

LORETO NORMANHURST CONCEPT PROPOSAL AND STAGE 1

CONSTRUCTION & OPERATIONAL NOISE ASSESSMENT

RWDI # 2101353

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SUBMITTED TO

Luke Gladwish
Associate Director
Carmichael Tompkins Property Group
Level 7, 222 Exhibition Street
Melbourne, VIC, 3000

SUBMITTED BY

**John Wassermann, BEng (Mech),
MEng (Sc), MIEAust, MAAS**
Senior Technical Director
John.Wassermann@rwdi.com

**Dave Perry, MArch (Sci), BA
(TvnPrd), MAAS**
Project Engineer
Dave.Perry@rwdi.com

RWDI Australia Pty Ltd (RWDI)
Level 4, 272 Pacific Highway
Crows Nest, NSW, 2065, Australia
T: +61.2.9437.4611
E-mail: solutions@rwdi.com
ABN: 86 641 303 871



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1 INTRODUCTION

RWDI was retained by Carmichael Tompkins Property Group (CTPG) on behalf of Loreto Normanhurst (the Client) for an environmental noise assessment for a Concept Design and Stage 1 project application to be located on the grounds of Loreto Normanhurst Girls School at 91-93 Pennant Hills Road, Normanhurst.

This report presents the project objectives, background, approach, and provides a discussion of the results from RWDI's assessment. A summary of the overall recommendations from the study are presented in Section 5, "Conclusions & Recommendations".

1.1 Project Background

Wilkinson Murray conducted a noise impact assessment as part the original State Significant Development Application (SSDA) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) (SSD-8996).

Due to design changes addressing community, organisational and public authority feedback an updated noise impact assessment (NIA) was deemed to be required.

This NIA provides the necessary additional assessment for the proposed project modifications to the originally project which is presented in Wilkinson Murray report ref 18120-B *Construction & Operational Noise Report* for both the Stage 1 project application and Concept Proposal (the Masterplan).

The revised Stage 1 and Masterplan are outlined below. The layout for Stage 1 is presented in Figure 1

1.1.1 Stage 1

The SSDA includes detailed plans for the first stage of the concept proposal (Stage 1 works). Accordingly, consent is sought for the following Stage 1 works:

- **Boarding Facility** (*Envelope 1*) – construction of the new 2-5 storey Boarding Facility with dining, parking, dock, and commercial kitchen to accommodate up to 216 boarders
- **Garden Plaza** (*Project A*) - construction of landscaped open space to be located in the existing primary school car park
- **Demolished Dock + Maintenance Wing** (*Project B*) – various works to pedestrianize existing services court achieved through landscaping and relocation of existing dock, kitchens, and waste area.
- **Multi-Sport Courts with underground carpark** (*Envelope 13*) – replacement all-weather multi-sport courts including construction of underground carpark with capacity for an additional 64 car parking spaces
- **Tennis Courts with underground carpark** (*Envelope 14*) – construction of two (2) all-weather tennis courts including underground carpark with capacity for an additional 42 car parking spaces
- **Link Road from Osborn Road – Mt Pleasant Avenue** (*Project H*) – construction of new one-way cross-site connection road between Osborn Road and Mt Pleasant Avenue
- **Osborn Road Carpark Expansion** (*Project J*) – upgrades to existing Osborn Road carpark

Several of the above items include work that require demolition and/or site preparation, as necessary. Construction staging will be considered in more detail within Section 6.



1.1.2 Concept Proposal

The Masterplan includes the establishment and modification of several new and existing buildings across the site for education and ancillary uses. These changes will facilitate an increase in enrolment capacity from 1150 to 2000 students. The new and upgraded buildings can be summarised as:

- **Boarding Facility** (*Envelope 1*) – described below in Stage 1;
- **Garden Plaza** (*Project A*) – described below in Stage 1;
- **Demolished Dock + Maintenance Wing** (*Project B*) – described below in Stage 1;
- **Secondary School** (*Envelope 2*) – relocation of main reception, staff and admin rooms. Third storey addition to 'Science' block with additional teaching spaces;
- **Arrival and Main Visitor Entrance** (*Project C*) – demolish and widen entry, demolish level 5 toilet block, construction of paved walkways;
- **Reception** (*Project D*) – open space and landscape design;
- **Learning Resource Centre Expansion** (*Project E*) – modification to rooftop including additional stairs;
- **Deirdre Rofe Extension** (*Project F*) – construction of three (3) storey extension adjacent to Deirdre Rofe building and additional third storey to the science wing;
- **Primary School** (*Envelope 4*) – expansion to accommodate years K-4 including outdoor play areas;
- **Mary Ward Building** (*Envelope 5*) – upgrades to accessibility including new lift and link bridge to the Learning Resource Centre;
- **Gymnasium** (*Envelope 6*) – construction of new Gymnasium including 3 multi-purpose courts and storage facilities;
- **Gonzaga Barry Performing Arts Centre** (*Envelope 7*) – modification including upgraded 300 seat theatre;
- **All-weather field with underground carpark** (*Envelope 8*) – full sized hockey/soccer field with underground carpark with capacity for an additional 200 car parking spaces and space for 200 bicycles;
- **Early Learning Centre** (*Envelope 11*) – subject of Hornsby Council Development Application;
- **Pedestrian Bridge Link** (*Envelope 12*) – Pedestrian Bridge Link between the Learning Resource Centre and the Mary Ward Wing;
- **Multi-Sport Courts with underground carpark** (*Envelope 13*) – described below in Stage 1;
- **Tennis Courts with underground carpark** (*Envelope 14*) – described below in Stage 1;
- **Link Road from Osborn Road – Mt Pleasant Avenue** (*Project H*) – described below in Stage 1; and
- **Osborn Road Carpark Expansion** (*Project J*) – described below in Stage 1.

The layout for the Concept Proposal is presented in Figure 2



Figure 1 : Proposed Stage 1 layout

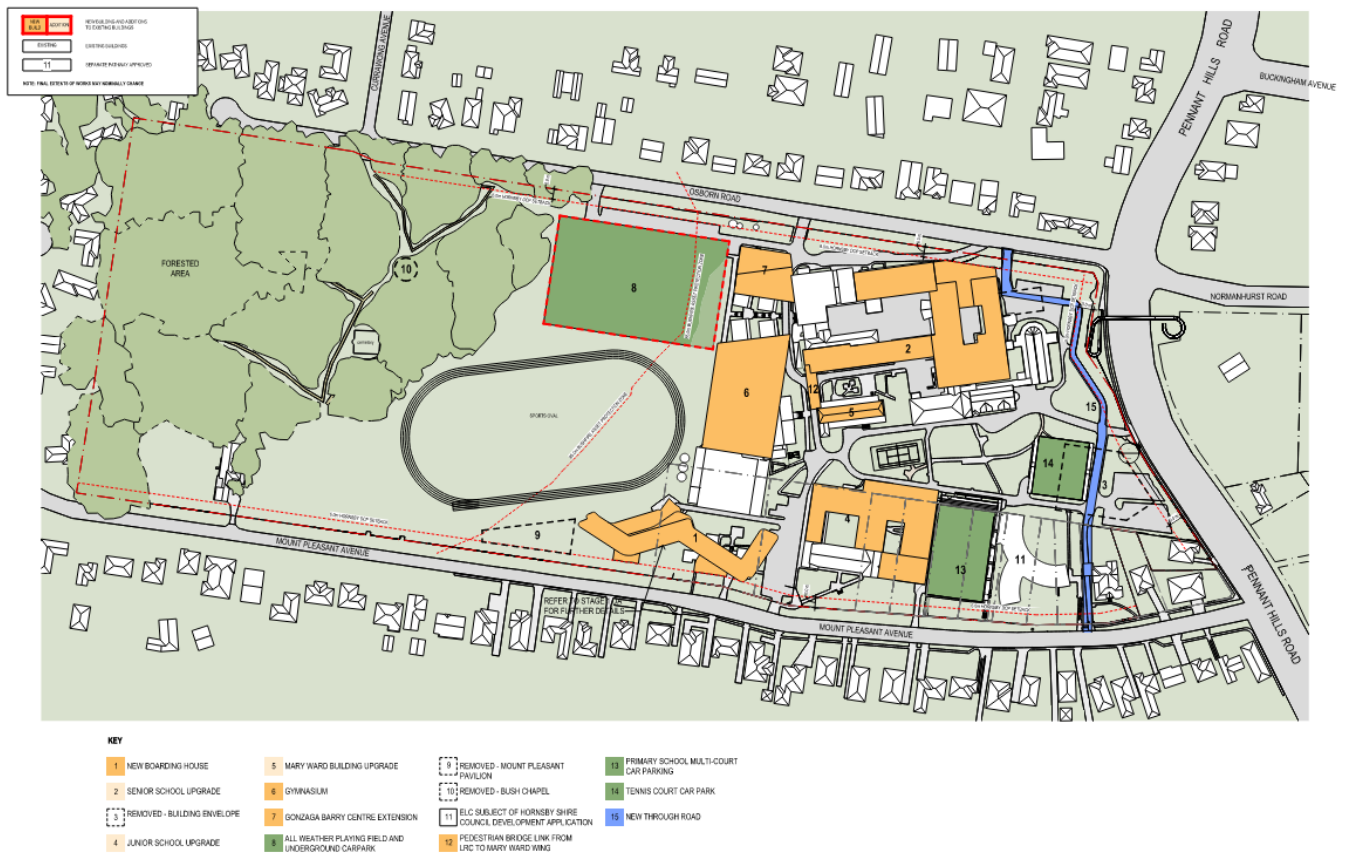


Figure 2 : Indicative concept proposal layout



2 EXISTING ACOUSTIC ENVIRONMENT

2.1 Noise Monitoring

To quantify and characterise the existing ambient noise environment, a baseline noise survey was undertaken at representative receiver locations around the site. The noise monitoring locations were selected to be representative of the surrounding sensitive receivers potentially affected by the construction and operation of the development.

The monitoring was conducted over two periods, the first in October 2018 between Wednesday 3rd and Thursday 14th, the second in 2020 between Tuesday 1st and Thursday 10th December.

The noise monitoring locations are presented in Figure 3.



Figure 3 : Noise monitoring and receiver locations

2.2 Receivers and Noise Monitoring Locations

The site is surround by residential receivers as shown in Figure 3. For the purposes of this assessment, all sensitive receivers have been categorised into four categories, as shown Table 1.

The noise monitoring equipment used for this measurement consisted of four ARL Type EL-15 environmental noise loggers set to A-weighted, fast response, continuously monitoring, and recording in 15-minute intervals at locations shown in Figure 3. Equipment calibration was checked before and after the survey and no significant drift was noted.

The measured noise levels have been used to establish appropriate noise goals for operation of the development and as a basis for assessing potential noise impacts during construction.

Table 1 : Unattended noise monitoring details

Noise Monitoring Location ID	Noise Monitoring Location Details	Equipment Serial Number
L01	Mt Pleasant (North) receivers	ARL-16-707-015
L02	Mt Pleasant (South) receivers	ARL-16-707-014
L03	Osborn Road (North) receivers	ARL-16-707-015
L04	Osborn Road (South) receivers	ARL-16-707-014

The loggers determine LA_1 , LA_{10} , LA_{90} and LA_{eq} levels of the ambient noise. LA_1 , LA_{10} and LA_{90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary of Acoustic Terms for definitions). The LA_1 is indicative of maximum noise levels due to individual noise events. This is used for the assessment of sleep disturbance. The LA_{90} level is normally taken as the background noise level during the relevant period.

2.3 Existing Background Noise Levels

Table 2 presents the measured existing ambient noise levels from the unattended noise survey. Any periods of inclement weather or extraneous noise are omitted from the measured data prior to determining the overall results.

2.3.1 Ambient background noise level

The measured rating background noise levels (RBL) were determined in accordance with the NSW *Noise Policy for Industry* with levels for the different monitoring locations as shown Figure 3. The unattended noise monitoring data has been filtered with meteorological data obtained from Observatory Hill weather station as per *NPfI* methodology.



Table 2 : Measured noise levels

Noise Logger	RBL (dBA) ¹				LAeq,period (dBA) ¹			
	Daytime	Evening	Night-time	Saturday	Daytime	Evening	Night-time	Saturday
L01²	47	44	39	47	56	54	52	55
L02²	49	47	44	48	58	56	55	54
L03³	59	56	38	59	70	69	67	70
L04³	42	39	33	42	55	54	50	40

Note 1: Daytime (6am – 7pm), Evening (7pm – 10pm), and Night-time (10pm – 6am) during weekdays and Saturday (8am – 1pm).

Note 2: Conducted October 2018 between Wednesday 3rd and Thursday 14th

Note 3: Conducted December 2020 between Tuesday 1st and Thursday 10th December

3 NOISE AND VIBRATION CRITERIA

The relevant noise criteria have been determined in consultation with Hornsby Shire Council requirements, the Secretary's Environmental Assessment Requirements, the NSW Noise Policy for Industry (NPfI), the Interim Construction Noise Guideline (INCG), the Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008) and Assessing Vibration: A Technical Guideline 2006.

3.1 Secretary's Environmental Assessment Requirements (SEARs)

The Secretary's Environmental Assessment Requirements (SEARs) outline the requirements for the construction and operational use of the proposed development. With regard noise the SEARS for SSD-8996 states the following:

Key issues	<p>8. Noise and Vibration:</p> <p>Identify and provide quantitative assessment of the main noise and vibration generation sources during construction and operation, including consideration of public address system, school bell and the use of the school hall for concerts etc. (both during and outside school hours).</p> <p>Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.</p>
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Further reference is made to *Assessing Vibration: A Technical Guide* 2006, the *NSW Noise Policy for Industry*, *NSW Road Noise Policy* and the *NSW Interim Construction Guideline* which are outlined below.

3.2 Noise Policy for Industry

Assessment of noise in accordance with *NSW Noise Policy for Industry* (2017) has two main components: intrusiveness and amenity criteria. These are compared to each other (after conversion of amenity noise level to $L_{Aeq,15min}$ equivalent level) to determine the overall project noise trigger level.

3.2.1 Intrusiveness noise level

The intrusiveness noise level is based on the $L_{Aeq,15min}$ associated with commercial activity being less than or equal to the measured L_{A90} Rating Background Level + 5dB as per Section 2.3 of the policy. A modifying factor should also be added where appropriate to allow for tonality, impulsiveness, and intermittency or low frequency effects.

3.2.2 Amenity noise level

The amenity noise level is determined in accordance with Section 2.3 of the policy based on the land use and relevant noise criteria specified in Tables 2.3 and 2.2 respectively.



The NSW *Noise Policy for Industry* sets out acceptable noise levels for various locations. Under the policy, all receivers would be most likely assessed against the 'suburban' criteria. As defined in the policy, suburban category is an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry.

3.2.3 Modifying factors

The NSW *Noise Policy for Industry* includes correction factors such as tonal noise, low-frequency noise, intermittent noise and duration. Where two or more modifying factors are present, the maximum adjustment to a noise source level is 10dBA (excluding duration correction).

3.2.4 Sleep Disturbance

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

Where the subject development/premises night-time noise levels at a residential location exceed:

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

a detailed maximum noise level event assessment should be undertaken.

3.2.5 Project noise trigger level

To determine the project trigger noise level, the amenity noise level must first be standardised to and equivalent $L_{Aeq,15min}$ in order to compare to the intrusiveness noise level. This is done in accordance with Section 2.2 of the policy as follows;

$$L_{Aeq,15min} = L_{Aeq, period} + 3dB$$

Therefore, based on the measured data presented in Section 2, the project-specific noise limits are determined below in **Error! Reference source not found..**

Table 2 : Project Noise Trigger Level (PNTLs)

Receiver	Time of Day	ANL ¹ L _{Aeq,period}	Measured RBL ²	Measured Noise Level L _{Aeq,period}	Criteria for New Sources	
					Intrusive L _{Aeq,15min}	Amenity L _{Aeq,15min}
Mt Pleasant Ave. (North)	Day	55	47	56	52	58
	Evening	45	44	54	49	48
	Night	40	39	52	44	43
Mt Pleasant Ave. (South)	Day	55	49	58	54	58
	Evening	45	47	56	52	48
	Night	40	44	55	49	43
Osborn Road (North)	Day	55	59	70	64	58
	Evening	45	56	69	61	48
	Night	40	38	67	43	43
Osborn Road (South)	Day	55	42	55	47	58
	Evening	45	39	54	44	48
	Night	40	33	50	38	43

Note 1: ANL = "Amenity Noise Level" for receivers in a Suburban area.

Note 2: RBL = "Rating Background Level".

3.3 Assessing Vibration: A Technical Guideline 2006

3.3.1 Types of vibration

There are three types of vibration as classified in the guide:

- *Continuous* – vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted RMS (root mean squared) acceleration values.
- *Impulsive* – rapid build up to a peak followed by a damped decay that may or may not involve several cycles. The duration is short, typically less than 2 seconds. Impulsive vibration (no more than three occurrences in an assessment period) is assessed on the basis of acceleration values.
- *Intermittent* – interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. Assessed on the basis of vibration dose values.

3.3.1.1 Acceptable values for continuous and impulsive vibration (1-80Hz)

Table 3 : Preferred weighted RMS vibration acceleration values

Type	Location	Assessment Period	Preferred Values m/s ²		Maximum Values m/s ²	
			z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration	Critical areas	Day or Night-time	0.005	0.0036	0.01	0.0072
	Residences	Daytime	0.01	0.0071	0.02	0.014
		Night-time	0.007	0.005	0.014	0.01
	Offices, schools, educational institutions and places of worship	Day or Night-time	0.02	0.014	0.04	0.028
	Workshops	Day or Night-time	0.04	0.029	0.08	0.058
Impulsive vibration	Critical areas	Day or Night-time	0.005	0.0036	0.01	0.0072
	Residences	Daytime	0.3	0.21	0.6	0.42
		Night-time	0.1	0.071	0.2	0.14
	Offices, schools, educational institutions and places of worship	Day or Night-time	0.64	0.46	1.28	0.92
	Workshops	Day or Night-time	0.64	0.46	1.28	0.92

3.3.1.2 Acceptable values for intermittent vibration

Intermittent vibration is assessed using the vibration dose value (VDV) root-mean-quad method. VDV accumulates the vibration energy received over the daytime and night-time periods. The vibration dose methodology is as per standard BS 6472-1992.

3.4 NSW Road Noise Policy 2008

Additional guidance for the assessment of noise from traffic on public roads are set out in the *RNP* (Department of Environment, Climate Change and Water, 2011).

Table 3 of the *RNP* is reproduced in Table 4 and presents the relevant criteria for road use within the Project.

Table 4 : Road traffic noise assessment criteria for residential land uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	L _{Aeq} , (15 hour) 55 (external)	L _{Aeq} , (9 hour) 50 (external)
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	L _{Aeq} , (15 hour) 60 (external)	L _{Aeq} , (9 hour) 55 (external)
	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local roads	4. Existing residences affected by noise from new local road corridors	L _{Aeq} , (1 hour) 55 (external)	L _{Aeq} , (1 hour) 50 (external)
	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		



4 OPERATIONAL NOISE IMPACT ASSESSMENT

4.1 Stage 1 Project

This section specifically applies to the Stage 1 works as its form and function have been specifically defined. Controlling noise criteria is based on noise measurement results presented in Section 2.

4.1.1 Boarding Facility (*Envelope 1*)

4.1.1.1 General Noise

The proposed use of the Boarding House is for accommodation and, as such, noise generated within this area is expected to be general domestic level noise which will be adequately contained by the facade of the building.

No special measures are required to protect the acoustic amenity of nearby residents.

4.1.1.2 Dining Area Noise

The new building will include an indoor / outdoor dining area located on the western side of the building at the lower ground level at RL 185. As such, the bulk of the proposed boarding building, RL 201, will shield residences to the east of the site on Mount Pleasant Avenue.

Noise levels at residences on Mount Pleasant Avenue have been predicted based on the following parameters:

- Half of total students (108 persons) speaking in a raised voice in the dining areas (each person speaking at a level of 68dBA at 1 metre);
- Distance attenuation;
- Shielding from the building;
- Ground topography;
- Ground absorption; and
- Atmospheric absorption.

Resultant noise levels at the residences opposite the proposed boarding school are predicted to be **25dBA** which is significantly below project-specific noise criteria at nearby residences of 48 $L_{Aeq,15min}$ at night.

4.1.1.3 Loading Dock Operations

The loading dock will be situated towards the southern end of the Boarding House site in the basement of the building. Access to the loading dock is via a driveway at a distance of approximately 30 metres from the residences on Mount Pleasant Avenue.

Truck movements associated with the loading dock will be limited to 7.00am to 6.00pm Monday to Saturday and 8.00am to 6.00pm Sundays & Public Holidays.

Trucks that will services the site will consist of small delivery van along with the occasional Pantech truck.

Noise levels at the nearest residences have been predicted based on the following noise levels associated with docks. details these L_{Aeq} noise levels.

Table 5 presents the sound power levels of the trucks using the loading dock.

Table 5 : L_{Aeq} noise levels of operation and events – dBA

Noise Source	Sound Power Level (SWL)	Sound Pressure Level at 3m $L_{Aeq,15min}$
Truck loading / unloading with Forklift	95	77
Forklift working	89	71
Truck moving on site	102	86

Noise levels at the nearest residences have been predicted to be **51dBA** at the nearest residence when a larger Pantech truck is in the loading dock. This level complies with the daytime noise criteria of 54dBA which is during the proposed hours of operation.

4.1.2 New Multi-Sport Courts & Underground Carpark (*Envelope 13*)

The proposed Multi-Sport Courts & Underground Carpark is located near the eastern boundary of the site on the existing all-weather multi-sport courts. The proposed usage of the facility is:

- Monday to Thursday (6.30am – 5.15pm); and
- Saturday (7.30.am – 12.30pm).

Patron numbers (including spectators) are expected to range between 10 – 80 during peak times.

As usage of the facility is proposed to start before 7.00am and on Saturdays, the relevant noise criteria for these periods has been determined with the methodology outlined in the *NPfI* and is presented below in Table 6.

Table 6 : PNTLs for Mount Pleasant Avenue (North)

Receiver	Time of Day	ANL ¹ $L_{Aeq,period}$	Measured RBL ²	Measured Noise Level $L_{Aeq,period}$	Criteria for New Sources	
					Intrusive $L_{Aeq,15min}$	Amenity ³ $L_{Aeq,15min}$
Mount Pleasant Avenue (North)	Morning Shoulder ⁴	-	47	55	52	-
	Day	55	47	56	52	58
	Saturday	-	47	55	52	58

Note 1: ANL = "Amenity Noise Level" for receivers in a Suburban area.

Note 2: RBL = "Rating Background Level".

Note 3: Assuming existing noise levels are unlikely to decrease in the future.

Note 4: Mourning Shoulder period (5.00am – 7.00am)

The following sound power levels (SWL) have been used to assess noise levels at the receivers located on Mount Pleasant Road.

Table 7 : Multi-sport courts SWLs

Item	Sound Power Level (SWL) dB(A)
Multi-sport court use	88

The nearest sensitive receivers are located on Mount Pleasant Avenue at distance of approximately 40 metres from the activity area. Noise level predictions at the nearest sensitive receivers are predicted to be no greater than **35dBA** $L_{Aeq,15min}$ during 'peak use' of Multi-Sport Courts. As such, compliance for sports activities is indicated with no specific noise controls required.

Similarly, due to the distance between the noise source and sensitive receivers the underground carpark beneath the Multi-sport courts is predicted to comply with the noise criteria defined in Table 2 during all time periods.

4.1.3 Tennis Courts with underground carpark (*Envelope 14*)

The proposed upgraded Tennis Courts and underground parking is located central to the site with the nearest sensitive receivers located approximately 60 m to the north-east. As a result of this distance and the low-risk noise activity no further assessment is required.

4.1.4 Osborn Road Carpark Expansion (*Project J*)

Expansion of the Osborn Road Carpark may potentially impact residential receivers on Osborn Road. Additional vehicle movements as a result of the upgraded carpark are assessed under the NSW Road Noise Policy (RNP) and are deemed 'local' roads.

Table 8 : RNP noise criteria for local road

Road Category	Type of project/land use	Assessment Criteria Daytime (7am – 10pm)
Local Roads (Osborne Road)	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq, (1 \text{ hour})}$ 55

The proposed upgrades would increase capacity from 60 to 87 spaces. For this assessment, it is assumed the additional 27 vehicles utilising the carpark all arrive via Osborn Street in the same hour, within the Daytime (7.00am – 10.00pm) assessment period.



SoundPlan 8 noise modelling software was used to assess and predict noise impacts on sensitive receivers located on Osborn Road.

Façade-reflected noise levels have been predicted to be up to 41.5dB $L_{Aeq,1hr}$ at the most affected residences during morning and afternoon peak hours, in compliance with *RNP* 55dB $L_{Aeq,1hr}$ noise criteria.

4.1.5 Mechanical Services

The major mechanical noise sources associated with the development will be exhaust fans and plant that will be located on the roof of the Boarding Facility. These will consist of roof mounted condensers or plant that have yet to be determined. Additionally, exhaust fans for the Multi-sport and Tennis underground carpark may be required.

Noise from most major plant, such fan coil units and pumps will be contained by the building structure. Therefore, it is the roof condensers and air handling units that may require noise mitigation to achieve the established site-specific noise criteria at surrounding receivers.

Detailed specifications of mechanical services equipment that would otherwise allow an acoustic assessment of noise emissions from the site are not available at this stage of the project as selection and design is conducted after project approval.

In line with the approvals for other developments, detailed assessment of operational noise emission should form a conditional requirement of the development, to be satisfied to the PCA, prior to the issue of the construction certificate.

To mitigate noise from mechanical plant, it is likely the some or all of the following noise control measures may need to be adopted at the design stage to meet noise objectives:

- Attenuators on carpark and other fans;
- Acoustic louvres;
- Noise barriers; and
- Variable speed controls on condenser fans.

The mechanical plant will be designed to meet the criteria presented in **Error! Reference source not found.** at the identified nearby receivers.

4.1.6 School Announcements & Bells

Announcements and school bells are typical activities associated with school operations. Typically, these are produced by the school PA system and can vary significantly depending on the final volume settings of the system.

At this stage, no design of the PA system has been determined. However, the following measures should be adopted to ensure that their impact at all surrounding residences is minimised:

- Speakers should be located and orientated to provide good coverage of the school areas whilst being directed away from residences. The coverage of the system should be subject of the detail design of the system.



- The volume of the system should be adjusted on site so that announcements and bells are clearly audible on the school site without being excessive. The system should initially be set so that noise at surrounding residences does not exceed the ambient noise levels by more than 5dBA.
- Once the appropriate level has been determined on site, the system should be limited to the acceptable level so that staff cannot increase noise levels.

The bell system should be set so that it only occurs on school days.

5 CONCEPT PROPOSAL

A review of the proposed future developments that are proposed in the development at some future stage has been conducted with respect to those buildings that can be considered “acoustically significant”, in that they have the potential to impact on surrounding residential receivers.

The assessment of noise emissions with respect to site specific noise criteria needs to be conducted at the time in the future that use, capacity and hours of operation are defined. These uses should be assessed against site specific noise criteria based on noise measurements that are conducted at the time of the specific application.

A review of potential impacts of these identified facilities are detailed as below.

5.1.1 All-weather field with underground carpark (*Envelope 8*)

The proposed ‘All-weather field’ with underground carpark is located near the western boundary line in close proximity to sensitive receivers on Osborn Road. The proposed usage of the facility is:

- Monday to Thursday (6.30am – 5.15pm);
- Saturday Term 1 & 3 (7.30am – 5.00pm); and
- Saturday Term 2 & 4 (7.30am – 12.30pm).

Patron numbers (including spectators) are expected to range between 5 – 200 during Monday to Thursday and 50 – 300 for activities occurring on Saturday.

As usage of the facility is proposed to start before 7.00 am and on Saturdays, the relevant noise criteria for these periods has been determined with the methodology outlined in the *NPfI* and is presented below in Table 9.

Table 9 : PNTLs for Osborne Road (South)

Receiver	Time of Day	ANL ¹ L _{Aeq,period}	Measured RBL ²	Measured Noise Level L _{Aeq,period}	Criteria for New Sources	
					Intrusive L _{Aeq,15min}	Amenity ³ L _{Aeq,15min}
Osborn Road (South)	Morning Shoulder ⁴	-	39	54	44	48
	Day	55	42	55	47	58
	Saturday	-	42	55	47	58

Note 1: ANL = "Amenity Noise Level" for receivers in a Suburban area.

Note 2: RBL = "Rating Background Level".

Note 3: Assuming existing noise levels are unlikely to decrease in the future.

Note 4: Mourning Shoulder period (5:00 am – 7:00 am)

It is difficult to assess noise emissions from the facility as no detailed design for the stadium, bench or bleacher seating exists. Notwithstanding, the following noise sources have been used to assess indicative noise levels at the receivers located on Osborne Road.

Table 10 : All-weather playing field SWLs

Item	Sound Power Level dB(A)/m ²
Soccer / Hockey game	62
Spectators	88

Noise level predictions at sensitive receiver locations on Osborne Road during 'peak use' of the All-weather playing fields are presented below in Table 11.

During periods of peak activity, occurring in the Day-time the noise level predictions indicate minor exceedances of 1 to 2dB at 32 Osborne Road and 34 Osborne Road, respectively.

All exceedances can be managed at a later design stage in communication with stakeholders, the school, residents, and other relevant party's. Appropriate mitigation to ensure operational noise levels remain under the criteria could include, but are not limited to:

- changes to design, orientation, or elevation limiting noise exposure to Osborne Street receivers;
- modification to the proposed Operating Hours and capacity; and
- addition of 1800 mm solid boundary fence to shield noise emissions from the facility.

During the AM shoulder period (5.00am – 7.00am) the staff, students and parents would be arriving and preparing for sports activity.

Assessment of road noise and car park emissions associated with the All-weather field and underground carpark would be done at a later time specific to project application. However, preliminary calculations based on the All-weather playing fields operating at 30% capacity during the 'Morning Shoulder' time period have been calculated. During this time noise levels are predicted to be less than the 'Morning Shoulder' criteria of 44 dBA $L_{Aeq,15min}$.

Table 11 : All-weather playing field predictions for Osborne Road

Receiver	Time of Day	Criteria for New Sources	Worst Case Predicted	Exceedance
		Intrusive $L_{Aeq,15min}$	dBA $L_{Aeq,15min}$	
4 Currawong Avenue	Daytime	47	41	-
16A Osborn Road			37	-
18 Osborn Road			42	-
20 Osborn Road			42	-
22 Osborn Road			44	-
24 Osborn Road			43	-
26 Osborn Road			36	-
26A Osborn Road			38	-
28 Osborn Road			45	-
30 Osborn Road			40	-
32 Osborn Road			48	1
34 Osborn Road			49	2
34A Osborn Road			43	-
40 Osborn Road			47	-
42 Osborn Road			44	-
44 Osborn Road			44	-
46 Osborn Road			43	-

5.1.2 Gonzaga Barry Performing Arts Centre (*Envelope 7*)

This site is proposed to be located opposite residences on the western side of the school site with the potential for noise impacts for receivers on Osborn Road.

It should be noted there is no details of the buildings design, layout or facade available at this stage of development. Potential noise impacts may be suitably managed at a later design stage with consideration to operational noise emissions.

Detailed assessment of noise emissions with respect to future site-specific noise criteria, based on future noise monitoring will be conducted to establish appropriate noise control measures to protect the acoustic amenity of residences. However, preliminary predictions have been conducted based on the following noise levels.

Noise criteria for operational use of the Gonzaga Barry Performing Arts Centre is based on the Stage 1 criteria reproduced below in Table 12.

Table 12 : Noise criteria for Osborn Road receivers

Receiver	Time of Day	ANL ¹ L _{Aeq,period}	Measured RBL ²	Measured Noise Level L _{Aeq,period}	Criteria for New Sources	
					Intrusive L _{Aeq,15min}	Amenity L _{Aeq,15min}
Osborn Road (North)	Day	55	59	70	64	58
	Evening	45	56	69	61	48
	Night	40	38	67	43	43
Osborn Road (South)	Day	55	42	55	47	58
	Evening	45	39	54	44	48
	Night	40	33	50	38	43

Note 1: ANL = "Amenity Noise Level" for receivers in a Suburban area.

Note 2: RBL = "Rating Background Level".

Indicative internal sound power levels used for the assessment are presented in Table 13.

Table 13 : Indicative L_{Aeq} noise levels of Gonzaga Barry operation and events – dBA

Noise Source	Sound Power Level – Internal (SWL)
Auditorium / Recital / Function Hall	102 dBA



Noise levels at residences have been predicted at nearby residences on the assumption that windows to the building are open and that operation will occur in the day and evening period. These are compared to Stage 1 criteria to provide an indication of likely compliance of future Masterplan developments of acoustic significance and are presented in Table 14 : .

Table 14 : Gonzaga Barry operational noise predictions

Receiver	Time of Day	Criteria for New Sources L _{Aeq,15min} dBA	Worst Case Predicted L _{Aeq,15min} dBA	Exceedance
Osborn Road (North)	Day	58	51	-
	Evening	48	51	3
Osborn Road (South)	Day	47	51	4
	Evening	44	51	7

Based on a review of the above, exceedances of up to 7dB are predicted when windows are open to the Osborn Road façade or any significant noise transfer path from Centre exists.

Therefore, following design concepts should be adopted to control noise emissions for the facility to limit noise emissions to sensitive receivers on Osbourne Road:

- Limiting operational use with regard to sensitive noise criteria time periods.
- Avoid Openings in the western side of the building.
- Suitable noise reduction glazing / façade to be detailed to control noise emissions.
- Plant on roof to be acoustically treated.

With the adoption of the above concepts, noise control for the operation of the Gonzaga Barry Centre is anticipated and feasible.

Adoption of these and other noise control methods in the design and operation of Envelope 7 (Gonzaga Barry) will ensure compliance with the site-specific criteria for all time periods.

6 CONSTRUCTION NOISE AND VIBRATION

This section of the assessment relates to Stage 1 works, whereby other stages of the development will be assessed when applications are made for these works. It should be noted that the methodology for establishing noise and vibration criteria detailed in the following sections is applicable to all stages of the Masterplan.

6.1 Interim Construction Noise Guideline (DECC, 2009)

The NSW EPA *Interim Construction Noise Guideline* (ICNG) requires project-specific Noise Management Levels (NMLs) to be established for noise affected receivers. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices are investigated to minimise noise emissions.

Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts would be managed via site specific construction noise management plans, to be prepared in the detailed design phase.

Figure 4 details the *ICNG* noise management levels.

Time of day	Management level L_{Aeq} (15 min) *	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> Where the predicted or measured L_{Aeq} (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ol style="list-style-type: none"> times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Figure 4 : Interim Construction Noise Guideline criteria

In addition, the following construction noise management levels $L_{Aeq,15min}$ are recommended for other receivers and areas:

- Active recreation areas (such as parks): external $L_{Aeq,15min}$ 65dBA
- Industrial premises: external $L_{Aeq,15min}$ 75dBA
- Offices, retail outlets: external $L_{Aeq,15min}$ 70dBA
- Classrooms at schools and other educational institutions: internal $L_{Aeq,15min}$ 45dBA

Based on the above, Table 15 presents the applicable noise management levels for construction activities at surrounding receivers that have been adopted for all applications.

Table 15 : Site-specific construction Noise Management levels

Location	Construction Noise Management Level (NMLs) - $L_{Aeq,15min}$				Highly Noise Affected Noise Level - $L_{Aeq,15min}$
	Day	Evening	Night	Saturday	
Mt Pleasant Ave (North)	57	49	44	57	75
Mt Pleasant Ave (South)	59	52	49	58	75
Osborn Road (North)	69	66	48	69	75
Osborn Road (South)	52	49	43	52	75

6.2 Hours of Operation & Programme

The proposed working hours for this project are as follows:

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm
- Sunday and Public Holidays No work

If required, after hours permits will be sought from the relevant authorities.

6.3 Construction Equipment & Noise Source Levels

Sound Power Levels (SWLs) for typical construction plant are identified in



Table 16. These SWLs have been measured at other similar construction sites. The table gives both Sound Power Level and Sound Pressure Levels (SPL) at 7m for the equipment. Sound Power Level is independent of measurement position.

Table 16 : Typical Construction Plant Sound Levels – dBA

Plant	Sound Power Level	Sound Pressure Level at 7m
Concrete Truck	109	84
Angle Grinder	109	84
Concrete Pump – 120mm diameter / 50 bar	112	87
Concrete Saw	116	91
Mobile Crane	98	73
Dump Truck	108	83
Compressor	100	75
Bobcat	103	78
Hand Tools	90	65
Excavator	108	83
Crawler Cranes	98	73
Tower Crane	104	79
Front End Loader	112	87
Excavator	107	82
Hammer Hydraulic	122	97
Bored Pile Rig	112	87
Asphalt Milling Machine	110	85
Bitumen Spray Truck	100	75
Road Profiler	107	82
Vibratory Roller (10-12 tonne)	109	86

6.3.1 Proposed Works

Assessment of likely construction noise at surrounding receivers has been undertaken for the following proposed Stage 1 works. These construction scenarios have been selected as they represent the highest risk of noise and vibration impacts for nearby sensitive receivers (including the school).

Boarding Facility (*Envelope 1*)

- Demolition
- Excavation
- Building Construction

- Façade / Fitout finishing works

Garden Plaza *(Project A)*

- Site preparation and clearing works
- Landscaping and finishing works

Demolished Dock + Maintenance Wing *(Project B)*

- Demolition
- Excavation
- Building Construction
- Landscaping and finishing works

Multi-Sport Courts with underground carpark *(Envelope 13)*

- Site preparation and clearing works
- Excavation
- Building Construction

Tennis Courts with underground carpark *(Envelope 14)*

- Site preparation and clearing works
- Excavation
- Building Construction

Link Road from Osborn Road - Mt Pleasant Avenue *(Project H)*

- Site preparation and clearing works
- Construction of roadway
- Landscaping and finishing works (including paving)

Osborn Road Carpark Expansion *(Project J)*

- Site preparation and clearing works
- Expansion of parking area

6.4 Construction Noise Modelling

Noise modelling of the development site was undertaken using the CONCAWE noise prediction algorithm in SoundPLAN V8.0 modelling software.

The noise model was constructed from a combination of aerial photography, existing ground topography, design ground topography and design masterplans for the development. The local terrain, receiver buildings and structures have been digitised in the noise model to develop a three-dimensional representation of the construction works and surrounding environment.

Maximum sound power levels (SWLs) for the typical operation of construction equipment applied in the modelling are listed in Table 17.

To assess construction noise levels against the NMLs, the maximum noise levels have been converted to equivalent $L_{Aeq,15min}$ noise emissions. Based on previous experience on large construction proposals suitable adjustments of between 2dB to 5dB have been applied to convert the L_{Amax} noise levels in to L_{Aeq} noise levels for assessment against the NMLs.

Table 17 : Construction scenarios for Stage 1 works

Stage 1	Phase	Equipment	Operating minutes in 15-min period	Number of items in same location	Sound Power Level (dB)		
					Maximum Item (SWL)	L_{Aeq} Activity	L_{Amax} Activity
Boarding Facility (Envelope 1)	Demolition	Excavator (25 tonne) – rock breaker	7.5	1	121	119	124
		Front End Loader	15	1	112		
		Dump Truck	15	2	100		
	Excavation	Piling Rig (Bored)	7.5	2	108	112	118
		Excavator (12 tonne)	15	2	97		
		Low Loader	15	1	106		
	Building Construction	Concrete Truck / Agitator	7.5	2	106	111	114
		Forklift	15	2	104		
		Compressor	15	1	95		
		Crane	15	2	100		
		Bump Truck	15	1	98		
		Concrete Pump	7.5	1	103		
		Truck (12-15 tonne)	15	2	106		
	Façade / Fitout	Hammer Drill	15	1	100	105	108
		Tower Crane	15	1	100		
		Forklift	15	1	101		
Garden Plaza (Project A)	Site preparation	Circular Saw (Battery Operated)	15	1	108	115	128
		Forklift	15	1	101		
	Landscape	Chainsaw	5	1	108	114	128
		Chipper	5	1	120		
Demolish Dock + Maintenance Wing (Project B)	Demolition	Concrete Saw (Soff-Cut)	7.5	1	103		111
		Excavator (20 tonne)	15	1	99		
		Dump Truck (approx. 15 tonne)	15	1	100		
		Front End Loader (L120)	15	1	104		

STUDY TYPE: CONSTRUCTION & OPERATIONAL NOISE ASSESSMENT
LORETO NORMANHURST CONCEPT PROPOSAL AND STAGE 1

RWDI#2101353
 December 16, 2020



Stage 1	Phase	Equipment	Operating minutes in 15-min period	Number of items in same location	Sound Power Level (dB)		
					Maximum Item (SWL)	L _{Aeq} Activity	L _{Amax} Activity
		Forklift	15	2	104		
		Compressor	15	1	95		
		Crane (small)	15	1	98		
		Bump Truck	15	1	98		
		Concrete Pump	7.5	1	103		
		Truck (12-15 tonne)	15	2	106		
	Landscape and finish	Hammer Drill	15	1	100	105	108
		Tower Crane	15	1	100		
		Forklift	15	1	101		
Multi-Sport Courts with underground carpark (Envelope 13) + Tennis Courts with underground carpark¹ (Envelope 14)	Site Preparation and Clearing Works	Dozer	15	1	110	111	118
		Chainsaw	5	1	108		
		Dump Truck (15 tonne)	5	1	98		
	Excavation	Excavator (20 tonne)	15	1	99	113	119
		Front End Loader (FEL) 962	15	1	112		
		Dump Truck (approx. 15 tonne)	15	2	100		
	Building Construction	Concrete Pump	7.5	2	106	107	112
		Concrete Truck / Agitator	15	2	106		
		Crane (small)	15	1	98		
Link Road from Osborn Road - Mt Pleasant Avenue (Project H)	Site Preparation	Dozer	15	1	110	111	118
		Chainsaw	5	1	108		
		Dump Truck (15 tonne)	5	1	98		
	Road Construction	Asphalt Milling Machine ¹	15	1	111	114	119
		Bitumen Spray Truck	15	1	100		
		Vibratory Roller (10 - 12 tonne) ¹	15	1	109		
		Compactor	15	1	108		
	Landscape and paving	Concrete Pump	15	1	95	111	114
		Concrete Truck / Agitator	15	1	98		
		Paving Machine	15	1	98		
		Compactor	7.5	1	103		

Stage 1	Phase	Equipment	Operating minutes in 15-min period	Number of items in same location	Sound Power Level (dB)		
					Maximum Item (SWL)	L _{Aeq} Activity	L _{Amax} Activity
Osborn Road Carpark Expansion (Project J)	Site preparation	Dozer	15	1	110	114	123
		Chainsaw	5	1	108		
		Dump Truck (15 tonne)	5	1	98		
	Extension of carpark	Concrete Pump	7.5	1	106	111	114
		Concrete Truck / Agitator	7.5	1	106		
		Paving Machine	15	1	104		
		Compactor	15	1	108		

NOTE 1: Similar construction methodologies and equipment assumed for both scenarios

Consistent with the requirements of the ICNG, and to inform the scheduling of construction activity and management of noise during the detailed design phase, the construction noise impacts are based on a worst-case assessment. The ICNG recommends that the realistic worst-case or conservative noise levels from the source should be predicted for assessment locations representing the most noise exposed residences or other sensitive land uses. For each receiver area the noise levels are predicted at the most noise-exposed location, which would usually be the closest receiver.

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted at the most-exposed receiver as the noise levels presented in this report are based on a realistic worst-case assessment.

6.5 Predicted Construction Noise Impacts

In the area surrounding the development site, the noise impacts have been quantitatively assessed for all construction activities associated with Stage 1 works. The activities considered are described in Section 6.3.1.

The typical L_{Aeq,15minute} noise levels at the surrounding noise sensitive receivers are provided in



Table 18 for each of the construction activities and are representative of the 'noisiest' construction periods allowing for the simultaneous operation of noise intensive construction plant in close proximity.

Table 18 : Predicted Construction Noise - Impacts Stage 1

Works	Stage	Sensitive Receiver Area	Noise Level – L _{Aeq,15min} dBA		
			NML Day Standard Hours ¹	Worst-case Predicted	Exceedance
Boarding Facility (Envelope 1)	Demolition	Mt Pleasant (North)	57 / 57	54	-
		Mt Pleasant (South)	59 / 58	52	-
		Osbourne Road (North)	69 / 69	43	-
		Osbourne Road (South)	52 / 52	45	-
	Excavation	Mt Pleasant (North)	57 / 57	52	-
		Mt Pleasant (South)	59 / 58	69	10 / 11
		Osbourne Road (North)	69 / 69	52	-
		Osbourne Road (South)	52 / 52	54	-
	Building Construction	Mt Pleasant (North)	57 / 57	46	-
		Mt Pleasant (South)	59 / 58	63	4 / 5
		Osbourne Road (North)	69 / 69	54	-
		Osbourne Road (South)	52 / 52	54	-
	Façade and Fitout	Mt Pleasant (North)	57 / 57	37	-
		Mt Pleasant (South)	59 / 58	59	- / 1
		Osbourne Road (North)	69 / 69	50	-
		Osbourne Road (South)	52 / 52	52	-
Garden Plaza (Project A)	Site Preparation	Mt Pleasant (North)	57 / 57	42	-
		Mt Pleasant (South)	59 / 58	41	-
		Osbourne Road (North)	69 / 69	<30	-
		Osbourne Road (South)	52 / 52	<30	-
	Landscaping	Mt Pleasant (North)	57 / 57	45	-
		Mt Pleasant (South)	59 / 58	44	-
		Osbourne Road (North)	69 / 69	<30	-
		Osbourne Road (South)	52 / 52	<30	-
Demolished Dock + Maintenance Wing (Project B)	Demolition	Mt Pleasant (North)	57 / 57	54	-
		Mt Pleasant (South)	59 / 58	50	-
		Osbourne Road (North)	69 / 69	36	-

Works	Stage	Sensitive Receiver Area	Noise Level – L _{Aeq,15min} dBA		
			NML Day Standard Hours ¹	Worst-case Predicted	Exceedance
	Building Construction / Landscape	Osbourne Road (South)	52 / 52	40	-
		Mt Pleasant (North)	57 / 57	44	-
		Mt Pleasant (South)	59 / 58	44	-
		Osbourne Road (North)	69 / 69	29	-
		Osbourne Road (South)	52 / 52	41	-
Multi-Sport Courts with underground carpark (Envelope 13)	Site Preparation	Mt Pleasant (North)	57 / 57	60	3 / 3
		Mt Pleasant (South)	59 / 58	44	-
		Osbourne Road (North)	69 / 69	31	-
		Osbourne Road (South)	52 / 52	22	-
	Excavation	Mt Pleasant (North)	57 / 57	64	7 / 7
		Mt Pleasant (South)	59 / 58	47	-
		Osbourne Road (North)	69 / 69	32	-
		Osbourne Road (South)	52 / 52	23	-
	Building Construction	Mt Pleasant (North)	57 / 57	57	-
		Mt Pleasant (South)	59 / 58	40	-
		Osbourne Road (North)	69 / 69	27	-
		Osbourne Road (South)	52 / 52	18	-
Tennis Courts with underground carpark (Envelope 14)	Site Preparation	Mt Pleasant (North)	57 / 57	65	8 / 8
		Mt Pleasant (South)	59 / 58	39	-
		Osbourne Road (North)	69 / 69	56	-
		Osbourne Road (South)	52 / 52	22	-
	Excavation	Mt Pleasant (North)	57 / 57	59	2 / 2
		Mt Pleasant (South)	59 / 58	33	-
		Osbourne Road (North)	69 / 69	51	-
		Osbourne Road (South)	52 / 52	19	-
	Building Construction	Mt Pleasant (North)	57 / 57	57	-
		Mt Pleasant (South)	59 / 58	31	-
		Osbourne Road (North)	69 / 69	49	-

Works	Stage	Sensitive Receiver Area	Noise Level – L _{Aeq,15min} dBA		
			NML Day Standard Hours ¹	Worst-case Predicted	Exceedance
		Osbourne Road (South)	52 / 52	18	-
Link Road from Osborn Road - Mt Pleasant Avenue (Project H)	Site Preparation	Mt Pleasant (North)	57 / 57	70	13 / 13
		Mt Pleasant (South)	59 / 58	42	-
		Osbourne Road (North)	69 / 69	63	-
		Osbourne Road (South)	52 / 52	37	-
	Construction of Link Rd	Mt Pleasant (North)	57 / 57	69	12 / 12
		Mt Pleasant (South)	59 / 58	45	-
		Osbourne Road (North)	69 / 69	64	-
		Osbourne Road (South)	52 / 52	39	-
	Landscaping and finishing works (including paving)	Mt Pleasant (North)	57 / 57	66	9 / 9
		Mt Pleasant (South)	59 / 58	41	-
		Osbourne Road (North)	69 / 69	47	-
		Osbourne Road (South)	52 / 52	17	-
Osborn Road (Project J)	Site Preparation	Mt Pleasant (North)	57 / 57	44	-
		Mt Pleasant (South)	59 / 58	43	-
		Osbourne Road (North)	69 / 69	56	-
		Osbourne Road (South)	52 / 52	65	13 / 13
	Landscaping	Mt Pleasant (North)	57 / 57	44	-
		Mt Pleasant (South)	59 / 58	43	-
		Osbourne Road (North)	69 / 69	56	-
		Osbourne Road (South)	52 / 52	65	13 / 13

During standard construction hours, exceedances of the NMLs (up to 13 dB) are predicted at the residential receivers in close proximity to the development. These exceedances typically occur during site clearing, demolition, and excavation construction phases. No exceedances are predicted during standard construction hours for the other construction activities modelled.

There are no noise sensitive receivers that are considered to be Highly Noise Affected, i.e. with predicted noise levels exceeding 7dB L_{Aeq}.

The ICNG describes strategies for construction noise mitigation and control that are applicable to this proposal. The strategies are designed to minimise, to the fullest extent practicable, noise during construction.

Where construction noise levels are predicted to exceed the NMLs it is recommended that construction noise mitigation measures should be considered, where reasonable and feasible. Typical construction noise mitigation measures include the following:

- Avoiding the coincidence of noisy plant working simultaneously close together would result in reduced noise emissions.
- Equipment which is used intermittently is to be shut down when not in use.
- Where possible, equipment with directional noise emissions should be oriented away from sensitive receivers.
- Regular compliance checks on the noise emissions of all plant and machinery used for the proposal would indicate whether noise emissions from plant items were higher than predicted.
- Non-tonal reversing alarms should be used on all items of plants and heavy vehicles used for construction.

6.6 Predicted Construction Vibration Impacts

Impacts associated with construction vibration are most likely to occur during excavation for the Boarding Facility and development of the Link Road from Osborn Road to Mount Pleasant Avenue.

Table 19 sets out the typical ground vibration levels at various distances for safe working distances.

Table 19 : Recommended safe working distances for vibration intensive plant

Item	Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Small Hydraulic Hammer	(300kg – 5 to 12t Excavator)	2m	7m
Medium Hydraulic Hammer	(900kg – 12 to 18t Excavator)	7m	23m
Large Hydraulic Hammer	(1600kg – 18 to 34t Excavator)	22m	73m
Vibratory Pile Driver	Sheet piles	2m to 20m	20m
Pile Boring	≤ 800mm	2m (nominal)	N/A
Jackhammer	Hand held	1m (nominal)	Avoid contact with structure

6.6.1 Boarding Facility (*Envelope 1*)

The proposed Boarding Facility is located on a steep gradient change with significant cut and fill required during the excavation phase. The construction management plan (ref *LH Normanhurst - Construction Management Plan (C) 08.12.20*) shows excavation within 9 meters from the Aquatic Centre building.



Details of proposed plant items and construction methodology are not available at this design stage. Once a contractor has been nominated a detailed Construction Noise and Vibration Management Plan (CNVMP) should be carried out.

Notwithstanding, based on the indicative construction equipment proposed in Table 17, the minimum working distances for the prevention of cosmetic damage are as follows:

- 13-tonne excavator with medium sized (900 kg) hydraulic hammer: 7m
- Pile Boring \leq 800 mm: 2 m (nominal)

The Aquatic Centre building is located 9 meters from the proposed activity and falls outside of the minimum working distance for cosmetic damage.

A review of the site plant and surrounding residential receivers indicates that the minimum distance between the vibration generating activities and surrounding residential buildings will be in the order of 40 metres. At this distance structural damage from all activities is unlikely to cause any structural damage to buildings.

6.6.2 Link Road from Osbourn Road (Project H)

Vibration intensive items of plant proposed for use during the construction of the development would include vibratory rollers associated with construction of the *Link Road from Osbourn Road* (Project H). There are no vibration sensitive receivers in close proximity to the road construction activities.

6.7 Construction Noise & Vibration Mitigation Measures

Without mitigation, noise levels from construction activities have been predicted to exceed the noise management levels nominated in the guidelines at some surrounding receivers. Therefore, noise control measures are recommended to ensure that noise is reduced where feasible. The following project-specific mitigation measures are recommended.

- Installation a 2.4 metre plywood hoarding around the construction site;
- Selection of quietest feasible construction equipment;
- Use of saw cutting in preference to rock-breakers where feasible; and
- Localised treatment such as barriers, shrouds, and the like around fixed plant, such as pumps, generators, and concrete pumps.
- In addition, the following measures should be included in a Noise & Vibration Management Plan.
- *Plant Noise Audit* – Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. To this end, testing should be established with the contractor.
- *Operator Instruction* – Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.
- *Equipment Selection* – All fixed plant at the work sites should be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures, and other noise attenuation measures in order to ensure that the total noise emission from each work site complies with EPA guidelines.
- *Site Noise Planning* – Where practical, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.

The adoption of the above measures is aimed at working towards achieving the noise management levels established at surrounding receivers.

6.7.1 Community Liaison and General Approaches to Mitigation

An effective community relations programme should be put in place to keep the community that has been identified as being potentially affected apprised of progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, meetings with surrounding owners/tenants, etc) of any anticipated changes in noise and vibration emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms. This programme should include a *Community and Stakeholder Engagement Strategy* developed specifically for the Project.

Close liaison should be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.

6.7.2 Noise & Vibration Management Plan

A Construction Noise & Vibration Management Plan for the site is recommended which should be prepared by the successful contractor. The plan should reference the findings of this assessment. Areas that should be addressed in plan include:

- Noise and vibration mitigation measures;
- Noise and vibration monitoring;
- Response to complaints;
- Responsibilities;
- Monitoring of noise emissions from plant items;
- Reporting and record keeping;
- Non-compliance and corrective action; and
- Community consultation and complaint handling.

6.8 Management of Construction Noise & Vibration to the School

Noise and vibration levels from construction are likely to be similar to the levels predicted for receivers immediately surrounding the site. Accordingly, measures that will be adopted to manage the school which should be detailed in a Construction Management Plan.

Measures that can be adopted to manage noise and vibration impacts at the school will be managed between the school and the successful contractor and could include:

- Closing of classroom windows;
- Relocating classes during busy construction periods; and
- Scheduling works during school holidays.



7 SUMMARY AND CONCLUSION

A construction and operational noise and vibration assessment of the Concept Masterplan and Stage 1 Loreto Normanhurst development has been conducted. Site-specific noise criteria that are applicable to this project have been presented.

7.1 Operational Noise Impacts

Site-specific operational noise criteria have been determined for the project based on ambient noise monitoring. A review of likely major mechanical plant indicates that noise levels can comply with established noise criteria during proposed operation with the inclusion of acoustic treatment. A detailed review of all mechanical plant with respect to site specific noise criteria is required at detailed design stage.

Noise from loading dock operations during the daytime period have been predicted to comply with site specific noise criteria.

Preliminary calculations of the proposed Concept Masterplan indicate that noise from the identified acoustically significant components of the Masterplan can be designed and managed to protect the acoustic amenity of surrounding residential receivers.

7.2 Construction Noise and Vibration Impacts

A noise assessment has been conducted for the proposed construction activities associated with the Stage 1 development to determine the potential for noise and vibration impact at surrounding receivers. Exceedances of noise management levels are expected at surrounding receivers when excavation and structure stages of the project occur. Accordingly, management of noise from construction activities should be included in the Site Construction Environmental Management Plan.

Vibration associated with on-site construction activities is unlikely to impact on surrounding residential receivers, however a Construction Noise and Vibration Management Plan (CNVMP) is required to assess potential impact to Aquatic Centre once construction methodology is known.