76 BELMORE STREET RYDE

Concept Plan Acoustic Report

Issued

11 April 2011

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Executive Summary

Noel Bell Ridley Smith & Partners (NBRS+Partners) has undertaken concept planning studies for the redevelopment of the 76 Belmore Street, Ryde Concept Plan site on behalf of Achieve Australia in the context of the Ryde DCP 2010.

A Part 3A Concept Plan application is proposed which anticipates a yield of up to 390 housing units.

As required by the Director General's Requirements for MP10_0110, as part of the application it is critical to understand the detail and to ascertain what is permissible under it as regards the formulation of the future project-specific applications.

This report identifies the acoustic considerations for the Concept Plan and establishes noise and vibration targets which are based on relevant Codes, Standards and guidelines.

The report considers noise generated by the proposed uses for the site, and noise and vibration affecting the proposed uses.

In doing so, the assessment determines the suitability of the Concept Plan for the proposed land use.

Generic design options to control the key acoustic issues are described. These design options will need to be refined, clarified and resolved during the project-specific application and detailed design process for each building on the site.

Based on the surveys which have quantified the existing noise levels affecting the site, and given that the design principles that have been outlined in this assessment are accommodated, it is expected that the acoustic targets presented in this report are achievable for the Concept Plan.

The key acoustic issues for the site are:

- Noise breakout to the environment from new plant serving the proposed buildings on the site
- Noise break-in into the proposed buildings from road traffic on surrounding streets

To address these issues, two noise impact assessments have been undertaken:

1) Environmental Noise Impact Assessment – to assess the impact of noise *break-out* from the site on the surroundings
2) Road Traffic Noise Impact Assessment – to assess the impact of noise *break-in* from road traffic on the different buildings / areas of the site

As part of these assessments, attended noise surveys have been carried out at various locations and various times of the day / night around the proposed Concept Plan site.

The purpose of the noise surveys is to identify existing ambient and traffic noise levels around the site, to assess the impact of the development on the surroundings and to identify any potential noise-sensitive receivers in the vicinity.

There is a continuous flow of road traffic on all of the local roads, and on Church Street to the southeast. This is the dominant continuous environmental noise source affecting the site during the day and night.

At night, the volume of traffic flow reduces but remains the dominant continuous environmental noise source affecting the site – particularly distant traffic on Church Street.

Based on the predicted increases and distribution of vehicle movements around the Concept Plan site, traffic noise levels expected to increase by up to 6 dB from the existing noise levels around the Concept Plan site. Future traffic flows will, therefore, lead to an increase in the existing traffic noise levels of more than 2 dB – as required by the ECRTN.

1. Environmental Noise Impact Assessment

Given the residential land-use proposed for the Concept Plan site, the main source of noise break-out from the developments associated with the Concept Plan site to the environment will be mechanical services plant – particularly roof plant.

Limits for mechanical plant noise levels generated by the new buildings will need to be derived from advice and guidance provided in the Protection of the Environment (Operations) Act 1997 (PoEO Act), and the Industrial Noise Policy of the NSW Environmental Protection Authority (now Department of Environment, Climate Change and Water) (EPA INP).

The project specific environmental noise limits for new plant will be derived for each of the buildings associated with the Concept Plan site - once the plant types and locations are known for each building.

These noise limits will be based on the measured noise levels provided in this assessment report, plus supplementary project-specific surveys, as required.

These noise limits will then be used to determine the noise control required for all new plant.

Source noise levels for plant associated with each building will need to be assessed and plant will be selected to meet these environmental noise criteria. Roof top plant will be enclosed or screened as required. If necessary, additional environmental noise control methods may include in-duct attenuators, acoustic louvres for plant rooms, and enclosures for noisy plant items.

With these noise control measures in place, we consider that environmental noise limits will be met at all affected receiver locations.

The use of each premise, including vibration associated with mechanical plant, will not give rise to transmission of vibration to any place of different occupancy greater than specified in AS 2670.2.

The same vibration criteria will apply to vibration from plant felt within the areas associated with each of the new developments.

Therefore, vibration transmission from mechanical plant to nearby properties is expected to be imperceptible, and well under the AS 2670.2 criteria. All plant will need to be provided with vibration isolation.

2. Road Traffic Noise Impact Assessment

Apartment internal noise levels are based on recommendations and guidance from the Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010, SEPP (Infrastructure) 2007, plus reference to AS2107:2000 and NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline.

In the majority of apartments, the background noise level will be dominated by the external noise sources.

This assessment presents the total internal noise levels that are set for each of the key spaces for each building.

Typically the noise levels are consistent with the recommendations of the Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010, SEPP (Infrastructure) 2007 plus reference to AS2107:2000 and NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline.

In accordance with good practice, it is intended that sensible and appropriate levels of technology and design be applied to reduce energy wastage and carbon dioxide emissions arising from the operation of the buildings, both for financial and environmental reasons, without reducing the functional standards necessary.

In order to satisfy these requirements and reduce the energy load of the buildings, the Architectural design may incorporate passive design measures to minimise energy consumption associated with air-conditioning and ventilation systems.

The design philosophy will be to provide both appropriate and sensible initiatives for the project that align with and support the functional and operational requirements. Specifically, wherever possible, ventilation requirements are achieved via operable windows in lieu of mechanical ventilation systems.

In-line with this philosophy, and recognising that the Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010 and SEPP (Infrastructure) 2007 do not differentiate between a windows closed or windows open condition for apartments, the recommendations given in the NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline for a windows open condition have been adopted for the apartment living and sleeping areas.

To achieve the total internal noise levels set for each space, the façades will need to be designed to provide the required external-to-internal sound insulation performance.

A separate acoustic assessment of the existing traffic noise levels affecting each building on the site will be undertaken as part of the project specific application for each site.

These assessments will need to determine the implications that the noise levels have on the apartment façade and ventilation options.

Based on the traffic noise surveys undertaken by Acoustic Studio as part of this assessment, and the expected increase in traffic noise levels which will result from increased traffic flows around the site, the following is provided to outline the likely implications that the traffic noise levels will have on the design of the façades for the buildings:

Communal (and Community) Areas

Target internal noise levels will most likely be achieved in all communal and community areas using commercial curtain wall systems.

It is expected that there will be no specific acoustic performance requirements which will demand high-performance glazing.

Apartments

Glazing required for the majority of the apartment façades will be determined by the requirement to control noise from external traffic.

It is expected that there will be no specific acoustic performance requirements which will demand high-performance glazing for any of the apartments in order to control road traffic noise.

However, there may be some restrictions on operable windows for some elevations – particularly those south-eastern facing apartments (Blocks C, D and E), and on the upper levels. This is as a result of the need, for rooms with no air-conditioning or mechanical ventilation, to achieve internal noise levels assuming windows are open.

Bedrooms are more stringent than living areas. However, the bedroom internal noise levels are to be achieved at night (between 10pm and 7am) – when traffic noise levels have reduced. This will need to be considered in determining the restrictions on operable windows for each building.

1 Introduction

The subject site (highlighted in Figure 1) is located at 76 Belmore Street, Ryde. Road frontages include Belmore Street, Junction Street, and Porter Street. The closest major / arterial road is Church Street to the southeast of the site.

The site currently includes the German International School, Sydney (now not used), administration offices within the "Tellaraga" heritage house, plus several other buildings, residential accommodation, activity centres and a community hall.

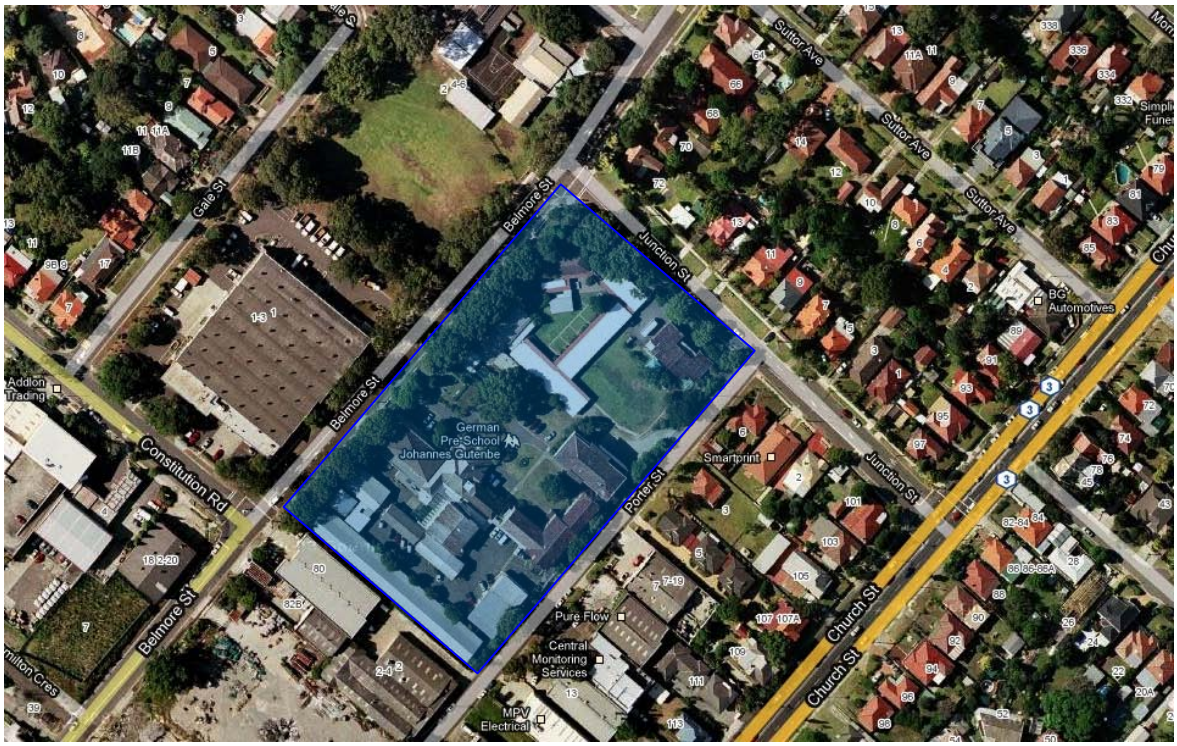

Figure 1: Concept Plan Site

Noel Bell Ridley Smith & Partners (NBRS+Partners) has undertaken concept planning studies for the redevelopment of the 76 Belmore Street, Ryde Concept Plan site on behalf of Achieve Australia in the context of the Ryde DCP 2010.

A Part 3A Concept Plan application is proposed which anticipates a yield of up to 390 housing units.

Figure 2 shows the current Concept Plan for the site.

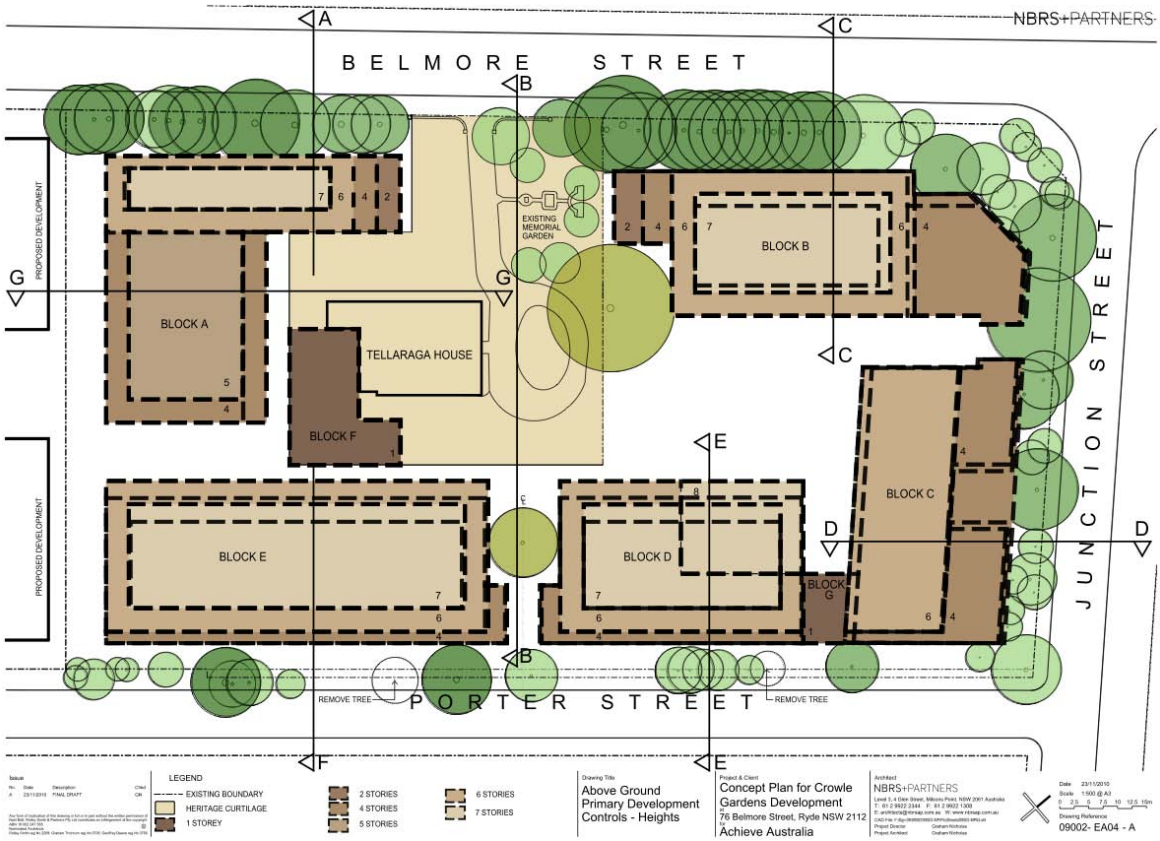

Figure 2: Concept Plan for site

As part of the application, it is critical to understand the detail of the Concept Plan and to ascertain what is permissible under it as regards the formulation of the future the project-specific applications.

This report identifies the acoustic considerations for the Concept Plan and establishes noise and vibration targets which are based on relevant Codes, Standards and guidelines.

The report considers noise generated by the proposed uses for the Concept Plan site, and noise and vibration affecting the proposed uses for the Concept Plan site.

In doing so, the assessment determines the suitability of the Concept Plan for the proposed land use.

Generic design options to control the key acoustic issues are described. These design options will need to be refined, clarified and resolved during the project-specific application and detailed design process for each building on the site.

Based on the surveys which have quantified the existing noise levels affecting the site, and given that the design principles that have been outlined in this assessment are accommodated, it is expected that the acoustic targets presented in this report are achievable for the Concept Plan.

2 Acoustic Issues Associated with the Concept Plan

The key acoustic issues for the Concept Plan site are:

- Noise breakout to the environment from new plant serving the proposed buildings on the site
- Noise break-in into the proposed buildings from road traffic on surrounding streets

For each of these issues, acoustic design criteria for each building on the development site will need to be established. For the purposes of this application assessment, criteria are based on:

- *NSW Industrial Noise Policy* (EPA INP), Environmental Protection Authority, January 2000
- AS 1055.2-1997: *Acoustics – Description and measurement of environmental noise. Part 2: Application to specific situations*, Standards Association of Australia
- AS/NZS 2107-2000: *Acoustics - Recommended design sound levels and reverberation times for building interiors*, Standards Association of Australia
- *Environmental Criteria for Road Traffic Noise,* Environmental Protection Authority (EPA ECTRN), May 1999
- *Assessing Vibration: A technical guideline,* Department of Environment and Conservation NSW, February 2006
- *Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010*
- *SEPP (Infrastructure) 2007*
- *NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline*

3 Noise Surveys

Attended noise surveys have been carried out at various locations and various times of the day / night around the subject site.

The purpose of the noise surveys is to identify existing ambient noise levels around the site, to assess the impact of the development on the surroundings and to identify any potential noise-sensitive receivers in the vicinity.

Two noise impact assessments have then been undertaken – one for each of the noise issues being considered, namely:

1) Environmental Noise Impact Assessment – to assess the impact of noise *break-out* from the site on the surroundings

2) Road Traffic Noise Impact Assessment – to assess the impact of noise *break-in* from road traffic on the different buildings / areas of the site

The noise surveys and findings for each assessment are provided in the following sections, with detailed assessment information provided in the appendices.

4 Environmental Noise Impact Assessment

The site currently includes the German International School, Sydney (now not used), administration offices within the “Tellaraga” heritage house, plus several other buildings, residential accommodation, activity centres and a community hall.

Road frontages include Belmore Street, Junction Street and Porter Street.

The closest major / arterial road is Church Street to the southeast.

There is a continuous flow of road traffic on all of these roads, and this is considered to be the dominant continuous environmental noise source affecting the site during the day and night. At night, the volume of traffic flow reduces but remains the dominant continuous environmental noise source affecting the site – particularly distant traffic from Church Street.

4.1 Unattended Environmental Noise Survey

It was not possible to find an accessible, secure and relevant location for a noise logger on the existing site. Consequently, an unattended noise survey was not undertaken.

Instead, attended noise measurements were taken at various times of the day and night to generate a profile for the existing noise environment around the site.

4.2 Attended Environmental Noise Surveys

Attended noise measurements were undertaken during October and November 2010 at the site and surrounding areas at various times of the day and night to generate a profile for the existing noise environment.

A Brüel and Kjær 2250 sound level meter (serial no. 2446899) was used for all measurements. The meter was checked for calibration before and after all measurements. No deviation occurred.

The weather was clear and dry during the surveys, with little or no wind. The weather conditions did not adversely affect the measured noise levels.

L_{eq}, L_{10} and L_{90} noise parameters were measured for 10 to 15-minute periods on each occasion. Measurements were recorded as octave band linear sound pressure levels from 31.5 Hz to 8 kHz, plus overall A-weighted levels.

The measurement locations are shown in Figure 3.

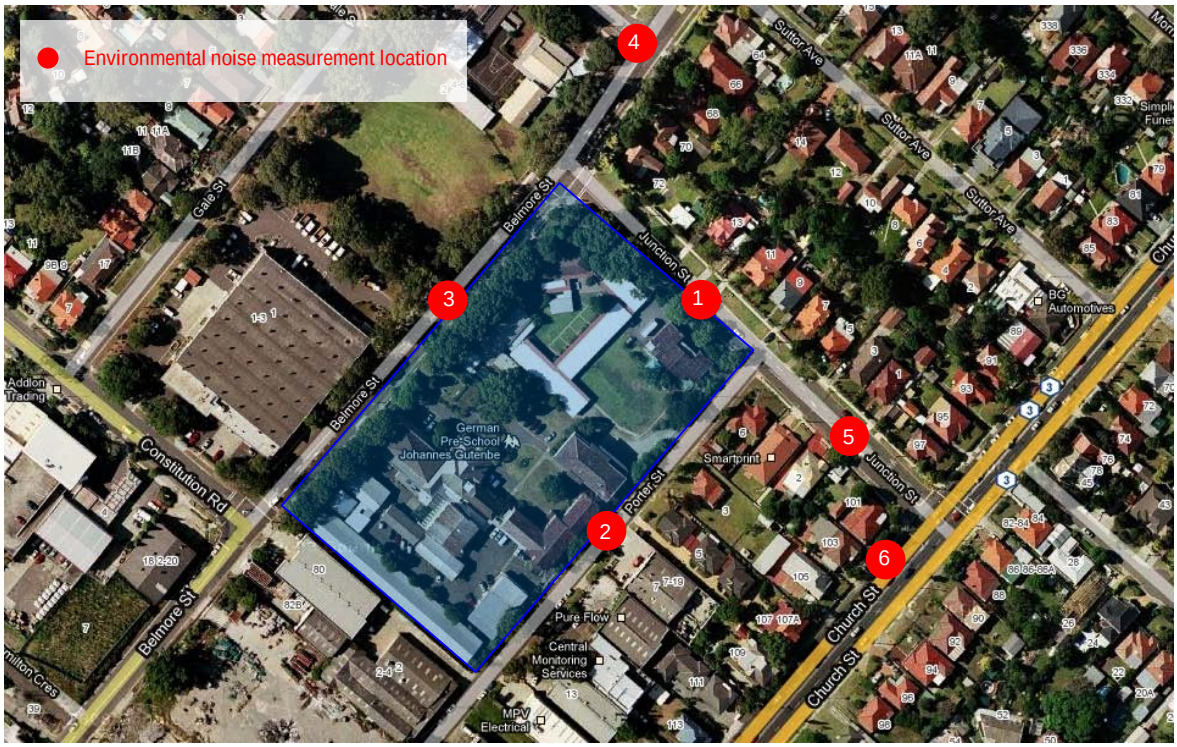

Figure 3: Environmental noise measurement locations at the Concept Plan site

These measurement locations represent the background noise environment at key locations around the subject site at different times of the day.

Measurement locations and respective dates / times were selected to provide relevant *lowest* background noise levels around the site.

Both the daytime and nighttime continuous background noise environment at each site is dominated by road traffic. The measured levels, for each time of day and night, are provided in Tables 1 to 3.

Measurement Location Date / Time			Z-weighted Noise level, dB re 20μPa							
	dBL_N	dB(A)	Octave band centre frequency, Hz							
			63	125	250	500	1k	2k	4k	8k
1	L_{90}	49.5	60.15	59.21	54.26	48.72	44.38	43.46	40.3	34.41
Fri 29/10/10 08:50 - 09:05	L_{eq}	66	66.22	68.2	64.26	61.96	60.87	63.21	57.96	50.69
2	L_{90}	47	59.41	59.52	53.66	45.74	42.34	41.6	37.2	30.65
Fri 29/10/10 08:20 - 08:35	L_{eq}	61	66.76	67.38	62.93	58.85	56.53	58.03	51.97	44.28
3	L_{90}	48.5	56.01	56.27	51.37	45.17	41.97	42.43	40	35.91
Fri 29/10/10 09:40 - 09:55	L_{eq}	63.5	63.07	63.79	59.63	58.6	57.52	60.55	56.44	49.01
5	L_{90}	52.5	60.21	61.56	55	50.24	47.95	47.62	43.85	36.7
Fri 29/10/10 09:05 - 09:20	L_{eq}	62.5	65.44	70.5	65.93	61.09	58.33	58.62	54.05	48.32
6	L_{90}	65	70.06	71.69	65.62	62.26	59.86	60.19	57.73	51.55
Fri 29/10/10 09:25 - 09:40	L_{eq}	77	77.93	83.32	79.9	74.12	71.78	72.57	70.01	64.24

Table 1: **Morning:** A-weighted and octave band linear environmental noise measurements from attended surveys at the Concept Plan site

Measurement Location Date / Time			Z-weighted Noise level, dB re 20μPa							
	dBL_N	dB(A)	Octave band centre frequency, Hz							
			63	125	250	500	1k	2k	4k	8k
1	L_{90}	50	58.53	58.79	53.34	47.06	43.22	43.45	41.37	39.21
Wed 17/11/10 16:00 - 16:15	L_{eq}	64	66.11	71.2	68.72	61.52	58.91	60.4	55.36	50.27
2	L_{90}	49.5	60	59.01	53.63	46.6	43.79	44.4	41.11	37.11
Wed 17/11/10 16:15 - 16:30	L_{eq}	60	65.11	64.82	60.27	57.12	56.17	57.25	49.85	43.84
3	L_{90}	52.5	57.79	57.55	54.05	48.22	46.32	46.57	44.35	41.12
Wed 17/11/10 16:45 - 17:00	L_{eq}	67	65.55	69.31	63.99	61.46	61.33	63.74	59.43	52.76
6	L_{90}	63.5	73.99	72.9	67	61.18	58.55	58.17	55.41	50.01
Wed 17/11/10 16:30 - 16:45	L_{eq}	75	78.99	82.25	79.47	74.32	71.74	70.25	67.51	62.41

Table 2: **Afternoon:** A-weighted and octave band linear environmental noise measurements from attended surveys at the Concept Plan site

Measurement Location Date / Time		Z-weighted Noise level, dB re 20μPa							
	dBL_N dB(A)	Octave band centre frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
1	L_{90} 46	50.16	54.66	50.97	44.21	41.49	41.99	35.39	22.44
Tue 26/10/10 22:35 - 22:50	L_{eq} 57.5	60.67	61.57	57.62	56.2	53.43	54.38	48.97	40.54
2	L_{90} 44	49.52	53.48	49.69	43.86	39.53	39.49	32.72	22.44
Tue 26/10/10 22:50 - 23:05	L_{eq} 53	53.92	58.49	53.42	49.42	47.76	49.65	44.02	42.55
3	L_{90} 39.5	47.06	50.38	46.96	38.59	34.84	34.57	27.34	19.95
Tue 26/10/10 23:35 - 23:50	L_{eq} 51	59.34	56.55	53.39	49.45	46.97	47.37	42.37	35.47
4	L_{90} 39	47.37	50.14	46.11	37.86	34.42	35.14	28.43	19.14
Tue 26/10/10 23:20 - 23:35	L_{eq} 53.5	57.28	63.04	62.68	54.39	50.65	47.39	43.28	37.01
5	L_{90} 43.5	48.12	52.4	47.2	40.77	38.1	38.73	34.04	26.81
Tue 26/10/10 23:00 - 23:15	L_{eq} 55	56.82	62.63	59.99	54.45	50.74	51.1	46.34	38.81
6	L_{90} 60	56.37	62.05	58.38	56.53	52.75	55.51	53.18	42.71
Tue 26/10/10 22:15 - 22:30	L_{eq} 74	70.23	78.4	73.4	71.85	68.92	69.4	67.09	60.56

Table 3: **Evening / Night:** A-weighted and octave band linear environmental noise measurements from attended surveys at the Concept Plan site

There is a continuous flow of road traffic on all of the local roads, and on Church Street to the southeast.

This is the dominant continuous environmental noise source affecting the site during the day and night.

At night, the volume of traffic flow reduces but remains the dominant continuous environmental noise source affecting the site – particularly distant traffic from Church Street.

Based on our observations of traffic flows during the attended surveys, we do not expect the noise level between midnight and 8 am (ie the time period not covered by the attended surveys reported in Tables 1 to 3) to reduce significantly below those noise levels measured during the evening / nighttime period (Table 3).

Therefore, for the purposes of this Concept Plan assessment, the noise levels in Table 3 are assumed to apply also to the nighttime period between midnight and 8 am. This is considered to be a conservative (ie worst case) assumption.

4.3 Traffic Noise Limits

The appropriate traffic noise criteria for the proposed development are those set in the publication The Environmental Criteria for Road Traffic Noise (ECRTN), May 1999, published by the Environmental Protection Authority (EPA) of NSW (now the NSW Department of Environment, Climate Change and Water).

This publication sets road traffic noise criteria for a number of road/land use scenarios. In the case of the Concept Plan site, the relevant scenario is that for land use developments with potential to create additional traffic on local roads. For developments of this type, the nominated external noise criteria are as follows:

Day (7 am – 10 pm)	$L_{Aeq(1hr)}$ 55 dB (external)
Night (10 pm – 7 am)	$L_{Aeq(1hr)}$ 50 dB (external)

Where the $L_{Aeq(1hr)}$ represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7 am to 10 pm or the period 10 pm to 7 am (whichever is relevant). If this cannot be defined accurately, the highest hourly A-weighted L_{eq} noise level is to be used instead.

These criteria refer to the L_{Aeq} (the A-weighted equivalent continuous noise level) occurring when measured 1 m from the façade of the building. The criteria include a 2.5 dB allowance for noise reflected from the façade.

However, it is noted that traffic noise levels measured around the site and presented in Tables 1 to 3 already exceed the stated noise criteria during each time period.

The ECRTN also provides for cases where the stated noise criteria are already exceeded. In these cases, where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. In all cases, traffic arising from the development should not lead to an increase in the existing noise levels of more than 2 dB.

4.4 Future Traffic Flows and Traffic Noise Levels

The Transport and Accessibility Impact Assessment undertaken by Halcrow has estimated that the peak hour site-generated traffic flows will increase from 30 to 141 - 155 vehicle trips per hour.

Therefore, the Concept Plan development for the site has the potential to increase the *existing* traffic flows on the surrounding road network by approximately 111 to 125 vehicle trips per hour, or an increase of 370% to 415%.

The Halcrow assessment also identifies that, if the Concept Plan site was developed in accordance with the DCP controls and Meadowbank Employment Area Master Plan, the peak hour site-generated traffic flows would increase from 30 to 74 vehicle trips per hour.

Therefore, comparing the current Concept Plan proposal with the Meadowbank Employment Area Master Plan, the Concept Plan development for the site has the potential to increase the traffic flows on the surrounding road network by approximately 67 to 81 vehicle trips per hour, or an increase of 190% to 210%.

The increase in vehicle trips will be distributed across the surrounding road network. The Halcrow assessment indicates that the largest increase in vehicle trips will be to the south of the site – accommodating 35% of the trips.

In terms of expected noise impacts, the increases in vehicle trips equate to increases in traffic noise levels at any existing residential receiver of approximately;

- 6 dB – comparing the predicted Concept Plan traffic flows with the *existing* traffic flows, or
- 3 dB – comparing the predicted Concept Plan traffic flows with the *DCP controls and Meadowbank Employment Area Master Plan* traffic flows.

On this basis, traffic noise levels expected to increase by up to 6 dB (excluding Location 6 – Church Street) from the existing noise levels around the Concept Plan site reported in Tables 1 to 3.

Future traffic flows will, therefore, lead to an increase in the existing traffic noise levels by more than the 2 dB recommended by the ECRTN.

4.5 Noise Break-out – Mechanical Plant Noise to the Environment

Given the residential land-use proposed for the Concept Plan site, the main source of noise break-out from the developments associated with the proposal to the environment will be mechanical services plant – particularly roof plant.

Limits for mechanical plant noise levels generated by the new buildings will need to be derived from advice and guidance provided in the Protection of the Environment (Operations) Act 1997 (PoEO Act), and the Industrial Noise Policy of the NSW Environmental Protection Authority (now Department of Environment, Climate Change and Water) (EPA INP).

The NSW INP sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. Both are used to derive the project specific noise level.

Assessing intrusiveness
The intrusiveness criterion essentially means that the equivalent continuous noise level of the source should not be more than 5 dB above the measured existing background noise level.

Assessing amenity
The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise, including plant. The existing noise level from industry (or plant) is measured - if it approaches the criterion value, then the noise levels from new plant need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion.

The cumulative effect of noise from all industrial or plant sources is considered in assessing impact.

Project specific noise level
For the new plant associated with the development, the more stringent of the intrusive and the amenity criteria sets the project specific noise level for each building and each residential receiver.

The project specific environmental noise limits for new plant will need to be derived for each of the buildings associated with the Concept Plan - once the plant types and locations are known for each building.

These noise limits will be based on the measured noise levels provided in Tables 1 to 3, plus supplementary project-specific surveys, as required.

These noise limits will then be used to determine the noise control required for all new plant.

Source noise levels for plant associated with each building will need to be assessed and plant will be selected to meet these environmental noise criteria. Roof top plant will be enclosed or screened as required. If necessary, additional environmental noise control methods may include in-duct attenuators, acoustic louvres for plant rooms, and enclosures for noisy plant items.

With these noise control measures in place, we consider that environmental noise limits will be met at all affected receiver locations.

4.6 Mechanical Services Vibration

The use of each premise, including vibration associated with mechanical plant, must not give rise to transmission of vibration to any place of different occupancy greater than specified in AS 2670.2.

The following root mean square (rms) vibration velocity limits will apply at the nearest receivers to each building on the site, in each one-third octave centre frequency band between 8 Hz and 8000 Hz:

- Residences, night 0.14 mm/s (Curve 1.4),
- Residences, day 0.2 mm/s to 0.4 mm/s (Curves 2 to 4), and
- Offices 0.4 mm/s (Curve 4).

The same vibration criteria will apply to vibration from plant felt within the areas associated with each of the new developments. Therefore, vibration transmission from mechanical plant to nearby properties is expected to be imperceptible, and well under the AS 2670.2 criteria.

All plant will need to be provided with vibration isolation.

5 Road Traffic Noise Impact Assessment

Attended noise measurements were undertaken during October and November 2010 across the site and surrounding areas at various times of the day and night to generate a profile for the existing traffic noise environment.

A Brüel and Kjær 2250 sound level meter (serial no. 2446899) was used for all measurements. The meter was checked for calibration before and after all measurements. No deviation occurred.

The weather was clear and dry during the surveys, with little or no wind. The weather conditions did not adversely affect the measured noise levels.

L_{eq}, and L_{10} noise parameters were measured for 10 to 15-minute periods on each occasion. Measurements were recorded as octave band linear sound pressure levels from 31.5 Hz to 8 kHz plus overall A-weighted levels.

The measurement locations are shown in Figure 4.

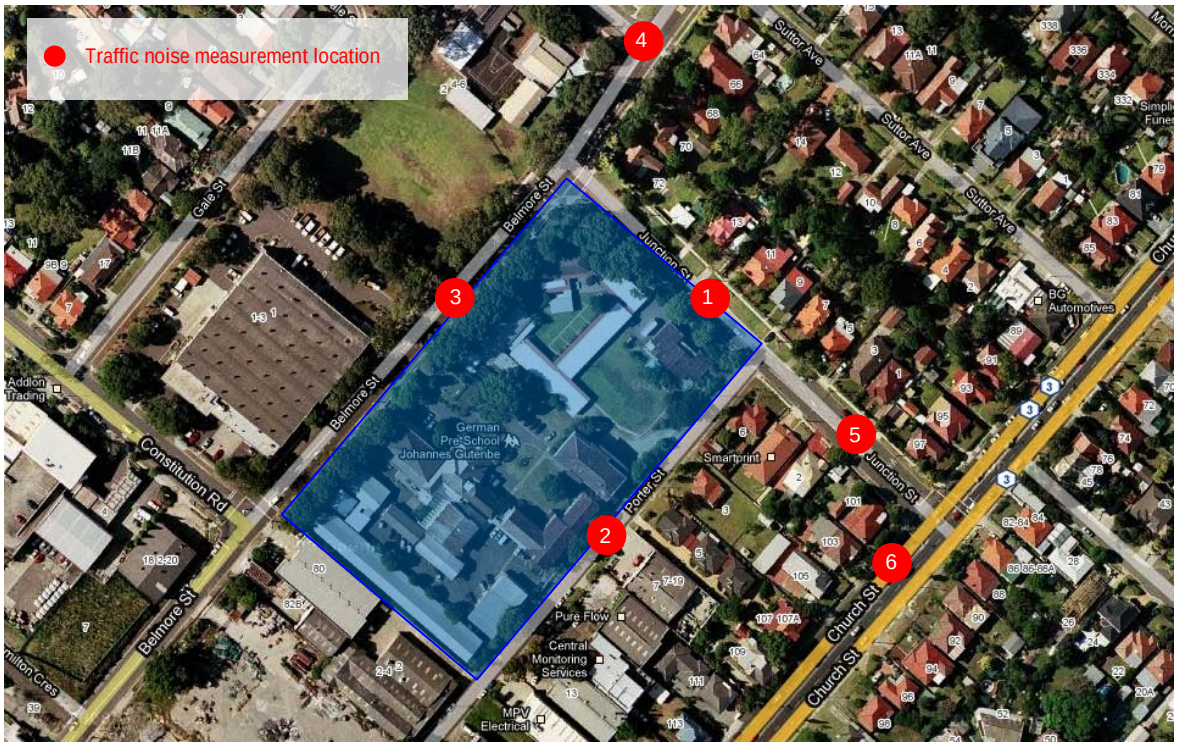

Figure 4: Traffic noise measurement locations at the Concept Plan site

These measurement locations are exposed to road traffic noise from traffic on the road network throughout the Concept Plan site, and represent the worst-case traffic noise environment affecting the buildings proposed on the site as part of the Concept Plan.

Measurement locations and respective dates / times were selected to provide relevant *highest* traffic noise levels affecting the site (for the road traffic noise impact assessment).

The measured traffic noise levels are summarised in Tables 4 to 6. These noise levels represent the average maximum of the traffic noise levels measured at each location. They are to be used to determine the sound insulation performance required for each of the building facades on the site.

Measurement Location Date / Time		Z-weighted Noise level, dB re 20μPa							
			Octave band centre frequency, Hz							
	dBL_N	dB(A)	63	125	250	500	1k	2k	4k	8k
1	L_{eq}	66	66.22	68.2	64.26	61.96	60.87	63.21	57.96	50.69
Fri 29/10/10 08:50 - 09:05	L_{10}	70	68.78	70.86	67.33	65.65	64.8	67.56	62.11	54.36
2	L_{eq}	61	66.76	67.38	62.93	58.85	56.53	58.03	51.97	44.28
Fri 29/10/10 08:20 - 08:35	L_{10}	65.5	69.75	69.33	65.71	63.18	60.62	61.86	56.77	48.54
3	L_{eq}	63.5	63.07	63.79	59.63	58.6	57.52	60.55	56.44	49.01
Fri 29/10/10 09:40 - 09:55	L_{10}	68	66.11	67.01	62.71	63.14	61.88	65.31	61.45	53.03
5	L_{eq}	62.5	65.44	70.5	65.93	61.09	58.33	58.62	54.05	48.32
Fri 29/10/10 09:05 - 09:20	L_{10}	65.5	68.07	72.89	68.69	64.76	61.53	61.82	56.77	49.59
6	L_{eq}	77	77.93	83.32	79.9	74.12	71.78	72.57	70.01	64.24
Fri 29/10/10 09:25 - 09:40	L_{10}	79.5	81.19	87.36	82.82	77.2	74.74	75.48	72.9	67.37

Table 4: **Morning :** A-weighted and octave band linear traffic noise measurements from attended surveys during October/November 2010, dB re 20μPa, at the locations shown in Figure 4

Measurement Location Date / Time		Z-weighted Noise level, dB re 20μPa							
	dBL_N dB(A)	Octave band centre frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
1	L_{eq} 64	66.11	71.2	68.72	61.52	58.91	60.4	55.36	50.27
Wed 17/11/10 16:00-16:15	L_{10} 68.5	66.91	70.82	67.6	65.41	63.21	64.96	60.16	53.77
2	L_{eq} 60	65.11	64.82	60.27	57.12	56.17	57.25	49.85	43.84
Wed 17/11/10 16:15-16:30	L_{10} 59.5	67.59	67.36	62.6	58.3	55.96	55.97	50.12	45.04
3	L_{eq} 67	65.55	69.31	63.99	61.46	61.33	63.74	59.43	52.76
Wed 17/11/10 16:45-17:00	L_{10} 71.5	69.12	70.98	66.96	65.7	65.8	68.29	64.02	56.49
6	L_{eq} 75	78.99	82.25	79.47	74.32	71.74	70.25	67.51	62.41
Wed 17/11/10 16:30-16:45	L_{10} 77	81.82	85.83	82.23	75.31	71.96	72.2	69.45	64.45

Table 5: **Afternoon :** A-weighted and octave band linear traffic noise measurements from attended surveys during October/November 2010, dB re 20μPa, at the locations shown in Figure 4

Measurement Location Date / Time		Z-weighted Noise level, dB re 20μPa							
			Octave band centre frequency, Hz							
	dBL_N	dB(A)	63	125	250	500	1k	2k	4k	8k
1	L_{eq}	57.5	60.67	61.57	57.62	56.2	53.43	54.38	48.97	40.54
Tue 26/10/10 22:35-22:50	L_{10}	57	63.81	64.16	60.65	57.14	54.08	52.38	47.1	35.56
2	L_{eq}	53	53.92	58.49	53.42	49.42	47.76	49.65	44.02	42.55
Tue 26/10/10 22:50-23:05	L_{10}	48.5	56.44	61.1	55.52	50.57	45.59	43.96	38.53	29.83
3	L_{eq}	51	59.34	56.55	53.39	49.45	46.97	47.37	42.37	35.47
Tue 26/10/10 23:35-23:50	L_{10}	51	62.94	60.12	56.07	51.28	49.52	46.19	38.41	31.51
4	L_{eq}	53.5	57.28	63.04	62.68	54.39	50.65	47.39	43.28	37.01
Tue 26/10/10 23:20-23:35	L_{10}	53.5	59.84	63.47	56.87	52.43	49.03	48.33	46.23	38.56
5	L_{eq}	55	56.82	62.63	59.99	54.45	50.74	51.1	46.34	38.81
Tue 26/10/10 23:00-23:15	L_{10}	57	58.5	64.93	60.3	54.89	51.99	53.15	49.16	40.3
6	L_{eq}	74	70.23	78.4	73.4	71.85	68.92	69.4	67.09	60.56
Tue 26/10/10 22:15-22:30	L_{10}	75.5	72.6	80.93	75.65	71.94	69.49	72.1	69.62	61.98

Table 6: **Evening / Night :** A-weighted and octave band linear traffic noise measurements from attended surveys during October/November 2010, dB re 20μPa, at the locations shown in Figure 4

There is a continuous flow of road traffic on Belmore Street, Junction Street, Porter Street and Church Street throughout the day and this is considered the dominant continuous environmental noise source affecting the site during the day.

At night, the volume of traffic flow reduces but remains the dominant continuous environmental noise source affecting the site – particularly distant traffic from Church Street.

Based on our observations of traffic flows during the attended surveys, we do not expect the noise level between midnight and 8 am (ie the time period not covered by the attended surveys reported in Tables 1 to 3) to reduce significantly below those noise levels measured during the evening / nighttime period (Table 6).

Therefore, for the purposes of this Concept Plan assessment, the noise levels in Table 6 are assumed to apply also to the nighttime period between midnight and 8 am. This is considered to be a conservative (ie worst case) assumption.

5.1 Traffic Noise Limits

The appropriate traffic noise criteria for the proposed development are those set in the publication The Environmental Criteria for Road Traffic Noise (ECRTN), May 1999, published by the Environmental Protection Authority (EPA) of NSW (now the NSW Department of Environment, Climate Change and Water).

This publication sets road traffic noise criteria for a number of road/land use scenarios. In the case of the Concept Plan site, the relevant scenario is that for land use developments with potential to create additional traffic on local roads. For developments of this type, the nominated external noise criteria are as follows:

Day (7 am – 10 pm)	$L_{Aeq(1hr)}$ 55 dB (external)
Night (10 pm – 7 am)	$L_{Aeq(1hr)}$ 50 dB (external)

Where the $L_{Aeq(1hr)}$ represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7 am to 10 pm or the period 10 pm to 7 am (whichever is relevant). If this cannot be defined accurately, the highest hourly A-weighted L_{eq} noise level is to be used instead.

These criteria refer to the L_{Aeq} (the A-weighted equivalent continuous noise level) occurring when measured 1 m from the façade of the building. The criteria include a 2.5 dB allowance for noise reflected from the façade.

However, it is noted that traffic noise levels measured around the site and presented in Tables 4 to 6 already exceed the stated noise criteria during each time period.

The ECRTN also provides for cases where the stated noise criteria are already exceeded. In these cases, where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. In all cases, traffic arising from the development should not lead to an increase in the existing noise levels of more than 2 dB.

5.2 Future Traffic Flows and Traffic Noise Levels

The Transport and Accessibility Impact Assessment undertaken by Halcrow has estimated that the peak hour site-generated traffic flows will increase from 30 to 141 - 155 vehicle trips per hour.

Therefore, the Concept Plan development for the site has the potential to increase the *existing* traffic flows on the surrounding road network by approximately 111 to 125 vehicle trips per hour, or an increase of 370% to 415%.

The Halcrow assessment also identifies that, if the Concept Plan site was developed in accordance with the DCP controls and Meadowbank Employment Area Master Plan, the peak hour site-generated traffic flows would increase from 30 to 74 vehicle trips per hour.

Therefore, comparing the current Concept Plan proposal with the Meadowbank Employment Area Master Plan, the Concept Plan development for the site has the

potential to increase the traffic flows on the surrounding road network by approximately 67 to 81 vehicle trips per hour, or an increase of 190% to 210%.

The increase in vehicle trips will be distributed across the surrounding road network. The Halcrow assessment indicates that the largest increase in vehicle trips will be to the south of the site – accommodating 35% of the trips.

In terms of expected noise impacts, the increases in vehicle trips equate to increases in traffic noise levels at any new residential receiver of approximately;

- 6 dB – comparing the predicted Concept Plan traffic flows with the *existing* traffic flows, or
- 3 dB – comparing the predicted Concept Plan traffic flows with the *DCP controls and Meadowbank Employment Area Master Plan* traffic flows.

On this basis, traffic noise levels expected to increase by up to 6 dB (excluding Location 6 – Church Street) from the existing noise levels around the Concept Plan site reported in Tables 4 to 6.

Future traffic flows will, therefore, lead to an increase in the existing traffic noise levels by more than the 2 dB recommended by the ECRTN.

5.3 Internal Noise Level Targets

Apartment internal noise levels are based on recommendations and guidance from the Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010, SEPP (Infrastructure) 2007, plus reference to AS2107:2000 and NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline.

5.3.1 Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010

The Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010 states that *"…New residential developments must be designed so that the repeatable maximum $L_{Aeq,1hr}$ level does not exceed 45 dB(A) inside living or bedroom areas, with windows closed…"*

The DCP also states that *"…New units are to be constructed in accordance with:*

i) Australian Standard 3671 – 1989: Acoustics – Road Traffic Noise Intrusion, Building Siting and Construction; and

ii) Australian Standard 3671 – 1987 (we presume this is an error and is meant to be AS2107:2000)*: Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors…"*

5.3.2 SEPP (Infrastructure) 2007

The SEPP (infrastructure) 2007 states that *"…the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*

a) in any bedroom in the building – 35 dB(A) at any time between 10pm & 7am,

b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 40 dB(A) at any time…"

5.3.3 NSW Department of Planning Development Near Rail Corridors and Busy Roads – Interim Guideline

The NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline provides the following recommendations for noise criteria in residential buildings for airborne road (and rail) noise:

Sleeping areas (bedroom)	:	35 $dBL_{Aeq,\ 9\ hr}$ from 10 pm to 7 am
Other habitable rooms (excl garages, kitchens, bathrooms and hallways)	:	40 dBL_{Aeq} at any time

These criteria are consistent with the SEPP (Infrastructure) 2007 criteria.

In addressing the effects of operable windows on internal noise levels for sleeping areas in residential developments, The NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline states that *"…If internal noise levels with windows or doors open exceed the criteria by more than 10 dB(A), 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…"*

We consider this to mean that the following internal noise levels apply to residential buildings with windows open:

Sleeping areas (bedroom)	:	45 $dBL_{Aeq,\ 9\ hr}$ from 10 pm to 7 am
Other habitable rooms (excl garages, kitchens, bathrooms and hallways)	:	50 dBL_{Aeq} at any time

5.3.4 AS2107

AS2107:2000 recommends design noise levels within occupied spaces for a large range of building and occupancy types. They are given as equivalent continuous A-weighted sound pressure levels measured in decibels, dBL_{Aeq}.

The noise levels recommended take into account the function of the area(s) and apply to the noise level measured within the space unoccupied but fully fitted-out and ready for occupancy.

The Standard applies to steady-state or quasi-steady-state sounds (eg air-conditioning noise – "steady-state", and continuous traffic noise – "quasi-steady-state"). The noise levels apply to the normal operating conditions of the building and represent the total noise level from all steady-state or quasi-steady-state sounds normally affecting the space, including sources external to the building.

For residential buildings near minor roads, AS2107 recommends the following design sound levels.

Type of occupancy/activity	Recommended design sound level, dBL_{Aeq}	
	Satisfactory	Maximum
Living areas	30	40
Sleeping areas	30	35
Work areas	35	40
Apartment common areas (eg. foyer, lift lobby)	45	55

Table 7: Recommended interior noise levels for apartments near **minor** roads, after AS 2107

For residential buildings near major roads, AS2107 recommends the following design sound levels.

Type of occupancy/activity	Recommended design sound level, dBL_{Aeq}	
	Satisfactory	Maximum
Living areas	35	45
Sleeping areas	30	40
Work areas	35	45
Apartment common areas (eg. foyer, lift lobby)	45	55

Table 8: Recommended interior noise levels for apartments near **major** roads, after AS 2107

The *satisfactory* design sound level is defined in The Standard as: "The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive."

The *maximum* design sound level is defined as: "The level of noise above which most people occupying the space start to become dissatisfied with the level of noise." Therefore, it can also be considered as acceptable, but there is a greater perception of intrusion of this noise level into the activities of the space. Beyond this maximum level

there is a risk of increasing user dissatisfaction with the environment of the space in question.

These limits are also referenced in AS 3671-1989, which provides guidelines for building constructions to reduce traffic noise to acceptable levels.

5.4 Internal Noise Levels Set for Developments Forming Part of the Concept Plan Site

In the majority of apartments, the background noise level will be dominated by the external noise sources.

Table 9 presents the total internal noise levels that are set for each of the key spaces for each building. Noise levels are the total noise level in each space. For spaces unaffected by external noise they represent the noise level from the air-conditioning / ventilation. For areas affected by external noise they represent the noise level from the air-conditioning / ventilation PLUS noise from the external sources.

Typically the noise levels are consistent with the recommendations of the Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010, SEPP (Infrastructure) 2007, plus reference to AS2107:2000 and NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline.

For apartments with mechanical ventilation, they are the total noise level with windows closed and the ventilation for that space operating normally. For naturally-ventilated apartments, they are the total noise level with windows open.

In accordance with good practice, it is intended that sensible and appropriate levels of technology and design be applied to reduce energy wastage and carbon dioxide emissions arising from the operation of the buildings, both for financial and environmental reasons, without reducing the functional standards necessary.

In order to satisfy these requirements and reduce the energy load of the buildings, the Architectural design may incorporate passive design measures to minimise energy consumption associated with air-conditioning and ventilation systems.

The design philosophy will be to provide both appropriate and sensible initiatives for the project that align with and support the functional and operational requirements. Specifically, wherever possible, ventilation requirements are achieved via operable windows in lieu of mechanical ventilation systems.

In-line with this philosophy, and recognising that the Meadowbank Employment Area Master Plan contained within Part 4.2 of the City of Ryde Development Control Plan 2010 and SEPP (Infrastructure) 2007 do not differentiate between a windows closed or windows open condition for apartments, the recommendations given in the NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline for a windows open condition have been adopted for the apartment living and sleeping areas.

Room type / Space	Recommended internal noise level, dBL_{Aeq}	
	Lower	Upper
Apartment Living Areas	40 at any time (50 windows open)	n/a
Apartment Sleeping Areas	35 from 10pm to 7am (45 windows open)	n/a
Apartment common areas (eg. foyer, lift lobby) - from AS2107:2000	45	55
Communal and Community Spaces - based on apartment common areas from AS2107:2000	45	55

Table 9: Internal background noise level targets for each development forming part of the Concept Plan site

5.5 Achieving the Internal Noise Levels

To achieve the total internal noise levels set for each space, the façades will need to be designed to provide the required external-to-internal sound insulation performance.

A separate acoustic assessment of the existing traffic noise levels affecting each building on the site will be undertaken as part of the project specific application for each site.

These assessments will need to determine the implications that the noise levels have on the apartment façade and ventilation options.

The assessments should include:

- Further measurement of background noise levels around the sites (as required).
- Further measurement of traffic noise levels around the sites (as required).
- Consideration of the required internal noise levels in the living areas and sleeping areas of the apartments.
- Calculations to determine requirements for façade construction (particularly glazing) and natural ventilation to achieve the internal noise levels.

The following is provided to outline the likely implications that the existing traffic noise levels will have on the design of the façades for the buildings – based on the traffic noise surveys undertaken by Acoustic Studio (Refer Tables 4, 5 and 6) and the expected increase in traffic noise levels which will result from increased traffic flows around the site (refer to Section 5.2).

5.5.1 Common, Communal and Community Areas

Target internal noise levels will most likely be achieved in all common, communal and community areas using commercial curtain wall systems.

It is expected that there will be no specific acoustic performance requirements which will demand high-performance glazing.

5.5.2 Apartments

Glazing required for the majority of the apartment façades will be determined by the requirement to control noise from external traffic.

It is expected that there will be no specific acoustic performance requirements which will demand high-performance glazing for any of the apartments in order to control road traffic noise.

However, there may be some restrictions on operable windows for some elevations – particularly those south-eastern facing apartments (Blocks C, D and E), and on the upper levels. This is as a result of the need, for rooms with no air-conditioning or mechanical ventilation, to achieve internal noise levels assuming windows are open.

Bedrooms are more stringent than living areas. However, the bedroom internal noise levels are to be achieved at night (between 10pm and 7am) – when traffic noise levels have reduced. This will need to be considered in determining the restrictions on operable windows for each building.

5.6 Achieving internal noise levels from air-conditioning

Noise generated by building services, particularly the air-conditioning systems, also needs to be considered to ensure that the internal noise levels in Table 9 are met.

To achieve the total internal noise levels set for each space, noise control treatments including attenuators and internally-lined ductwork will need to be incorporated into the systems design as required.

6 Noise and Vibration from Rail Line

During the site noise surveys, observations of rail noise and vibration levels affecting the site were made wherever possible.

Rail noise was not audible above the background noise level from road traffic.

Rail vibration was not perceptible.

Furthermore, the NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline states that acoustic assessments (noise) are required only when the residential development is within 80 m of the closest operational track and vibration assessments are required when the residential development is within 60 m of the closest operational track.

Given the above, a detailed rail noise and vibration assessment has not been undertaken for the site, and the rail noise and vibration criteria from the NSW Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline are expected to be met for all buildings.

7 Internal Acoustic Issues

7.1 Noise and Vibration Transfer between Internal Spaces

Appropriate standards of acoustic privacy between occupied rooms will need to be achieved by controlling mechanical services noise, and limiting sound transfer with appropriate design of walls and partitions.

For the apartments, the level of sound insulation provided between adjacent sole occupancy units (horizontally and vertically) will be at least equal to the requirements of the Building Code of Australia, Part F5.

7.2 Room Acoustics

Sound absorptive materials will be integrated with the room finishes to maintain comfortable and functional spaces where required.

AS2107:2000 provides guidance on reverberation times (RTs) for occupied spaces for a large range of building and occupancy types which take into account the function of the spaces. This guidance will be considered as appropriate to establish the extent of sound absorptive materials required for each space.

8 Construction Noise and Vibration

As required by Director General's Requirements, control of noise and vibration levels generated during the project construction stages will be necessary.

Currently the project is at Concept Plan stage and the detailed construction program is not yet fully defined. Therefore, this report provides a recommendation that a construction noise and vibration management plan will need to be prepared for each project.

The construction noise and vibration management plan will need to determine applicable criteria together with best noise and vibration control practices to be observed during the construction of the proposed development.

In preparing the construction noise and vibration management plan, reference will need to be made to the following legislation, codes and standards:

- The Department of Environment, Climate Change and Water (DECCW) *"Interim Construction Noise Guideline"*, 2009
- The Department of Environment, Climate Change and Water (DECCW) *"Assessing Vibration: A Technical Guideline"*, 2006
- Environment Protection Authority (EPA, currently DECCW) *"Environmental Noise Control Manual"*, 1994
- Standards Association of Australia "*AS 2436-198: Guide to Noise Control on Construction, Maintenance & Demolition Sites"*, 1981
- Standards Association of Australia *"AS 2670.2-1990: Evaluation of human exposure to whole-body vibration – Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)"*, 1990
- British Standards Institution *"BS 6472:1992 – Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)"*, 1992
- Protection of the Environment Operations Act 1997