Graythwaite, 20 Edward Street, North Sydney

Proposed Concept Plan and Project Application

Sydney Church of England Grammar School (Shore)

Acoustic Impact Assessment

Report Number 10-8964

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Mayoh Architects
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Northbridge
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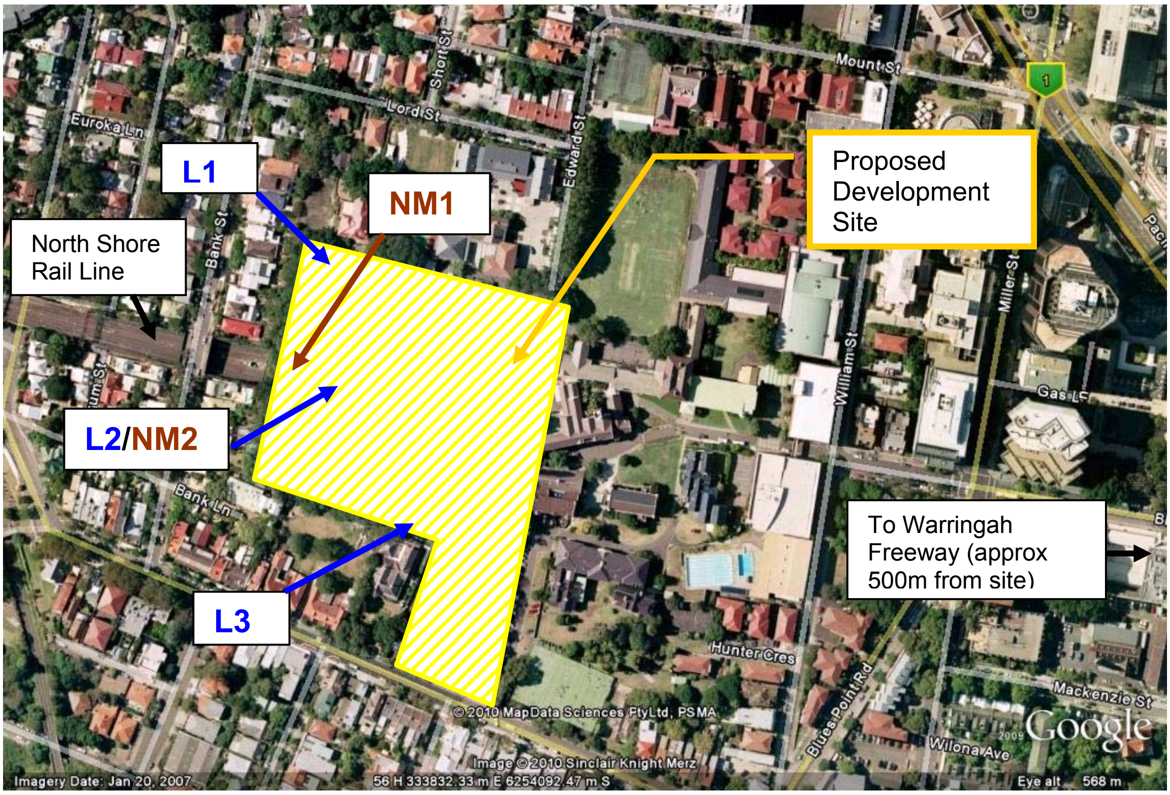
1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been commissioned by Mayoh Architects on behalf of Sydney Church of England Grammar School (Shore) to provide an Acoustic Impact Assessment during the concept plan project application stage of the proposed expansion of the School at Edward Street, North Sydney.

1.1 Assessment Requirements

The proposed 2.7 hectares Graythwaite development site is situated between the existing Senior School site and Preparatory School sites in North Sydney. The site is located at the south end of Edward Street and is bounded by Union Street to the south. The Pacific Highway and Warringah Freeway are approximately 500 m to the east of the proposed site. There are a number of residential premises surrounding the proposed site. **Figure 1** shows an aerial view of the development site along with noise logger locations L1, L2 and L3 and operator attended monitoring locations NM1 and NM2.

Figure 1 Development Site Location



The assessment was undertaken in accordance with the requirement of NSW Department of Planning, *"Development Near Rail Corridors and Busy Roads - Interim Guideline"*[1].

The North Shore railway line runs above ground to the west and underground below the proposed site. This is a passenger suburban line and thus does not carry freight trains. The significant outcome of this is that an acoustical assessment of the effects of passenger rail noise and vibration upon the subject development is warranted.

[1] This document supersedes the Rail Infrastructure Corporation (RIC) guidelines, *"Consideration of Rail Noise and Vibration in the Planning Process - Interim Guidelines for Applicants"*.

2 PROJECT OVERVIEW

Proposed Development Description

In summarised terms, the Development Application for the Shore Project at Graythwaite comprises the following:

1. Three stages of development to be completed over 10 to 15 years, comprising:

   Stage 1

   - Conservation and refurbishment of the Graythwaite House (the House), Coach House, Tom O'Neill Centre and associated garden area (the House will not be used for school classes but rather for administrative support and other activities, including perhaps the school archives)
   - Drainage and Stormwater improvements, site levelling and landscaping of the site (significantly on the middle and lower terraces)
   - Transport, traffic, parking and access improvements to the Graythwaite and Shore sites (spread over Stages 1 to 3)
   - Miscellaneous works including site fencing
   - No anticipated increase in student or staff population

   Stage 2

   - Development of a new building to the north of the house which may be used for education or administration purposes
   - Demolition of the Ward building to the east of the house
   - Construction of two new buildings to the east of the house for classrooms, teaching or other educational facilities
   - Capacity or potential to accommodate approximately 100 students and 10 staff

   Stage 3

   - Construction of two new buildings to the west of the house for classrooms, teaching or other educational facilities
   - Capacity or potential to accommodate approximately 400 students and 40 staff
   - Potential demolition and replacement of the Tom O'Neill Centre

2. Additional gross floor area (new buildings) of approximately 5,500m^2

3. Capacity or potential to accommodate approximately 500 students and 50 staff

The master plan for Stages 1 to 3 (including building footprints/envelopes) would be the subject of an application for Concept Plan approval. Stage 1 works are to be the subject of a Project Application (to be commenced as soon as practicable to ensure that the house is restored as soon as possible). Further Project Applications would be submitted for Stages 2 and 3.

Figure 2 shows the proposed concept plan and the proposed buildings.

Figure 2 Proposed Site Plan

Site Plan courtesy of Mayoh Architects

2.1.1 Building Locations

Existing Buildings

The School advises the existing buildings (i.e. Graythwaite House, the Tom O'Neill Centre or the Coach House) are not affected by existing rail operations.

New Buildings

The North building is to be located to the north of Graythwaite House, away from the rail corridor. The conclusions reached for existing buildings by the School would equally apply to this building.

The West buildings are to the north of the rail corridor but partly have foundations below ground level. The buildings are in the approximate vicinity of the NM1 and NM2 noise monitoring locations. The concept design for the West building is that it is oriented such that the normal (i.e. non-emergency) ingress/egress is from the east of the buildings and there are few classroom windows on the western side. Windows will be primarily on the north and south sides.

The North East building is north of the rail corridor, but the South East building is directly over the rail corridor. The latter building also has an in-ground basement. Both of the East buildings are at a higher elevation than the West buildings relative to the rail corridor.

3 RAIL NOISE INTRUSION INTO DEVELOPMENT

3.1 Assessment Criteria

3.1.1 Airborne Noise

The NSW Government Department of Planning's Interim Guideline *Development Near Rail Corridors and Busy Roads (2008)* recommends a maximum internal airborne noise level ($L_{Aeq(9hour)(night)}$ and $L_{Aeq(15hour)(day)}$) for educational institutions including child care centres of **40 dBA**.

The document also provides criteria for internal noise levels due to rail noise contribution with windows or doors open. It states:

> *"If internal noise levels with windows or doors open exceed the criteria by more than 10 dBA, 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".*

3.1.2 Ground-borne Noise

Regenerated noise is most common in railway tunnel situations where receivers are located in buildings above or in close proximity to the railway tunnels. It results from the transmission of vibration through the ground rather than the direct transmission of noise through the air. The vibration is generated by wheel/rail interaction and is transmitted from the trackbed, via the ground and into the building structure. The vibration entering the building then causes the walls and floors to vibrate faintly and hence to radiate noise (commonly termed "ground-borne noise" or "regenerated noise"). If it is of sufficient magnitude to be audible, the noise has a low frequency rumbling character, which progressively increases and then decreases in level as a train approaches and departs the site.

The NSW Government Department of Planning's Interim Guideline *Development Near Rail Corridors and Busy Roads (2008)* recommends a maximum ground-borne noise level ($L_{Amax(slow)}$ for 95% of rail passby events) for educational institutions including child care centres of **40 dBA**.

3.1.3 Ground-borne Vibration

For the assessment of vibration, the NSW Department of Planning *"Development Near Rail Corridors and Busy Roads – Interim Guideline"* refers to criteria set out in *"British Standard BS 6472:1992 Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)".* In order to evaluate intermittent vibration such as that associated with rail activities, this standard provides methodology to assess vibration in terms of "dose". Thus the assessment takes into account such factors as the overall vibration level, the duration of vibration events and number of vibration events in each period (day and night).

Table 1 Acceptable Vibration Dose Values for Intermittent Vibration (dB re 10^{-9}mm/s)

Location	Daytime (7 am – 10 pm)		Night-time (10 pm – 7 am)	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Offices, schools, educational institutions and places of worship	112 dB	118 dB	112 dB	118 dB

3.2 Rail Noise and Vibration Monitoring

3.2.1 Attended Noise and Vibration Measurement Procedure

Attended Noise and Vibration Measurements were undertaken on Thursday 9 September 2010 at monitoring location NM1 adjacent to the railway tunnel entrance and at NM2 at noise logger location L2. Refer to **Figure 1** for site plan. Noise measurement locations were selected as being conservatively representative of approximate worst affected building façade locations.

Attended airborne noise measurements were performed using a calibrated Brüel and Kjær 2260 Precision Sound Level Meter (serial number 2414703). Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding the acceptable variation of ±0.5 dBA (AS 1055).

The acoustic instrumentation (SLM and calibrator) employed throughout the monitoring programme comply with the requirements of AS 1259.2-1990, "*Sound Level Meters*" and carry current NATA or manufacturer calibration certificates.

For each train passby, the L_{Amax} and L_{AE} noise levels were recorded, as well as the frequency spectra of each of these parameters. "L_{AE}" refers to the sound exposure level (a measurement integrated over time, reflecting both the noise level and the duration of the event). L_{AE} values may be summed logarithmically and used to calculate the total daily noise exposure due to train noise emissions over the daytime (7.00 am to 10.00 pm) or night-time (10.00 pm to 7.00 am) periods. Maximum Noise Level, abbreviated here as L_{AFmax} is the fast-response (F) maximum A-weighted noise level recorded during each train passby. Train type, speed and directions were also noted where possible.

In addition, attended vibration measurements were performed at this location using a calibrated Brüel and Kjær 2260 Precision Sound Level Meter (serial number 2414605), Brüel and Kjær Type 4370 accelerometer (1068050) and a Brüel and Kjær Type 2635 charge amplifier (735382). The vibration signal, together with the airborne noise signal, was recorded on a Rion DA-20 digital data recorder. A calibration signal was recorded at the beginning and end of the measurements. No significant calibration shift was observed during any of the measurement periods.

3.2.2 Rail Noise and Vibration Measurements

Train passby measurements were conducted on Thursday 9 September 2010. The results are summarised in **Table 2**.

It should be noted that for the application of train horns during normal operations, it is generally understood that these are a safety critical device and are therefore exempt from the standard assessment criteria. Where horns were sounded within the passby measurement, the airborne noise L_{Amax} and L_{AE} levels have been omitted.

Table 2 Summary of Attended Measurement Results - 09 September 2010

Time	Train Type	Direction	Speed	Noise		Vibration
				LAmax[1]	LAE[1]	Lv(max)
			(km/h)	(dBA)	(dBA)	(dB re 1nm/s)
Measurement Location NM1						
11:13:52	Suburban	Up	-	-	-	87 dB
11:16:14	Suburban	Down	48	66 dBA	73 dBA	82 dB
11:20:19	Suburban	Down	-	66 dBA	73 dBA	84 dB
11:32:58	Millenium	Up	-	-	-	86 dB
11:35:34	Suburban	Down	51	66 dBA	74 dBA	86 dB
11:39:02	Suburban	Down	50	66 dBA	75 dBA	**93 dB**
11:42:43	Suburban	Up	53	67 dBA	76 dBA	87 dB
11:53:08	Suburban	Down	-	66 dBA	75 dBA	83 dB
11:59:06	Suburban	Up	40	-	-	87 dB
12:01:29	Suburban	Up	44	-	-	85 dB
12:04:20	Suburban	Down	-	60 dBA	71 dBA	88 dB
12:07:08	Suburban	Down	-	63 dBA	74 dBA	83 dB
12:11:04	Millenium	Up	-	-	-	87 dB
12:20:06	Suburban	Down	-	65 dBA	74 dBA	88 dB
12:26:47	Suburban	Up	40	-	-	87 dB
Measurement Location NM2						
12:59:06	-	-	-	-	-	74 dB
13:01:37	-	-	-	56 dBA	65 dBA	78 dB
13:05:39	-	-	-	67 dBA	71 dBA	74 dB

Note 1: Noise measurements influenced by train horns have been omitted in accordance with accepted practice.
Note 2: Train Passbys were not visible from NM2.

3.2.3 Rail Noise Assessment

In order to calculate the LAeq noise levels during the daytime and night-time periods in accordance with the DoP guideline, it is necessary to determine the number of passenger and freight trains within the assessment periods.

The number of train passbys was taken from the CityRail website for passenger trains travelling on the Northshore and Northern Lines via Waverton Station. The number of train passbys and the subsequent predicted LAeq noise levels at NM1 and NM2 are presented in **Table 3** and **Table 4** respectively.

Table 3 Predicted Railway Noise Levels at Noise Monitoring Location NM1.

Hour Period	Overall (Up and Down) Trains		External Noise Level
(Weekdays)	Train Numbers (Northshore Line + Northern Line)	Average LAE	LAeq(period)
7am - 10pm	305 + 108	75	54
10pm - 7am	69 + 20	75	49

Table 4 Predicted Railway Noise Levels at Noise Monitoring Location NM2.

Hour Period (Weekdays)	Overall (Up and Down) Trains		External Noise Level
	Train Numbers (Northshore Line + Northern Line)	Average LAE	$L_{Aeq(period)}$
7am - 10pm	305 + 108	70	48
10pm - 7am	69 + 20	70	44

Standard building construction with no special acoustic treatment measures to the facade, including 3 mm float glass to doors and windows typically will provide 20 dBA noise reduction from outside to inside; whilst with windows open, a 10 dBA reduction would be achieved. **Table 5** contains the predicted external and internal L_{Aeq} noise levels at the façade locations of the proposed buildings.

Table 5 Predicted daytime external airborne Railway Noise Levels at the proposed buildings.

Building	External Noise Level $L_{Aeq(period)}$	Internal noise level[1] $L_{Aeq(period)}$	Internal noise level with window open[2] $L_{Aeq(period)}$
WEST building (south and west facing facades)	54[3]	34	44
WEST building (North and East facing facades)	<50	<30	<40
GRAYTHWAITE	<45	<25	<35
NORTH building	<45	<25	<35
EAST building	<45	<25	<35

Note 1: Standard building construction with no special acoustic treatment measures to the facade
Note 2: A nominal sound reduction of 10 dBA is commonly used for prediction with a door/window open for ventilation
Note 3: To conservatively account for elevation, no distance correction from NM1 has been made.

The information contained in **Table 5**, indicates the following:

- The predicted noise levels at all proposed buildings are anticipated to comply with the internal (windows closed) criteria of 40 dBA.
- The predicted noise levels at all proposed buildings except the south and west facing facades of the West building are anticipated to comply with the internal (windows open) criteria of 40 dBA.
- With windows open, the internal L_{Aeq} noise levels during the daytime are predicted to exceed the airborne criteria by 4 dB at West building (south and west facing facades).

3.2.4 Rail Vibration Assessment

The maximum vibration at the predicted worst affected site location (NM1) was measured to be **93 dB** as shown in bold in **Table 2**. Measurements taken at monitoring location NM2 indicate lower vibration levels than at NM1.

The maximum measured vibration level of 93 dB re 1nm/s is significantly lower than the criteria values of 112 dB (preferred) and 118 dB (maximum) for intermittent vibration as stipulated in **Table 1**.

3.2.5 Ground-borne Noise Assessment

The measured vibration data has been analysed to determine the **highest** maximum vibration levels (on a one-third octave band basis) experienced throughout the measurements. These vibration levels are summarised in **Table 6**.

For convenience, units of dB re 1E-9 m/s have been used in this report for expressing the magnitude of vibration emissions. A level of 100 dB corresponds to a vibration level of 0.1 mm/s and a level of 120 dB corresponds to a vibration level of 1.0 mm/s.

Table 6 Highest Maximum Ground Surface Vibration Levels at monitoring location NM1.

Train Type	Frequency (Hz) - Vibration Level (dB)													Overall Level (dB)
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	
Passenger	60	60	67	79	84	83	85	82	69	65	58	46	43	90

Table 7 Highest Maximum Ground Surface Vibration Levels at monitoring location NM2.

Train Type	Frequency (Hz) - Vibration Level (dB)													Overall Level (dB)
	20	25	31.5	40	50	63	80	100	125	160	200	250	315	
Passenger	49	55	56	61	69	71	73	73	66	53	49	46	46	78

The vibration transmitted into buildings depends on the "coupling loss" between the ground and the building footings, and also on the extent of amplification in building elements such as suspended floors. Coupling loss refers to the reduction in vibration levels at the building foundations with respect to the ground vibration. The amount of coupling loss depends greatly on the manner in which a building is constructed.

In the case of slab-on-ground constructions, the surface area of the slab is large and the slab is in contact with the underlying soil. For such constructions, there would be little or no coupling loss (ie reduction in vibration levels between the ground and building foundations). Such a construction has been assumed for the proposed development in order to give a conservative estimate of the ground-borne railway noise.

The level of ground-borne noise within buildings adjacent to the railway results from the vibration of the walls, floors and ceilings, and also the acoustical properties of the room.

In order to predict the level of ground-borne noise within the proposed development, the correction factors in **Table 8** have been applied.

Table 8 Corrections for Ground-borne Noise

Correction Type	Frequency (Hz) - Correction (dB)												
	20	25	31.5	40	50	63	80	100	125	160	200	250	315
Conversion to Noise (unweighted)	-27	-27	-27	-27	-27	-27	-27	-27	-27	-27	-27	-27	-27
A-Weighting	-51	-45	-39	-35	-30	-26	-23	-19	-16	-13	-11	-9	-7

On the basis of the typical maximum vibration levels in **Table 6** and the attenuation calculated from average measurement differences between NM1 (at a low level near to the railway) and NM2 (located on higher ground similar to the proposed development), the corrections in **Table 8** for typical residential building constructions were applied to predict ground-borne noise levels for the proposed development. **Table 9** provides a summary of the predicted $L_{max(slow)}$ ground-borne noise levels for train passbys. The overall noise level has been calculated by logarithmically adding the A-weighed noise levels in each one third octave frequency band.

Table 9 Summary of Predicted A-weighted Ground-borne Noise Levels

Noise Levels	Frequency (Hz) - Noise Levels (dBA)													
	20	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**dBA**
Lmax(slow)	-30	-20	-13	0	13	23	28	29	19	18	16	10	4	**33**

Note The predicted ground-borne noise levels are for the lower floor. The predicted ground-borne noise levels for the upper floors is expected to be 3 dB less.

These levels comply with the ground-borne noise criteria of 40 dBA.

Earlier analyses indicate that rail induced noise and vibration will not cause a significant impact that can't be easily addressed through design or operation and that does not require any special construction to achieve noise/vibration dampening. It will be prudent, however, to undertake further specific detailed noise and vibration analyses in conjunction with the detailed design required for the future Project Applications in relation to the East and West Buildings.

4 NOISE EMISSIONS FROM THE PROPOSED DEVELOPMENT ON SURROUNDING RECEIVERS

4.1 Assessment Criteria

4.1.1 Industrial Noise Policy (INP)

The DECCW oversees the Industrial Noise Policy (INP), released by the EPA in January 2000 which provides a framework and process for deriving noise criteria. The INP criteria for industrial noise sources (eg mechanical plant) have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity for particular land uses for residents and sensitive receivers in other land uses.

Assessing Intrusiveness

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured Rated Background Level (RBL), over any 15 minute period.

Assessing Amenity

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The criteria relate only to other industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industrial-type noise sources, (including air-conditioning mechanical plant) need to be designed so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion. For areas of high road traffic, there are further considerations that influence the selection of the noise criterion

Area Classification

The INP classifies the noise environment of the subject area as “Urban”.

The INP characterises the “Urban” noise environment as an area that:

- is dominated by ‘urban hum’ or industrial noise source
- has through traffic with characteristically heavy and continuous traffic flows during peak periods
- is near commercial districts or industrial districts
- has any combination of the above

4.2 Continuous Unattended Noise Monitoring

4.2.1 Methodology

Environmental noise loggers were deployed at three (3) locations representative of the locations most likely affected by existing noise sources. The locations of the noise loggers are contained in **Table 10** and shown in **Figure 1**.

Table 10 Logger Locations

Description	Location	Logger Type	Serial Number
Location 1 (L1)	NW end of development site	ARL EL215	194447
Location 2 (L2)	W end of development site	ARL EL215	194603
Location 3 (L3)	S development site to rear of building at 44 Union St.	ARL EL215	194637

Weather data for the subject area during the noise monitoring period was obtained from the Bureau of Meteorology's automatic weather station at Sydney Airport. Noise data during periods of any rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded in accordance with INP weather affected data exclusion methodology.

4.2.2 Measurement Results

A summary of the continuous unattended noise monitoring results is contained in **Table 11**. A full graphical representation of the noise level recorded at noise logger locations L1, L2 and L3 is provided in **Appendix A**, **B** and **C** respectively.

Table 11 Continuous unattended noise monitoring results – 01 to 09 September 2010.

Location	Period	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}
L1	Daytime	65	55	42	58
	Evening	56	49	38	47
	Night	54	43	34	48
L2	Daytime	61	52	40	53
	Evening	57	47	36	46
	Night	51	43	34	48
L3	Daytime	61	54	42	52
	Evening	49	44	36	43
	Night	46	42	34	45

Review of the information contained in **Table 11** indicates the following:

- Measured background L_{A90} sound pressure levels are similar (within 2 dB) at each noise logger location.
- Measured daytime background L_{A90} sound pressure levels were 42 dBA, 40 dBA and 42 dBA at noise logger locations L1, L2 and L3 respectively.
- Measured daytime $L_{Aeq(period)}$ sound pressure levels were 58 dBA, 53 dBA and 52 dBA at noise logger locations L1, L2 and L3 respectively.

4.3 Project Specific Noise Levels

Having defined the area type, the processed results of the unattended noise monitoring have been used to generate project specific noise criteria summarised in **Table 12**. Continuous unattended noise logger data as presented in **Table 11** (refer to **Figure 1**) adjacent to the relevant noise sensitive residential receivers have been used to specify the project specific noise criteria shown in bold in **Table 12**. These are the lower of the intrusive and amenity criteria.

Table 12 Criteria for Project Specific Noise Emissions to Nearby Residences on Bank Street.

Time of day	Noise Level dBA re 20 µPa			
	ANL[1] (period)	Measured RBL $L_{A90(15minute)}$[2]	INP Criteria	
			Intrusive	Amenity
			$L_{Aeq(15minute)}$ Criterion for New Sources	$L_{Aeq(Period)}$ Criterion for New Sources[3]
Day	60	42	**47**	60
Evening	50	38	**43**	50
Night	45	34	**39**	45

Note 1: ANL Acceptable Noise Level for an urban area
Note 2: RBL Rating Background Level from data from noise logger L1
Note 3: Assuming existing noise levels unlikely to decrease
Note 4: Project Specific Criteria are shown in bold

Table 13 Criteria for Project Specific Noise Emissions to Nearby Residences on Union Street.

Time of day	Noise Level dBA re 20 µPa			
	ANL[1] (period)	Measured RBL $L_{A90(15minute)}$[2]	INP Criteria	
			Intrusive	Amenity
			$L_{Aeq(15minute)}$ Criterion for New Sources	$L_{Aeq(Period)}$ Criterion for New Sources[3]
Day	60	42	**47**	60
Evening	50	36	**41**	50
Night	45	34	**39**	45

Note 1: ANL Acceptable Noise Level for an urban area
Note 2: RBL Rating Background Level from data from noise logger L3
Note 3: Assuming existing noise levels unlikely to decrease
Note 4: Project Specific Criteria are shown in bold

It can be seen from the measured noise levels presented in **Table 12** and **Table 13** that similar ambient noise environments prevail at either end of the proposed development site. Given the proposed hours of operation of the School (being 8:00 am–5:00 pm with classes typically from 8:30 am-3:15 pm), the daytime criterion of **47 dBA** will be the governing criterion. It should be noted that, should any proposed items of mechanical plant be intended to operate on a 24 hour basis, that the night-time criterion of 39 dBA will become the overriding criterion.

4.3.1 Outdoor Terrace Noise Emission Criteria

The following is an excerpt from the Association of Australian Acoustical Consultants (AAAC) Technical Guideline for Child Care Centre Noise Assessment. Whilst not specifically prescribed to school applications, the information contained therein is considered to provide some guidance for the current study.

> *As the duration of time that children are allowed to play outside is reduced, the overall noise impact reduces. Therefore, it is reasonable to allow a higher level of noise impact for a shorter duration. AAAC members regard that a total time limit of 2 hours outdoor play per day (eg 1 hour in the morning and 1 hour in the afternoon) should allow an additional 5 dB noise impact.*
>
> ***Up to 2 hours (total) per day** - The $L_{eq,15\ min}$ noise level emitted from the outdoor play area shall not exceed the background noise level by more than 10 dB at the assessment location (i.e. **52 dBA**)*

***More than 2 hours per day** - The $L_{eq,15\ min}$ noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5 dB at the assessment location (i.e. **47 dBA**).*

4.4 Project Specific Noise Emission Impact Assessment

4.4.1 Student Noise Emission

Outdoor Terraces

There is a potential for noise management issues to occur in school developments with regard to student vocalisations. These noise emissions are usually associated with students engaged in outdoor recreational activities. We understand from the client that students could be expected to congregate within the Middle and Lower Terraces (identified in **Figure 2**).

The following information has been provided by the client with respect to potential usage of the outdoor terraces:

The amount of area that can be practically used by students on the Graythwaite site is limited by the slopes of the land, the number of trees, the distances from the school and the Graythwaite House surrounds. In general, students will not congregate around the heritage buildings outside of formal school activities in the refurbished Tom O'Neill Centre.

The Prep School will use the middle terrace south of Graythwaite during recess and lunch time. These students would be supervised and would constitute up to 100 (9 – 12 year olds) during those times. Areas near to the Headmaster's House and the external houses in Bank and Union Streets will not normally be used due to the sloping topography and school directives.

The Senior School will not use the middle terrace during breaks. Up to (100) students would use the lower terrace during the lunch time period.

Under classroom situations on the Graythwaite site, the Prep could typically have say 72 students with 3 teachers. Similarly, classes in the Senior School would be no more than 30 at any one time in the presence of a teacher although there may be cases where there are two or three classes in the field at any one time.

There is also the possibility of "Special" events use where a larger number of people may congregate. These may include community events or fire drills where the whole School population will be outdoors at the same time.

The typical operational hours of the School are 8.00am until 5.00pm Monday to Friday.

The School also envisages other potential uses such as cadet field work, possible limited athletics and scientific (botanical type) purposes which could occur during the usual operational hours of the school.

On the weekend, it is possible that the two terraces may be used for leisure or games by the boarders under supervision.

It is also possible that the School may hold a function on occasions on the terraces.

Based on the information provided above, with the exception of rare occurrences such as community events and fire drills, the more regular activity with the greatest potential acoustic impact on surrounding residential receivers is identified as being recess and lunch time periods. During these times, it is expected that a maximum of 100 students may occupy each terrace respectively. In practice, it is reasonable to expect that a maximum of half the students will be engaged in vocalisation at any one time.

Noise emission calculations to neighbouring residences have been made based on the following parameters:

- Overall sound power level for a group of 10 children adopted as being **90 dBA** with corresponding vocal spectrum.
- Distance from Middle Terrace to nearest potentially noise affected residential receiver in the order of **70 m** at an RL of 67.
- Distance from Lower Terrace to nearest potentially noise affected residential receiver in the order of **50 m**[1] at an RL of 56.
- Nearest residential receivers taken to be at an RL of 56.

Resultant noise levels have been calculated to the nearest residential boundary of the potentially worst affected receivers. Shielding afforded by relative topographies and intervening building structures (i.e. Kialoa) have not been taken into account during calculations.

Resultant noise levels have conservatively been calculated to be in the order of **51 dBA** at residences aligning Bank Street and **54 dBA** at residences aligning Union Street. Shielding afforded by the building envelope of Kialoa will attenuate noise from the lower terrace in the order of a further **10 dBA** to the rear garden of the nearest affected residence in Union Street.

Indoor Classrooms

The nearest potentially noise affected residential receivers to proposed building developments are those in Bank Street, some 30 m to the west of the proposed West Building. The building orientation and design of the West building is such that any noise transmission from teaching spaces within will be well below the both daytime criterion of **47 dBA** as stipulated in **Section 4.3**. This is also inherently true for proposed building developments at greater distances from residential receivers.

General Discussion

Notwithstanding the above assessment, Heggies deems assessment of outdoor school recreation activities against strict noise emission criteria to be inappropriate. Further, we believe occasional exceedances of established noise criteria should be tolerated due to the wider community benefit and absolute necessity of educational extablishments such as schools.

A review was conducted of Land and Environment Court cases which may be of relevance to this type of assessment. However no judgements were found which specifically relate to this type of noise source. Whether this indicates that it is not considered to be a significant acoustical issue is unclear. However, in the case of Christian Brothers v Waverley Council, which involved the use of a swimming pool, no specific criteria were mentioned but Commissioner Murrell commented that,

> *"It is important in our society for uses such as schools and residential areas to coexist".*

The issue of outdoor play areas associated with School developments has previously been addressed by Heggies (refer Heggies Report *10-4699 L002 Response to FCC Comments 270808 20080909*) an excerpt from which is attached as **Appendix A** for reference.

In summary, the following factors apply to the assessment of noise generated by school children during outdoor play:

- the nature of the noise source is not inconsistent with that experienced within residential communities, even those which are rural/residential;

[1] We understand from the client that the school has entered consultation specifically with regard to the use of the outdoor terraces with the owners of the nearest residence to the lower terrace identified as *Kialoa*. As such, the closest residences to the lower terrace for the purpose of this assessment are taken as being those aligning Union Street to the west of *Kialoa*.

- it occurs generally during short periods throughout the day, within school hours;
- it is not reasonable to consider that this noise source would interfere with regular domestic activities which may occur during this time; and
- the wider community benefits through the provision of the facility.

4.4.2 Student Use of New Buildings

The East Buildings are adjacent to the existing school buildings and student access/egress would be concentrated in that location. Prior to a detailed noise assessment in relation to the later Project Application, it is not anticipated that there will be any adverse noise impacts from these buildings during operation.

The West buildings are adjacent to Bank Street and the building design will be an important aspect of acoustic management. In this regard, the current concept has entries to the West building at the eastern end (i.e. away from Bank Street). Also, there are no balconies and limited windows at the Bank Street ends.

A full noise assessment will be undertaken for the subsequent Project Application, but it is envisaged that practical design will limit noise emissions to meet acceptable criteria.

4.4.3 Mechanical Plant Noise Emission

The noise emission of mechanical plant associated with the development should be controlled so that the operation of such plant does not adversely impact nearby residential properties and other dwellings within the same development. At this stage of the project the location and selection of mechanical plant has not been made. Therefore appropriate assessment will need to be conducted at the detailed design stage of the project.

It is envisaged that the mechanical plant noise sources will be controllable by common engineering methods that may consist of:

- Judicious location
- Barriers
- Silencers
- Acoustically lined ductwork

The selected mechanical equipment must be reviewed and assessed for conformance with established criteria at the detailed design stage of the project when specific plant selection and location is determined. At the Construction Certificate stage of the project appropriate noise control measures can be determined.

5 CONCLUSION

Rail Noise Intrusion Into Development

This report has addressed the effects of rail noise and vibration on the proposed development in accordance with The NSW Government Department of Planning's Interim Guideline *Development Near Rail Corridors and Busy Roads (2008).*

Results of noise predictions from measurements indicate that, with windows closed, all proposed buildings of the development will meet the airborne noise criteria by means of standard building construction without specific noise control measures included in the design.

Results of noise predictions from measurements indicate that, with windows open, all proposed buildings of the development except the south and west facing facades of the West Building will meet the airborne noise criteria by means of standard building construction without specific noise control measures included in the design.

Internal noise levels within classrooms aligning the south and west facades of the West Building are predicted to exceed the relevant criteria by up to 4 dB with windows open. In light of this exceedance, it is recommended that alternative means of ventilation be provided to allow these rooms to close windows during noisier periods.

Results of vibration measurements show that the maximum measured rail vibration complies with established criteria for intermittent rail vibration by a significant margin.

Ground-borne noise levels have been assessed for the proposed development and comply with established noise criteria.

Earlier analyses indicate that rail induced noise and vibration will not cause a significant impact that can't be easily addressed through design or operation and that does not require any special construction to achieve noise/vibration dampening. It will be prudent, however, to undertake further specific detailed noise and vibration analyses in conjunction with the detailed design required for the future Project Applications in relation to the East and West Buildings.

Noise Impacts from Development on Surrounding Receivers

Noise emission criteria from the proposed development have been established in accordance with the Department of Environment, Climate Change and Water's Industrial Noise Policy. Reference has also been made to the Association of Australian Acoustical Consultants (AAAC) Technical Guideline for Child Care Centre Noise Assessment.

The design and orientation of proposed buildings is such that classroom noise emissions are not anticipated to adversely impact upon neighbouring residential receivers.

Potential exceedances of noise emission criteria from the middle and lower terrace areas are observed. A discussion of relevant issues arising from similar studies is presented in **Section 4.4.1** and **Appendix A.**

In-principle noise control solutions for any proposed mechanical plant have been offered. Review of selected plant and location should be made at the detailed design stage to ensure compliance with noise emission criteria established herein.

6 CLOSURE

This report has been prepared by Heggies Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Mayoh Architects and Shore School; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Heggies.

Heggies disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

7 ASSESSMENT OF NOISE IMPACT

The response of an individual to noise is subjective and can be influenced by many factors, some of which include:

- The audibility of the sound.
- Whether the noise is steady and unobtrusive in character, or has annoying characteristics such as impulsiveness, tonality, fluctuations, intermittency.
- The times at which the noise occurs and the frequency of occurrence (i.e. number of times per day, number of days per week).
- Whether the noise is associated with other, non-acoustic aspects which are annoying or undesirable such as, lighting glare, dust generation, smell, loss of property value, perceived danger etc.
- Whether the source will introduce a new or distinctive type of noise to the area.
- Whether or not the receiver derives benefit or enjoyment from activities or other circumstances associated with the noise source.
- Whether the noise was present before the receiver moved to the area.
- Whether the noise source can be seen, is readily identifiable and a visual reminder that reinforces acoustic perception.
- Whether the sound, by its audibility (irrespective of loudness) is annoying or distracting, such as a dripping tap, barking dog etc.
- Whether the noise source has information content that captures the attention of the receiver (e.g. voices, music).
- Whether the noise source lends itself to some practical form of noise reduction or control, and whether the persons affected consider that their concerns are being considered.

When assessing the potential impact of noise from a development upon surrounding receivers, the position of “the reasonable person” must be adopted. There is substantial variation between the responses of individuals to noise. Some people are very sensitive to noise and will react adversely to small increases in their normal noise environment whilst others will find living in noisy environments quite acceptable. The majority of the population lies in between and will accept noise levels which are in keeping with the society in which they live.

8 OUTDOOR RECREATIONAL AREAS

To the best of our knowledge, there have been no social surveys conducted to quantify the levels of noise generated from outdoor play areas of schools of varying size and type or to document the response of the surrounding community to the noise from school children engaged in outdoor play.

Whether this is due to the noise source being of a highly variable nature, making the quantification of such emissions extremely difficult, or because this source is considered to be an integral part of any school development, is a point of some conjecture. Whilst attempts could certainly be made to measure the levels of noise which may be experienced at a nearby receiver, the reliability, statistical replication and relevance of such an assessment would always be open to question. In addition, the purpose of quantifying a noise source is to enable its comparison with a criterion which has been developed in consultation with appropriate parties, for the purpose of assessing the potential impact of the noise upon a receiver.

In the instance of noise emissions from school children involved in outdoor play, predominantly during recess and lunch breaks, we consider the process of attempting to assign a noise level to this source and then comparing it with a predetermined criterion for the purposes of assessing "offensiveness", to be inappropriate. It is difficult to imagine any school from which these emissions could, or would, comply with any 'typical' intrusiveness-based criterion. Being an essential part of every residential community, schools are located to permit ready access to students and, by definition, are generally surrounded by residential premises. The same can also be said for schools in rural areas. An assessment based on a comparison between a measured and/or predicted level with a specific criterion may set an undesirable precedent for both existing and future schools.

It is generally accepted that children playing outdoors will make noise. In this instance it is inarguable that the noise received at the two nearest existing residences to the north and north-west of the grassed outdoor play area will be audible, particularly during the recess and lunch periods. It is virtually impossible to quantify the level of noise received at these two residences due to the inevitable variability of the sources and their locations. The noise level generated during recess and lunch periods will vary according to the following factors:

- the number of children in the area - not all students would be expected to occupy this area at the same time,
- the level of noise made by each student – this is obviously different from individual to individual, and various factors such as age, personality, mood, activity and countless other factors will play a part,
- the louder events are not capable of being sustained over an extended period, and
- the location of the students relevant to the residences – as the distance between the source and the receiver increases, the noise level at the receiver will decrease.