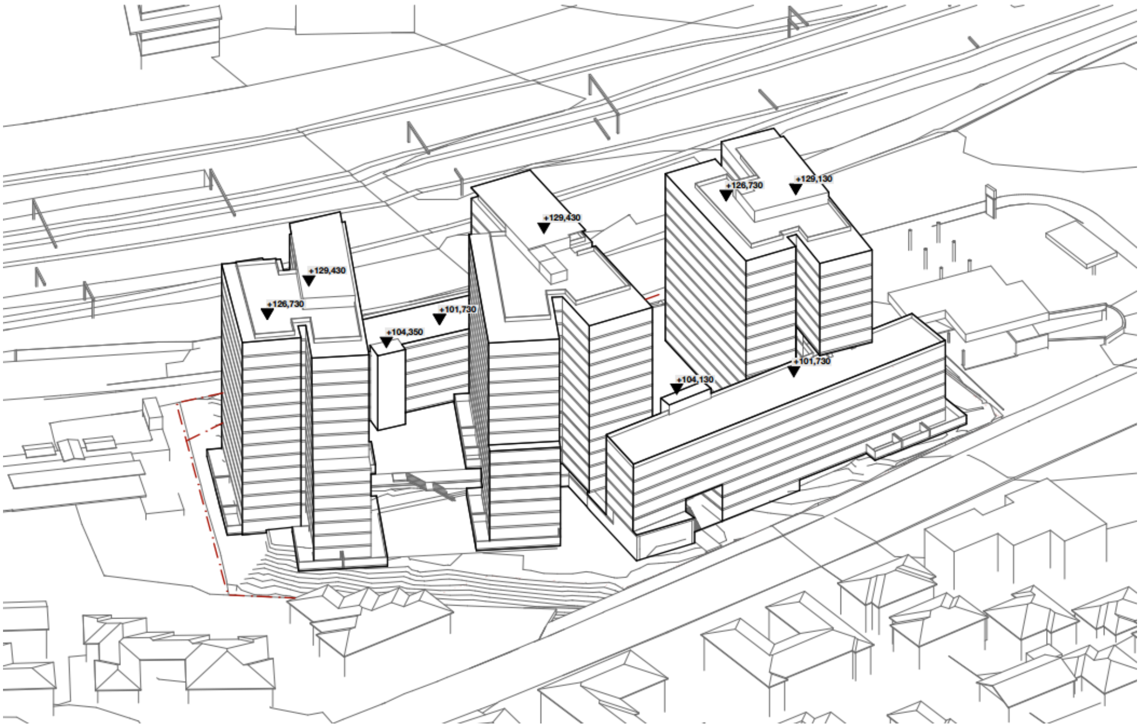
Stage 1 work comprises a subdivision to create two separate lots for the proposed residential development and Epping Service Facility.

Concept Proposal for a residential flat building development comprises:

- Building envelopes for residential flat buildings with a maximum height of 48m;
- An indicative yield of around 442 dwellings;
- Residential gross floor area (GFA) of around 39,000m²;
- Non-residential uses in the lower level/s of the building;
- Car parking for approximately 356 spaces within the basement; and
- Two proposed basement parking entrances.

Figure 2-1 shows a concept drawing of the development up to the 48m height restriction.

Figure 2-1 Concept drawing (Source: Bennett and Trimble)



3 EXISTING NOISE ENVIRONMENT

The existing noise levels of the site must be determined in order to assess the impact that the development will have on the amenity of the area.

Owing to construction currently being undertaken near the site, background noise measurements were unable to be undertaken. Background noise levels were instead taken from a background noise study conducted by SLR Consulting in 2011 as part of the *Noise and Vibration Technical Paper for Operations and Additional Construction Works* for the then North West Rail Link. The result from the SLR noise measurement are shown below in Table 3-1.

The background noise level has been determined by SLR in accordance with the *NSW Industrial Noise Policy (INP)* and this document defines the background noise level as the Rating Background Level (RBL). A definition of RBL is provided in the glossary above.

Table 3-1 Adopted background levels (SLR Consulting)

Location	Period	RBL (dBA)
12/10 Edensor St, Epping	Day (7am-6pm)	45
	Evening (6pm-10pm)	41
	Night (10pm-7am)	32

4 NOISE & VIBRATION ASSESSMENT CRITERIA

4.1 Criteria for Road & Rail Noise affecting the Site

The document *Development near Rail Corridors and Busy Roads – Interim Guideline* published by the Department of Planning refers to the Infrastructure SEPP when determining appropriate airborne and groundborne noise criteria.

4.1.1 Airborne Noise Criteria

The Infrastructure SEPP sets out the following criteria for internal noise levels from airborne traffic noise:

> *"If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
>
> - *in any bedroom in the building: 35dB(A) at any time 10pm-7am*
> - *anywhere else in the building (other than a garage kitchen, bathroom or hallway): 40dB(A) at any time."*
>
> *If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia*

The objectives can be translated to external noise levels by allowing an additional 10 dB for the accepted noise reduction from outside to inside through an open window. The criteria are summarised in Table 4-1.

Table 4-1 Infrastructure SEPP noise criteria

Room Type	Internal Criteria (dBA)	External Criteria (open windows) (dBA)	External Level at which Ventilation is required (dBA)
Bedrooms (Night only)	35	45	55
Any Habitable Room	40	50	60

4.1.2 Groundborne Vibration Criteria

Criteria must be set for groundborne vibration from the Sydney Metro Northwest tunnel. The Planning guideline states:

> *"Vibration levels such as the intermittent vibration emitted by trains should comply with the criteria in* Assessing Vibration: a technical guideline *(DECC 2006). The standards used for assessing the risk of vibration damage to structures are German Standard DIN 4150 Part 3 1999 and British Standard BS 7385 Part 2 1993. Human comfort is normally assessed with reference to the above British Standard or Australian Standard AS 2670.2 1990".*

Based on the above standards, the EIS for the Sydney Metro Northwest set vibration limits based on the maximum one second RMS vibration level not to be exceeded for 95% of rail pass-by events. In addition to limiting the continuous and intermittent vibration levels, vibration dosage, calculated from all pass-bys in a period must also be considered. The appropriate vibration criteria are set out in Table 4-2 below.

Table 4-2 Groundborne vibration criteria

Receiver	Period	Continuous Vibration Limit	Vibration dosage (VdV)[1]
Residential	Day	106 dBV (0.2 mm/s)	0.4 $m/s^{1.75}$
	Night	103 dBV (0.14 mm/s)	0.26 $m/s^{1.75}$

Note: 1. In the absence of acceleration data, eVdV is calculated as an approximation based on RMS vibration values.

4.1.3 Groundborne Noise Criteria

With respect to groundborne noise, the NSW Department of Planning guideline notes the following:

> *"Where buildings are constructed over or adjacent to land over tunnels, groundborne noise may be present without the normal masking effect of airborne noise. In such cases, residential buildings should be designed so that the 95th percentile of train pass-by complies with a groundborne L_{Amax} noise limit of 40dBA (daytime) or 35dBA (night time) measured using the slow response time setting on a sound level meter."*

4.2 Criteria for Noise Generated by the Development

Criteria must be set to limit the impact that the development has on the existing environment.

Noise generated from the use of the development including the operation of the carpark and any mechanical plant must comply with the *Noise Policy for Industry (NPfI).*

The *NPfI* recommends two noise trigger levels, "Intrusiveness" noise level and "Amenity" noise level, both of which are relevant for the assessment of noise. In most situations, one of these is more stringent than the other and dominates the noise assessment.

4.2.1 Intrusiveness Level

An intrusiveness level applies for residential receivers only.

The intrusiveness level requires that the L_{Aeq} noise level from the source being assessed, when measured over 15 minutes, should not exceed the Rating Background Noise Level (RBL) by more than 5dBA.

Where the noise level from the source varies over time due to changes in operating conditions, meteorological conditions or other factors, the upper 10th percentile of 15-minute L_{Aeq} noise levels can be used for comparison with the intrusiveness level.

4.2.2 Amenity Level

The amenity level sets a limit on the total noise level from *all industrial noise sources* affecting a receiver. Different levels apply for different types of receiver (e.g. residence, school classroom); different areas (e.g. rural, suburban); and different time periods, namely daytime (7.00am-6.00pm), evening (6.00pm-10.00pm) and night time (10.00pm-7.00am).

The noise level to be compared with this amenity level is the L_{Aeq} noise level, measured over the time period in question, due to all industrial noise sources, but excluding non-industrial sources such as transportation.

The project amenity level is to be set 5dB below the overall amenity level to allow for the possible cumulative effect of a number of noise generating developments.

Intrusiveness levels have been set based on the measured RBL values referred to in Section 4.2.1. For the purposes of determining the amenity levels, the proposed development is considered suburban.

4.2.3 Development Mechanical Noise Criteria

Table 4-3 shows the relevant mechanical noise criteria for this project.

Table 4-3 NPfI criteria for noise from the proposed development

Time Period	RBL (dBA)	Intrusiveness Criterion $L_{Aeq,15min}$ (dBA)	Amenity Criterion $L_{Aeq,period}$ (dBA)
Daytime (7am–6pm)	45	50	50
Evening (6–10pm)	41	46	40
Night time (10pm–7am)	32	37	35

4.2.4 Road Traffic Noise generated by Development

The proposed development includes a two-storey underground carpark to accommodate the new residents. The increase of traffic on the neighbouring roads needs to be considered with respect to the *Road Noise Policy (RNP)*. The carpark will exit onto Beecroft Road and Ray Road. According the descriptions in the *RNP* and the traffic impact assessment conducted by SCT consulting, Beecroft Road is classified as an arterial Road and Ray road is classified as a sub-arterial road. *RNP* sets overall criteria for road traffic noise on arterial and sub-arterial roads shown in Table 4-4 below.

Table 4-4 Road traffic noise criteria for sub-arterial (collector) roads

Usage	External Assessment Criteria	
	$L_{Aeq,15hr}$ (dBA) Day (7am-10pm)	$L_{Aeq,9hr}$ (dBA) Night (10pm-7am)
Residential – Arterial/Sub-arterial	60	55
Increase of existing traffic noise	+2	

For land use developments with the potential to generate additional traffic on existing roads, the *RNP* requires an assessment of the increase in total traffic noise level where the future noise level will exceed the criteria in Table 4-4. Any increase in the total traffic noise above 2dB as a result of the proposed development indicates that there will be an impact. The noise level increase criterion of 2dB is taken to refer to the $L_{Aeq(15hour)}$ or $L_{Aeq(9hour)}$.

5 ASSESSMENT OF ROAD & RAIL NOISE IMPACT ON THE DEVELOPMENT

5.1 Facades affected by Road & Rail Noise

The proposed development is designed with minimal area fronting onto Beecroft Road. The worst impacted facades have been used to calculate the impact of road and rail noise on the development. Figure 5-1 shows the naming convention adopted for this assessment.

Figure 5-1 Noise affected facades

5.2 Beecroft Road Traffic Noise Methodology

Noise intrusion from the traffic on Beecroft Road has been calculated at each façade of the development.

Traffic noise levels have been predicted using the *Calculation of Road Traffic Noise (CoRTN)* model developed by the Welsh Office of the UK Department of Transport, 1988. The *CoRTN* method calculates the $L_{A10,18hr}$ noise level and takes into account the following factors:

- Traffic flow volumes;
- Average vehicle speed;
- Percentage of heavy vehicles;
- Gradient of road;
- Type of road pavement;
- Distance from receiver location to road;
- Shielding from barriers / building and intervening topography;
- Angle of view;
- Building facade reflection correction; and
- Ground absorption.

This procedure has been modified to permit calculation of 15-hour and 9-hour L_{A10} levels which have then been converted to L_{Aeq} levels using the US Federal Highway Administration (FHWA) procedure.

The proposed site is located on Beecroft Road, north of Carlingford Road. No traffic counter is located on this portion of road and the closest counting station is located to the south of Carlingford Road. The closest classification station is located on Beecroft Road, north of where Beecroft Road crosses the M2 motorway. Volumes from these stations have been conservatively used for this assessment. The volumes adopted for this assessment are shown in Table 5-1.

Table 5-1 Traffic volumes on Beecroft Road

Direction	15-Hour	%HV	9-Hour	%HV
Northbound	24802	4%	4073	4%
Southbound	24014	4%	3248	4%

5.3 Northern Line Rail Noise Methodology

The Northern Line north of Epping Station carries suburban commuter trains, intercity trains and freight trains. The southern end of the Epping to Thornleigh Third Track (ETTT) is just south of the development. The ETTT was built to carry a large proportion of the freight traffic heading north so as not to hinder express trains on the main line.

The *Epping to Thornleigh Third Track Operational Noise and Vibration Review – Jan 2015* conducted recently, includes the portion of track which the proposed development is exposed to. Speeds and predicted volumes from the above review have been adopted for this assessment.

Rail noise was calculated using a 3-D *CadnaA* model. The *Calculation of Rail Noise (CoRN)* method was used. Correction factors for each type of train were based on the Transport Rail Noise database (2013).

5.3.1 Commuter Train Volumes

The predicted volumes of different classifications of trains is shown Table 5-2. These volumes represent predicted volumes for the year 2026 and include a change in the mix of trains to account for the decommissioning of the older K-set and S-set trains.

Table 5-2 Adopted commuter train volumes

	Day		Night	
	Southbound	**Northbound**	**Southbound**	**Northbound**
A,T,M,H-set Trains	88	89	23	24
V-set (Intercity)	20	20	5	6

5.3.2 Freight Train Volumes

The predicted volumes of freight trains are shown in Table 5-3. These volumes refer to predicted levels in 2026. Conservatively, the highest daily level of freight trains has been adopted for this assessment. This volume is very near the capacity of the train line. The split of trains between the main line and the ETTT is based on the TfNSW rail monitor located at Beecroft.

Table 5-3 Adopted freight train volumes

	Day			Night		
	Southbound	**Northbound**	**ETTT**	**Southbound**	**Northbound**	**ETTT**
Freight Daily Average	10	3	10	12	2	7
Freight Highest Daily	14	4	14	17	3	10

5.4 Sydney Metro Northwest Groundborne Noise & Vibration Methodology

Overall groundborne noise and vibration levels generated by the Sydney Metro Northwest were calculated by SLR Consulting for the North West Rail Link Environmental Impact Statement (EIS). This is documented in the *Noise and Vibration Technical Paper for Operations and Additional Construction Works*. The method used was adjusted to allow the calculation of levels at the development site.

5.4.1 Proposed Volumes

The North West Rail Link Environmental Impact Statement gives predicted volumes of the metro line. These volumes are set out in Table 5-4.

Table 5-4 Predicted Sydney Metro Northwest volumes

Scenario	Day (7am-10pm)		Night (10pm-7am)	
	Southbound	Northbound	Southbound	Northbound
Opening	122	124	29	27
Future	172	182	39	29

5.4.2 Vibration Reference Spectrum

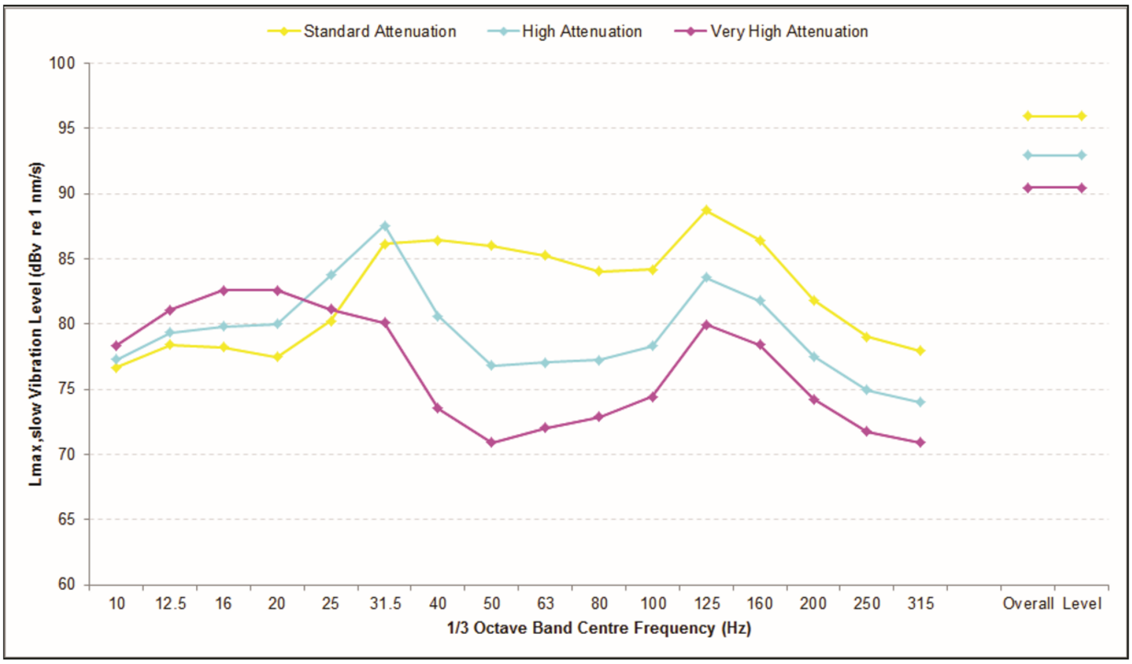
The SLR Consulting method for calculating groundborne noise involves measuring a reference vibration spectrum at 2m from the centre line of the rails. This reference spectrum is train and trackform dependent.

"Given the assumed similarities of the NWRL to the ECRL (in terms of tunnel diameter, concrete lining, slab track design, etc), the source vibration levels for the new fleet of single deck, rapid transit trains for use in the groundborne noise and vibration modelling have been determined from historical measurements of the ECRL conducted by SLR Consulting between 2009 and 2011.

In the absence specific data relating to the proposed single deck trains, source vibration levels have been assumed to be equivalent to A-Set (Waratah) trains, which are the most modern trains currently operating on the Sydney rail network. This assumption is considered to be slightly conservative on the basis that the proposed single-deck passenger trains are likely to have reduced axle loads and unsprung mass compared with A-Set trains, resulting in marginally lower source vibration levels."

The reference spectrum used by SLR Consulting for the EIS and therefore used for this study is shown in Figure 5-2. The vibration reference spectrum is based on a train at 80km/h and must be adjusted for speed where appropriate. A speed of 60km/h is assumed for this assessment due to the proximity of the development to Epping Station.

Figure 5-2 Vibration reference spectrum (Source: SLR Consulting – Noise and Vibration Technical Paper for Operations and Additional Construction Works)



5.4.3 Distance Loss & Material Damping

Vibration decays with distance due to geometric spreading. The distance in question is the slant distance from the tunnel to the nearest point of the structure. Figure 5-3 below shows the cross-section of the proposed development. This shows that the two levels of underground carpark extend below grade on the Beecroft Road side. It is assumed that the bottom floor of the carpark will sit on rock and the structure will not have piles extending further into the ground. Figure 5-4 shows the elevation of the Sydney Metro tunnel.

Figure 5-3 Elevation of proposed development (Source: Bennett and Trimble)

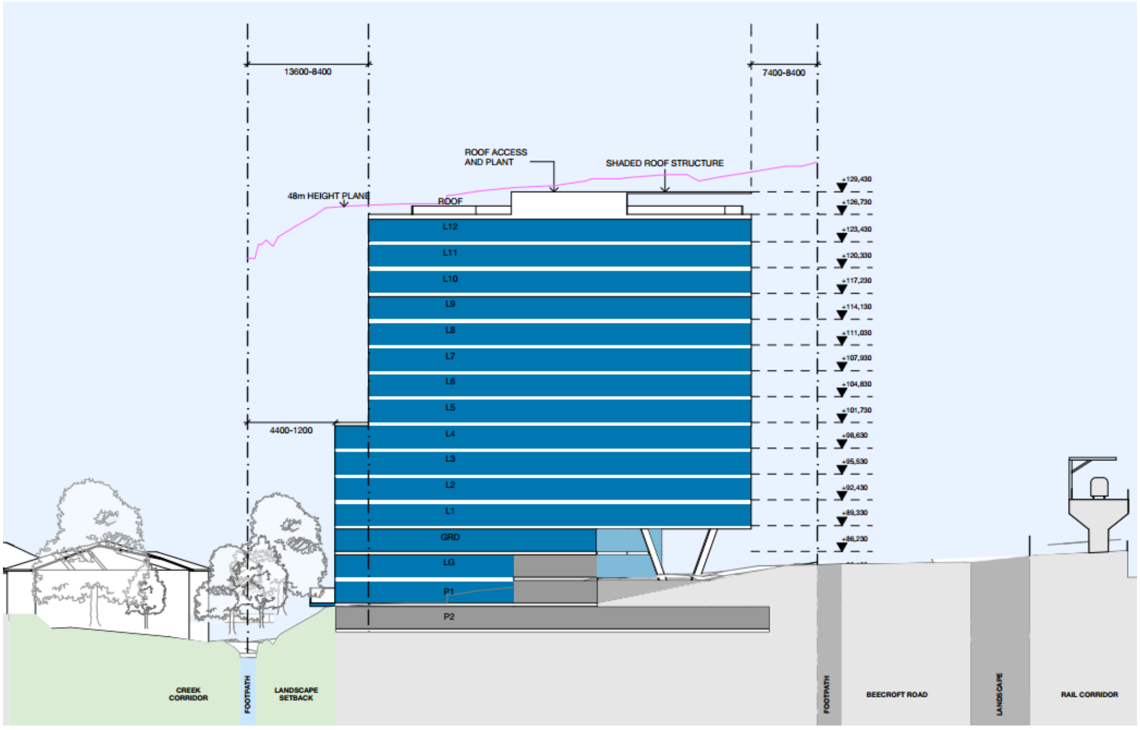
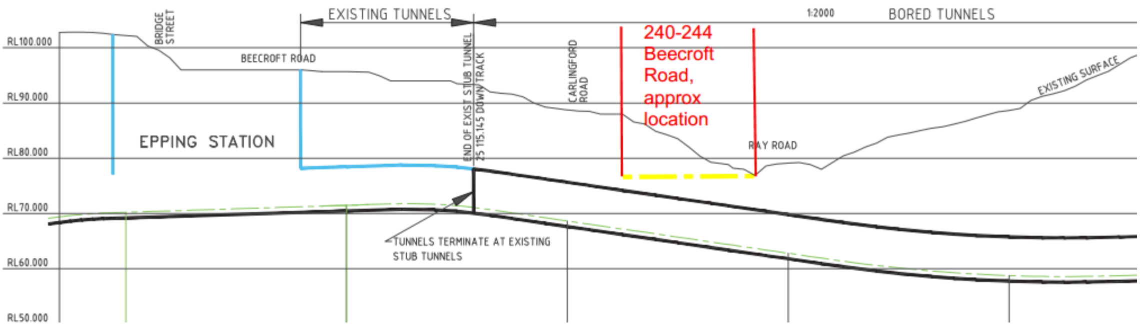
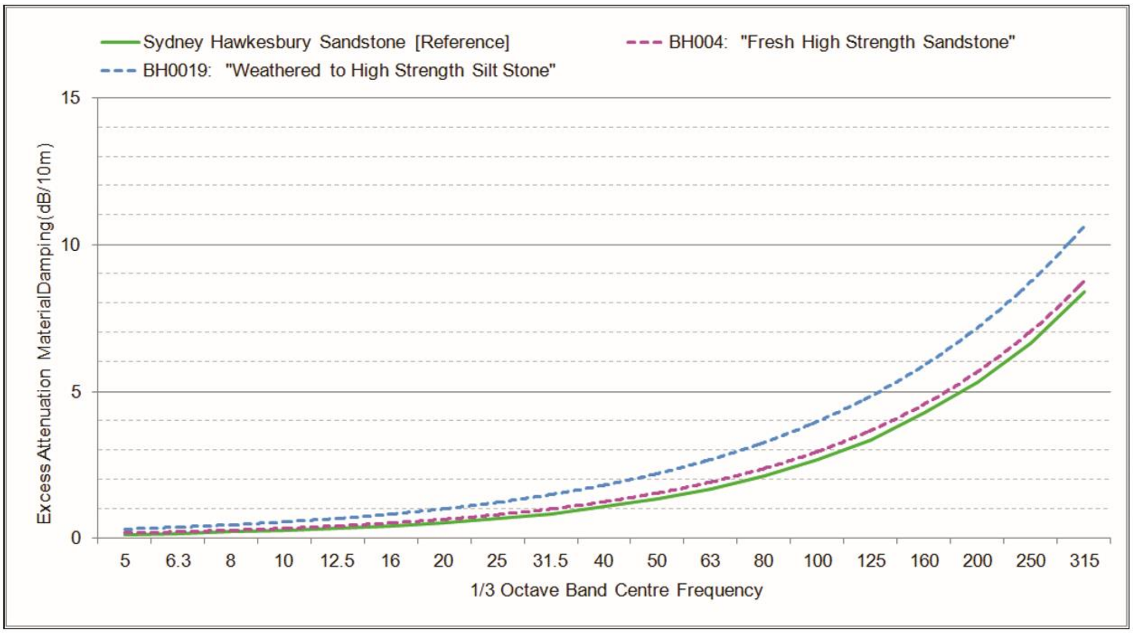


Figure 5-4 Sydney Metro Northwest elevation profile (Source: Aurecon – Parramatta to Epping Rail Link 2011)



In addition to geometric spreading, excess attenuation is provided by material damping. This is highly dependent on the type of ground and is determined by physical testing. Figure 5-5 shows the material damping curve used by SLR Consulting for the EIS. This data is consistent with testing Wilkinson Murray has conducted in sandstone and, as such, has been adopted for this assessment.

Figure 5-5 Excess material damping (Source: SLR Consulting – Noise and Vibration Technical Paper for Operations and Additional Construction Works)



5.4.4 Building Vibration Response

Building Vibration Response (BVR) is the way the structure in question responds to the vibration. The BVR is generally determined by three factors as described below:

- Resonance amplification due to floor, wall and ceiling spans: The FTA Guidance Manual indicates that the natural frequency for a light weight framed building would be in the range 15-20Hz, and for a heavy concrete floored building would be in the range 20-30Hz. It recommends that an amplification of 6dB be added in the natural frequency range.
- Floor-to-floor attenuation: A floor-to-floor attenuation of 2dB is assumed. Where there is a multi-floor occupancy, only the structureborne noise impact on the lowest occupied floor is considered.
- Attenuation across a structure, in the direction away from the alignment: When the noise sensitive area is situated in the back of the building away from the alignment, vibration attenuation across the structure would occur. Attenuation of 2dB reduction per 10m is considered conservatively in this model.

5.4.5 Conversion to Noise

A -27dB correction for conversion of vibration (re: 10^{-9} m/s) in room walls, floors and ceiling to noise (re: 20 μPa) is assumed in the model. This adjustment is based on a typical residential building. There will be some buildings which will have larger spaces or more sound absorption, but which will be constructed of the same building elements, and these may result in a slightly greater adjustment. However, to be conservative for these buildings, the -27dB adjustment has been adopted.

5.4.6 Trackform

It has been confirmed that type 2 trackform (Egg) has been installed under and near the development. This type of trackform will reduce mid frequency vibration and noise levels by an estimated 4dB relative to the levels discussed in the EIS.

5.5 Predicted Noise Levels

5.5.1 Predicted noise levels from Beecroft Road – dBA

Tower	Facade	Floor	Day $L_{Aeq,(15hr)}$	Night $L_{Aeq,(9hr)}$
Tower 1	South	GF-1	72	62
		2-5	72	62
		6-10	71	61
		11-14	70	60
	East	GF-1	74	68
		2-5	73	67
		6-10	71	65
		11-14	70	64
Tower 2	East	GF-1	72	62
		2-5	72	62
		6-10	71	61
		11-14	70	60
	North	GF-1	71	60
		2-5	71	61
		6-10	70	60
		11-14	70	59
Tower 3	South	GF-1	74	64
		2-5	73	63
		6-10	71	62
		11-14	70	61
	East	GF-1	75	68
		2-5	73	67
		6-10	71	65
		11-14	70	64
Tower 4	East	GF-1	72	62
		2-5	72	62
		6-10	71	61
		11-14	70	60
	North	GF-1	72	58
		2-5	71	60
		6-10	70	59
		11-14	70	58
Tower 5	South	GF-1	73	63
		2-5	72	63

Tower	Facade	Floor	Day $L_{Aeq,(15hr)}$	Night $L_{Aeq,(9hr)}$
		6-10	71	61
		11-14	70	60
	East	GF-1	74	67
		2-5	73	67
		6-10	71	65
		11-14	71	65
	North	GF-1	70	64
		2-5	73	64
		6-10	72	63
		11-14	71	62
Tower 6	East	GF-1	70	61
		2-5	72	61
		6-10	71	64
		11-14	70	63
	North	GF-1	70	62
		2-5	71	56
		6-10	71	60
		11-14	70	59
Podium	East – South portion	GF-5	75	68
Podium	East – North Portion	GF-1	74	68

5.5.2 Predicted noise levels from rail operations – dBA

Tower	Facade	Floor	Day $L_{Aeq,(15hr)}$	Night $L_{Aeq,(9hr)}$
Tower 1	South	GF-1	55	51
		2-5	57	53
		6-10	57	53
		11-14	57	53
	East	GF-1	59	55
		2-5	61	57
		6-10	61	57
		11-14	61	57
Tower 2	East	GF-1	58	54
		2-5	60	56
		6-10	60	56
		11-14	60	56
	North	GF-1	55	51
		2-5	56	52
		6-10	56	52
		11-14	56	52
Tower 3	South	GF-1	56	52

Tower	Facade	Floor	Day $L_{Aeq,(15hr)}$	Night $L_{Aeq,(9hr)}$
		2-5	58	54
		6-10	58	54
		11-14	58	54
	East	GF-1	60	56
		2-5	61	57
		6-10	61	57
		11-14	61	57
Tower 4	East	GF-1	58	54
		2-5	58	54
		6-10	58	54
		11-14	58	54
	North	GF-1	39	35
		2-5	39	35
		6-10	58	54
		11-14	58	54
Tower 5	South	GF-1	58	54
		2-5	58	54
		6-10	57	53
		11-14	56	52
	East	GF-1	59	55
		2-5	61	57
		6-10	61	57
		11-14	61	57
	North	GF-1	61	57
		2-5	57	53
		6-10	58	54
		11-14	59	55
Tower 6	East	GF-1	58	54
		2-5	59	55
		6-10	60	56
		11-14	60	56
	North	GF-1	61	57
		2-5	57	53
		6-10	57	53
		11-14	57	53
	Podium E South	GF-5	66	62
	Podium E North	GF-5	66	62

5.5.3 Total Airborne Noise Levels

Table 5-5 gives the total predicted levels from road and rail summarised for groups of floors. It shows only night levels, since these are more likely to exceed the criterion than day levels.

Table 5-5 Total external noise levels from road and rail – dBA

Tower	Facade	Floor	Day $L_{Aeq,(15hr)}$	Night $L_{Aeq,(9hr)}$
Tower 1	South	GF-1	72	62
		2-5	72	63
		6-10	71	62
		11-14	70	61
	East	GF-1	74	68
		2-5	73	67
		6-10	71	66
		11-14	71	65
Tower 2	East	GF-1	72	63
		2-5	72	63
		6-10	71	62
		11-14	70	61
	North	GF-1	71	61
		2-5	71	62
		6-10	70	61
		11-14	70	60
Tower 3	South	GF-1	74	64
		2-5	73	64
		6-10	71	63
		11-14	70	62
	East	GF-1	75	68
		2-5	73	67
		6-10	71	66
		11-14	71	65
Tower 4	East	GF-1	72	63
		2-5	72	63
		6-10	71	62
		11-14	70	61
	North	GF-1	72	58
		2-5	71	60
		6-10	70	60
		11-14	70	59
Tower 5	South	GF-1	73	64
		2-5	72	64
		6-10	71	62
		11-14	70	61
	East	GF-1	74	67
		2-5	73	67
		6-10	71	66

Tower	Facade	Floor	Day $L_{Aeq,(15hr)}$	Night $L_{Aeq,(9hr)}$
		11-14	71	66
	North	GF-1	71	65
		2-5	73	64
		6-10	72	64
		11-14	71	63
Tower 6	East	GF-1	70	62
		2-5	72	62
		6-10	71	65
		11-14	70	64
	North	GF-1	71	63
		2-5	71	58
		6-10	71	61
		11-14	70	60
	Podium E South	GF-5	76	69
	Podium E North	GF-5	75	69

5.5.4 Predicted Levels from Epping Services Facility

Epping services facility will be located to the north of the proposed development. One of the main purposes of the services facility is to provide ventilation to the Sydney Metro Northwest. There are two major noise sources associated with the services facility:

- Ventilation Building; and
- Traction Substation.

A report by Renzo Tonin & Associates for the Sydney Metro Northwest contractor[1] sets noise criteria for these systems based on the *NSW Industrial Noise Policy*. These criteria have been set for the proposed development based on the background noise set out in Table 3-1 and are set with reference to the closest existing residence, 6 Edensor Street. The services facility and 6 Edensor Street (marked as BG01) are shown in Figure 5-6.

[1] Renzo Tonin & Associates, *NWRL OTS – Epping Services Facility Stage 3 – Noise and Vibration, NWRLOTS-NRT-ESF-AV-RPT-301545-C*, 8 March 2016 (Tonin Report)

Figure 5-6 Epping Services Facility

Table 5-6 gives the criteria set out in the Tonin Report. These are very similar to the lower criteria set above in section 4.2, particularly for the night time period.

Table 5-6 Epping Service Facility noise limits (Tonin Report)

Period	Criteria
Day	50dBA
Evening	45dBA
Night	37dBA

The Tonin report also predicts the noise level to be expected at the proposed development at 42dBA. This level complies with the day and evening criteria, but exceeds the night criterion by 5dB. The report then indicates that mitigation of the 5dB will be addressed in the traction substation design package, but no confirmation of the 5dB reduction has been sighted.

Assuming the night criterion is exceeded by 5dB, the internal levels can be made acceptable by closing the bedroom windows. Based on the philosophy discussed in the Infrastructure SEPP, no specific ventilation methods will need to be adopted. This is consistent with the requirement to close windows to control road and rail noise as summarised in Table 5-8 below for Tower 6 - N.

5.5.5 Predicted Groundborne Noise & Vibration from Sydney Metro Northwest

Table 5-7 shows the predicted levels for groundborne noise and vibration calculated at the nearest residence to the Sydney Metro Northwest.

Table 5-7 Predicted vibration and groundborne noise levels

	Vibration (VdB)	Groundborne Noise (dBA)
Criteria	103	35
Predicted Level	61	34

5.6 Mitigation of Road & Rail Noise on Development

5.6.1 Mitigation of Airborne Noise from Beecroft Road & Rail Corridor

In order to reduce internal noise levels of the apartments to comply with the internal noise objectives of the Infrastructure SEPP, mitigation measures must be applied. Due to the height of the structure, the most practical method of reducing noise is to specify better than standard windows and doors. This method is discussed in detail in this report as part of the planning process to confirm that the Infrastructure SEPP noise levels can be achieved. However, alternative noise reduction methods can be considered during the design.

Based on the calculated levels in Section 5.5.3, indicative window/door requirements to achieve the internal noise objectives of the Infrastructure SEPP have been determined.

Table 5-8 sets out the minimum window/door requirements that would be expected to allow the SEPP noise criteria to be met, considering the contributions from rail movements and road traffic on Beecroft Road.

Additionally, it should be noted that the identified window and door standards are to be regarded as indicative only for planning purposes. Exact details should be established at the detailed design stage of each project.

Where a noise reduction of greater than 10dB is required to achieve the internal noise criteria, windows would need to be closed and these windows would need to be upgraded above standard windows. This in turn necessitates the requirement for mechanical ventilation or an air conditioning system capable of delivering fresh air.

During the design, consideration should be given to providing the required noise reduction without the need to close windows and install mechanical ventilation or air conditioning. The following could be considered to at least minimise the need for separate mechanical ventilation or air conditioning:

- Façade features which shield the windows from the noise; or
- Installation of acoustically treated air intakes to apartments along with using the bathroom exhaust system to provide fresh air.

Whilst the recommendations provided herein are indicative only, calculations confirm that, subject to appropriate building façade/glazing design and appropriate provision of mechanical ventilation, the proposed development may be established without undue risk of noise impacts.

Table 5-8 Indicative minimum required windows

Façade	Floor	Total Predicted External Level Night ($L_{Aeq,9hr}$) dBA	Total Predicted External Level Day ($L_{Aeq,15hr}$) dBA	Minimum required Glazing Bedrooms	R_W	Minimum required Glazing Living Areas	R_W
Tower 1 – S	GF-1	62	72	6mm openable	R_W 25	Standard	-
Tower 1 – S	2-5	63	72	6mm openable	R_W 25	Standard	-
Tower 1 – S	6-10	62	71	6mm openable	R_W 25	Standard	-
Tower 1 – S	11-14	61	70	6mm openable	R_W 25	Standard	-
Tower 1 – E	GF-1	68	74	10.38mm Lam	R_W 35	6mm openable	R_W 25
Tower 1 – E	2-5	67	73	10.38mm Lam	R_W 35	6mm openable	R_W 25
Tower 1 – E	6-10	66	71	10mm openable	R_W 30	Standard	-
Tower 1 – E	11-14	65	71	10mm openable	R_W 30	Standard	-
Tower 2 – E	GF-1	63	72	6mm openable	R_W 25	Standard	-
Tower 2 – E	2-5	63	72	6mm openable	R_W 25	Standard	-
Tower 2 – E	6-10	62	71	6mm openable	R_W 25	Standard	-
Tower 2 – E	11-14	61	70	6mm openable	R_W 25	Standard	-
Tower 2 – N	GF-1	61	71	6mm openable	R_W 25	Standard	-
Tower 2 – N	2-5	62	71	6mm openable	R_W 25	Standard	-
Tower 2 – N	6-10	61	70	6mm openable	R_W 25	Standard	-
Tower 2 – N	11-14	60	70	Standard	-	Standard	-
Tower 3 – S	GF-1	64	74	10mm openable	R_W 30	6mm openable	R_W 25
Tower 3 – S	2-5	64	73	10mm openable	R_W 30	6mm openable	R_W 25
Tower 3 – S	6-10	63	71	6mm openable	R_W 25	Standard	-
Tower 3 – S	11-14	62	70	6mm openable	R_W 25	Standard	-
Tower 3 – E	GF-1	68	75	10mm lam	R_W 35	6mm openable	R_W 25

Tower 3 – E	2-5	67	73	10mm lam	R_w 35	6mm openable	R_w 25
Tower 3 – E	6-10	66	71	10mm openable	R_w 30	Standard	-
Tower 3 – E	11-14	65	71	10mm openable	R_w 30	Standard	-
Tower 4 – E	GF-1	63	72	6mm openable	R_w 25	Standard	-
Tower 4 – E	2-5	63	72	6mm openable	R_w 25	Standard	-
Tower 4 – E	6-10	62	71	6mm openable	R_w 25	Standard	-
Tower 4 – E	11-14	61	70	6mm openable	R_w 25	Standard	-
Tower 4 – N	GF-1	58	72	Standard	-	Standard	-
Tower 4 – N	2-5	60	71	Standard	-	Standard	-
Tower 4 – N	6-10	60	70	Standard	-	Standard	-
Tower 4 – N	11-14	59	70	Standard	-	Standard	-
Tower 5 – S	GF-1	64	73	10mm openable	R_w 30	6mm openable	R_w 25
Tower 5 – S	2-5	64	72	10mm openable	R_w 30	Standard	-
Tower 5 – S	6-10	62	71	6mm openable	R_w 25	Standard	-
Tower 5 – S	11-14	61	70	6mm openable	R_w 25	Standard	-
Tower 5 – E	GF-1	67	74	10.38mm Lam	R_w 35	6mm openable	R_w 25
Tower 5 – E	2-5	67	73	10.38 lam	R_w 35	6mm openable	R_w 25
Tower 5 – E	6-10	66	71	10mm openable	R_w 30	Standard	-
Tower 5 – E	11-14	66	71	10mm openable	R_w 30	Standard	-
Tower 5 – N	GF-1	65	71	10mm openable	R_w 30	Standard	-
Tower 5 – N	2-5	64	73	10mm openable	R_w 30	6mm openable	R_w 25
Tower 5 – N	6-10	64	72	10mm openable	R_w 30	Standard	-
Tower 5 – N	11-14	63	71	6mm openable	R_w 25	Standard	-
Tower 6 – E	GF-1	62	70	6mm openable	R_w 25	Standard	-
Tower 6 – E	2-5	62	72	6mm openable	R_w 34	Standard	-
Tower 6 – E	6-10	65	71	10mm openable	R_w 30	Standard	-

Tower 6 – E	11-14	64	70	10mm openable	R_W 30	Standard	-
Tower 6 – N	GF-1	63	71	6mm openable	R_W 25	Standard	-
Tower 6 – N	2-5	58	71	Standard	-	Standard	-
Tower 6 – N	6-10	61	71	6mm openable	R_W 25	Standard	-
Tower 6 – N	11-14	60	70	Standard	-	Standard	-
Podium E South	GF-5	69	76	10.38mm Lam	R_W 35	10mm openable	R_W 30
Podium E North	GF-5	69	75	10.38mm Lam	R_W 35	6mm openable	R_W 25

5.6.2 Mitigation of Groundborne Noise

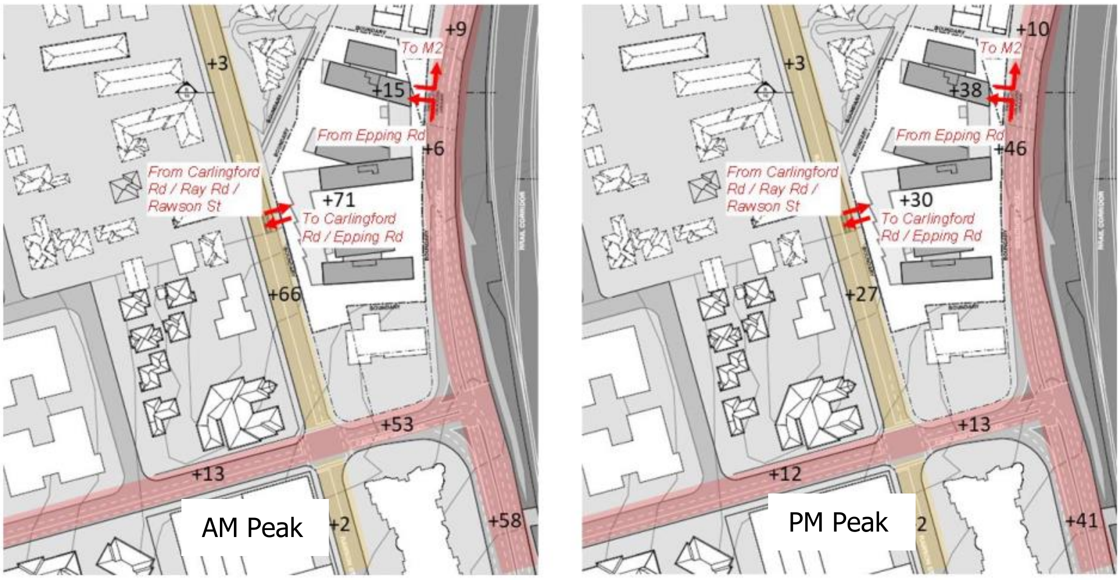
With the type 2 trackform installed near the development, no groundborne vibration or noise mitigation is required.

6 ASSESSMENT OF IMPACT OF DEVELOPMENT ON SURROUNDING RESIDENCES

6.1 Generated Road Traffic

The traffic report completed by SCT Consulting estimates the number of trips that are likely to be generated daily per residence. The development is expected to generate a total of 85 trips in the AM peak, 66 trips in the PM peak and a total of 672 trips daily. Figure 6-1 shows the location of the entry and exits and the expected distribution of trips during the peaks on each of the surrounding roads.

Figure 6-1 Trip generation distribution (source: SCT consulting 2017)



Due to the high existing traffic levels, the additional traffic generated by the development on Beecroft Road will have negligible impact. Similarly, the estimated traffic distribution in Figure 6-1 shows that only a small proportion of vehicles head north on Ray road. This small proportion of trips will not have a significant impact on existing traffic noise levels.

The only residences likely to be affected are the residences on the western side of Ray Road between the carpark entrance and Carlingford Road.

Given that the existing 15-hour and 9-hour traffic volumes on Ray Road are unavailable at this stage and the forecast trips are only for morning and afternoon peaks and 24 hours, the following conservative assumptions have been made in order to assess the traffic noise impacts:

- Daytime: The full daily volume of generated trips would occur during the 15-hour daytime period; and
- Night time: 20% of the daily volume of generated trips would occur during the 9-hour night time period.

Based on these assumptions, Table 6-1 gives the estimated traffic noise contribution from the development.

Table 6-1 Estimated traffic noise level at nearest affected residence from development

Period	Distance to Residences	Traffic Volumes	Noise Criteria	Estimated traffic noise (dBA L_{Aeq})(1)
Daytime (15hr)	25m	684	60dBA	50dBA
Night Time (9hr)	25m	137	55dBA	46dBA

Note 1: Noise level from development traffic only.

In both the 15-hour and 9-hour predictions, the predicted levels are 9-10dBA below the criteria. This means that it is not possible for the total future traffic noise levels to exceed the criteria at the same time as the increase from the development exceeds 2dB, irrespective of the existing traffic flows. It is therefore concluded that there will be no significant traffic noise impact from the development.

A detailed assessment of the existing and forecast traffic noise levels should be undertaken as part of the detailed design.

6.2 Mechanical Plant Noise

Mechanical plant noise from the development must comply with the *NPfI*. No details of mechanical plant are currently available. The plant can be designed at a later design stage to comply with any limits. Mitigation measures can be introduced including attenuators and barriers.

The most important noise criterion is 35dBA at night, applying at nearby residential buildings.

7 CONCLUSION

Noise from Beecroft Road and the Northern Line currently affects the proposed development site. Given the proximity of Beecroft Road to the site, road traffic noise will dominate the noise environment at any future building on the site. The windows and doors required in the development to ensure compliance with the Infrastructure SEPP are shown in Table 5-8 above. Where upgraded windows are required, mechanical ventilation or air conditioning will be required to residences.

The site will also potentially be affected by vibration and groundborne noise from the Sydney Metro Northwest when it becomes operational. The track near the site has been treated with type 2 trackform and this will ensure the vibration and noise criteria set will be complied with without additional mitigation.

The Sydney Metro Northwest Service Facility may result in a noise level which will exceed the night criterion, but this can be mitigated by closing windows to bedrooms, as is required to control road and rail noise (Table 5-8).

The noise from mechanical services at the development, such as carpark exhaust systems and air conditioning, can be controlled to comply with accepted noise criteria at existing residential premises with the use of standard noise control measures. A further analysis will be required at a later time to design the mitigation.

The traffic noise generated by the development as resident's ingress and egress the carpark is not expected to have an impact on existing traffic noise levels.