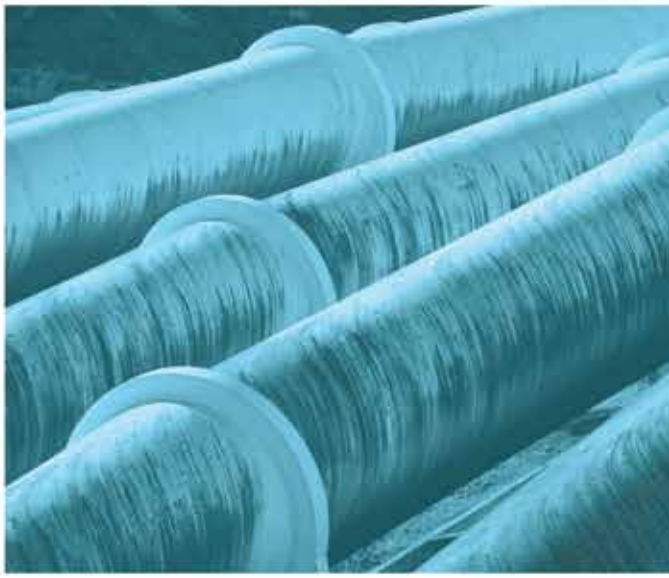



Nepean Hospital - Total Asset Management and Child and Adolescent Mental Health Services

Noise Impact Assessment

Prepared for Health Infrastructure
July 2022

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Total Asset Management and Child and Adolescent Mental Health Service

Noise Impact Assessment

Report Number

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6 July 2022

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1 Introduction

Indigeco has been engaged by NSW Health Infrastructure (HI) to provide acoustic consulting to provide acoustic consulting services for the proposed Total Asset Management (TAM) and Child and Adolescent Mental Health Service (CAMHS) development, located in the southeast corner of the Nepean Hospital campus. Indigeco has utilised our specialist services partner EMM Consulting Pty Limited (EMM) to prepare this report.

This noise and vibration impact assessment (NVIA) has been prepared to accompany the Review of Environmental Factors (REF) for the proposed development. This document addresses operational and construction noise and vibration requirements typically applied by the NSW Environment Protection Authority (EPA).

The assessment of operational and construction noise and vibration is typically undertaken in accordance with the following EPA guidelines and Australian Standards:

- NSW Environment Protection Authority (EPA) 2017, *Noise Policy for Industry (NPfI)*;
- NSW Department of Climate Change (DECC) 2009, *Interim Construction Noise Guideline (ICNG)*;
- NSW Department of Environment and Conservation (DEC) 2006, *Assessing Vibration: a technical guideline*; and
- Australian and New Zealand Standard AS/NZS 2107:2016 'Acoustics – Recommended design sound levels and reverberation times for building interiors'.

The above will form the basis of assessment for construction and operational noise and vibration impacts from the development.

Reference has been made to the Acoustic Logic Consultancy (ALC) 2018, *Nepean Hospital and Integrated Ambulatory Services Redevelopment – SSDA Acoustic Assessment* prepared for Health Infrastructure. Baseline noise levels and noise emission objectives established in the document have been utilised in this report.

2 Site background and proposal

2.1 Site location

The Nepean Hospital campus is located on the Great Western Highway, Kingswood NSW. The hospital campus includes public and private development and is bound by the Great Western Highway to the north, Somerset Street to the east, Derby Street to the south and Parker Street to the west (refer to Figure 2.1).

The Nepean Hospital is currently under redevelopment, with Stage 1 of the project nearing completion and Stage 2 currently in design.

The TAM development will be located in place of the existing fleet parking in the southeast corner of the Nepean Hospital development adjoining Derby Street and Somerset Street (refer to Figure 2.2).

The CAMHS development will be located to the north of the TAM development, adjoining the oral health building.

The surrounding uses of the hospital site include medical, commercial and residential land uses. Noise impacts associated with the proposed works are to be addressed to these receivers.

2.2 Development description

2.2.1 TAM development

The development includes the demolition of an existing carpark and construction of a new single level management and maintenance facility which will provide for the following:

- meeting rooms;
- staff rooms and amenities;
- private and open plan offices;
- workshops to cater for the following maintenance sectors:
  - gardening;
  - painting;
  - plumbing;
  - welding;
  - heating, ventilation and air-conditioning (HVAC); and
  - electrical.

2.2.2 CAMHS development

The development includes the demolition of existing low-set buildings on the site and the construction of a two-level freestanding structure which will incorporate the following:

- Carer bedroom
- Lounge
- Loading dock
- Services rooms (main switch board, comms)
- Amenities
- Offices
- Bedrooms
- Meeting rooms
- Sensory
- Learning centre
- Interview rooms
- Administration and staff

Plant equipment will be located along the western and southern façades of the structure with fans on the roof.

2.3 Demolition and construction works

The expected construction works associated with the proposal includes:

- demolition of existing low-set structures on the CAMHS site;
- minor demolition and site preparation of the existing fleet parking; and
- construction and fitout of the TAM buildings.

This study provides a preliminary assessment of construction noise and vibration generated by typical construction works which may have potential acoustic impacts on surrounding noise sensitive land uses.

It is anticipated that a detailed construction management plan will be generated by the main works contractor once detailed methodologies are formulated for the construction of the development.

2.4 Proposed operation

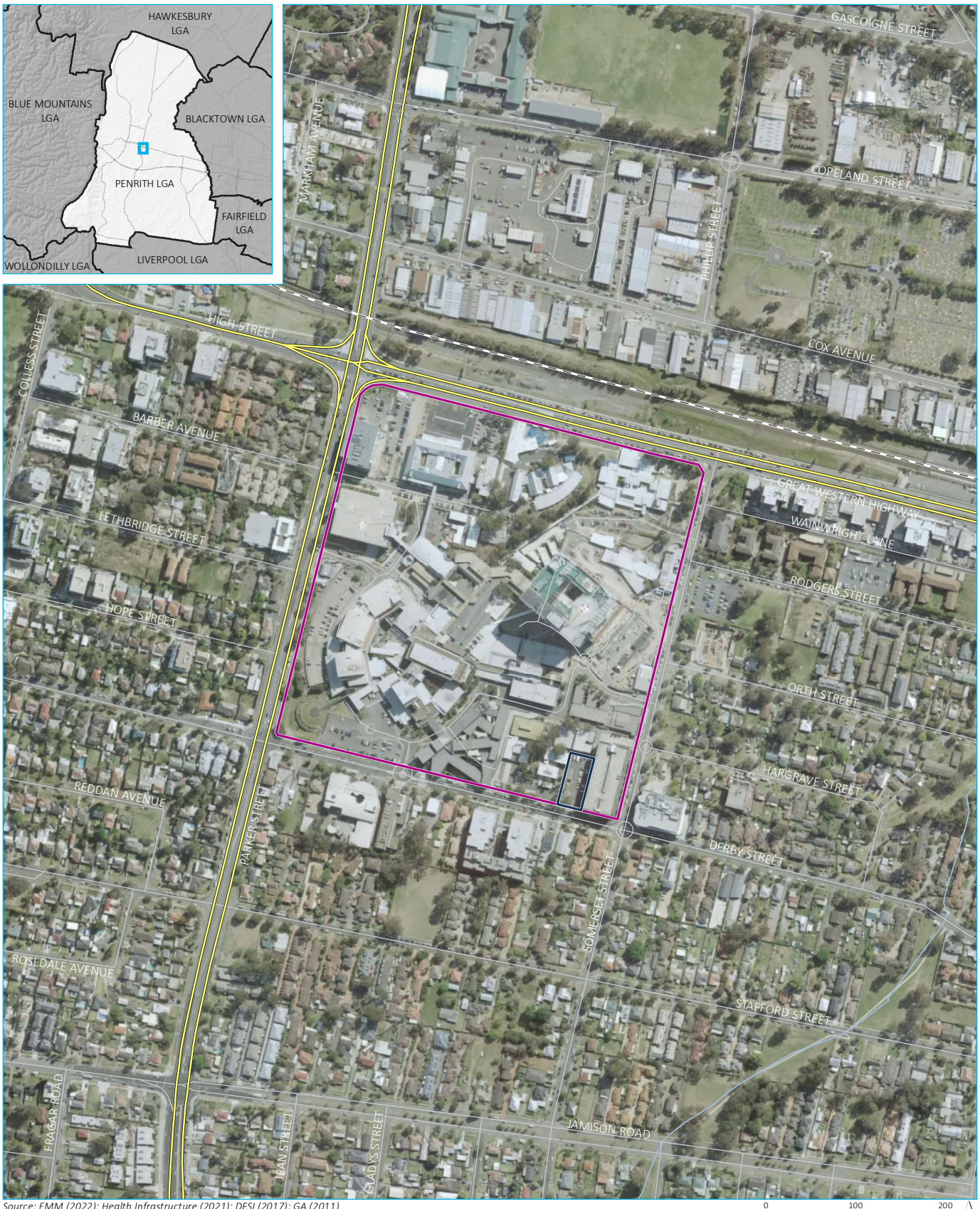
2.4.1 CAMHS development

The CAMHS development operation is generally associated with the provision of mental health clinical services. Operational noise impacts are expected to be associated with mechanical plant servicing the development.

2.4.2 TAM development

The operation of the office component of the project will be limited to office and administration uses. Operational noise impacts are expected to be limited to mechanical plant servicing the development for this component.

Noise associated with the workshops has been separately addressed for likely uses within these spaces and the potential for impact on surrounding noise sensitive uses external to the hospital campus.



Source: EMM (2022); Health Infrastructure (2021); DFSI (2017); GA (2011)

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KEY

- Nepean Hospital Precinct
- TAM Project
- Rail line
- Major road
- Minor road
- Watercourse/drainage line

Site locality

Nepean Hospital Redevelopment - TAM Project
Noise and Vibration Impact Assessment
Figure 2.1

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2.5 Noise sensitive assessment locations

Noise sensitive assessment locations addressed as part of this assessment are identified in Figure 2.2 and are summarised in Table 2.1.

Table 2.1 Assessment locations

Assessment location	Address	Current / proposed use
R1	28-32 Somerset Street, Kingswood	Mixed use residential
R2	34-36 Somerset Street, Kingswood	"Somerset Specialist Centre" Unoccupied / future healthcare
R3	38 Somerset Street, Kingswood	"Somerset Private Hospital" Healthcare
R4	29-33 Somerset Street, Kingswood	Residential
R5	46 Derby Street, Kingswood	Healthcare
R6	48-56 Derby Street, Kingswood	"Omega Apartments" Mixed use residential

Buildings within the Nepean Hospital campus in the vicinity of the project are summarised in Table 2.2.

Table 2.2 Nepean Hospital campus buildings

Assessment location	Building / department
N1	Oral Health
N2	Sexual Health
N3	Court Building
N4	Adult Mental Health
N5	Nepean Hospital Executive Building
N7	East Block

Source: EMM (2022); Health Infrastructure (2021); MetroMap (2021); DFSI (2017)

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KEY

- Noise assessment location
- Nepean Hospital Precinct
- TAM Project
- Future CAMHS site
- Minor road
- Cadastral boundary

Assessment locations

Nepean Hospital Redevelopment - TAM Project
Noise and Vibration Impact Assessment
Figure 2.2

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3 Existing site conditions

3.1 Background

Some assessment locations in the vicinity of the project are currently exposed to construction noise associated with the Stage 1 works of the Nepean Hospital redevelopment. In the absence of this construction noise, the most potentially exposed receivers are subjected to intermittent traffic flows along Somerset and Derby Street.

3.2 Noise monitoring

Ambient noise conditions have been adopted from the ALC (2018) report prepared for the Stage 1 redevelopment. The noise monitoring conducted as part of the 2018 assessment was undertaken prior to construction works on site and as such the noise data collected is not affected by construction related activities. The results from the noise monitoring are presented in Table 3.1.

Table 3.1 Previously recorded ambient noise levels – ALC (2018)

Location	Equivalent continuous sound pressure level, dB $L_{Aeq\ period}$			Rating background noise level, dB		
	Day	Evening	Night	Day	Evening	Night
Logger A 15 Barber Street	65	65	60	48	47	38
Logger B Somerset Street	59	57	54	47	41	37

The rating background noise levels provided in the ALC (2018) report will be used as a basis for addressing potential noise impact in this assessment. EMM has not verified the ALC data but note that levels reported are typical of such areas in our experience.

4 Noise and vibration criteria

4.1 Operational noise emissions

Noise emissions from the operation of the development are to comply with the noise conditions of the development consent, if approval is granted. It is anticipated that this will be based on the requirements of the EPA (2017) Noise Policy for Industry (NPfI).

The EPA NPfI provides guidance on establishing site specific noise emission objectives to govern noise from an industrial or commercial site to maintain suitable levels of acoustic amenity for surrounding receivers. To ensure these objectives are met, the EPA provides project specific noise trigger levels, namely intrusiveness and amenity.

The objectives of noise trigger levels are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. It should be noted that the audibility of a noise source does not necessarily equate to disturbance at an assessment location.

The project noise trigger levels (PNTL) have been established using noise monitoring at the site by ALC and provided in the ALC (2018) report.

4.1.1 Intrusiveness noise levels

The intrusiveness criteria apply to residential receivers and requires that $L_{Aeq,15min}$ noise levels from the site during the relevant operational periods do not exceed the rating background level (RBL) by more than 5 dB.

The rating background noise levels used for assessment purposes have been adopted from the ALC (2018) report prepared for Stage 1.

4.1.2 Project amenity noise levels

The assessment of amenity is based on noise levels specific to the land use. The noise levels relate only to noise generated by a commercial or industrial site and exclude road or rail traffic noise. Where the measured existing noise approaches recommended amenity noise levels, it needs to be demonstrated that noise levels from new industry will not contribute to existing industrial noise such that amenity noise levels are exceeded.

Consistent with the ALC (2018) report, the neighbouring area is classed as ‘suburban’ given the majority low rise single dwellings in the area. To allow for cumulative noise impacts from other sources (including other sites on the Nepean campus), the acceptable amenity noise targets should be adjusted down 5 dB according to the NPfI. In accordance with the NPfI, in areas of high traffic noise, the project amenity noise level may be derived from the $L_{Aeq,period(traffic)}$ (ie from traffic) minus 15 dB. Project amenity noise levels were determined on the basis of the ALC report, applying the high traffic noise area approach as appropriate.

4.1.3 Project noise trigger level

The project noise trigger level (PNTL) is the lower of the calculated intrusiveness or amenity noise level. To standardise the time periods for the intrusiveness and amenity noise levels, the NPfI considers that the $L_{Aeq,15min}$ is equivalent to the $L_{Aeq,period}$ + 3 dB, unless robust evidence is provided for an alternative approach for the project being considered.

A summary of the PNTL for assessment of operational noise from the project is presented in Table 4.1, based on RBL data provided in the ALC (2018) report prepared for Stage 1.

Table 4.1 Project noise trigger levels – residential receivers

Assessment location	Assessment period[1]	Intrusiveness noise level, $L_{Aeq,15min}$, dB[2]	Amenity noise level, $L_{Aeq,15min}$, dB[2]	PNTL[3], $L_{Aeq,15min}$, dB
Parker Street and Derby Street assessment locations	Day	53	53	53
	Evening	52	43	43
	Night	43	38	38

Notes: 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: remaining periods.

2. The intrusiveness noise target and amenity noise target are adopted from the ALC (2018) report and are based on these areas having high levels of traffic noise.

3. PNTL is the lower of the calculated intrusiveness or amenity noise levels.

The amenity noise levels for neighbouring land uses other than residential are provided in Table 4.2. For the most part, these uses are within the hospital. Noise sensitive locations are typically those on properties other than the site itself (ie Nepean Hospital) and as such would not be addressed as part of the REF. For the purposes of this assessment, a conservative approach is adopted by assessing onsite sensitive uses in the same way.

Noise targets for healthcare private practice has been adopted from the 'commercial' amenity noise levels of the NPfI. Where the healthcare use incorporates wards (eg Somerset Private Hospital), the hospital ward amenity target has been adopted.

Table 4.2 Project noise trigger levels – land uses other than residential

Receiver type	Amenity noise level, $L_{Aeq,15min}$ dB
Hospital ward	
internal	33 – noisiest 1-hour period
external	48 – noisiest 1-hour period
Commercial premises	63 – when in use

Notes: 1. Project amenity $L_{Aeq,15min}$ noise level is the recommended amenity noise level $L_{Aeq,period}$ +3 dB as per the NPfI.

4.2 Construction noise

The assessment of noise from construction works was completed using the NSW EPA Interim Construction Noise Guideline (ICNG), which provides two methods for the assessment of construction noise emissions:

- quantitative: suited to major construction projects with typical durations of three weeks or more; and
- qualitative: suited to short-term maintenance projects of less than three weeks.

The method for a quantitative assessment requires a more complex approach, involving noise predictions from construction activities to the nearest sensitive receivers, whilst the qualitative assessment methodology is a more simplified approach that relies primarily on noise management strategies. Due to the type of construction works proposed and anticipated duration, assessment of construction noise from the site has adopted a quantitative assessment approach.

The ICNG recommends standard hours for normal construction work which are Monday to Friday from 7.00 am to 6.00 pm, Saturdays from 8.00 am to 1.00 pm, and no work on Sundays or public holidays. The proposed construction works will likely only occur during the ICNG standard hours, however, this will be subject to the planning approval.

Where predicted noise levels from construction works during standard hours are above the noise affected level at a sensitive receiver, feasible and reasonable mitigation measures should be considered and adopted where appropriate.

4.2.1 Noise management levels

Table 2 of the ICNG provides guidance on establishing noise management levels (NML) for residential receivers during standard hours and has been reproduced in Table 4.3.

Table 4.3 ICNG residential NMLs

Time of day	NML $L_{Aeq,15min}$	How to apply
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 1.00 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. • Where the predicted or measured $L_{Aeq,15min}$ 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.
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 1.00 pm No work on Sundays or public holidays	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. 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: • 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); and • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Source: ICNG (DECC 2009)

4.2.2 Noise to Nepean Hospital buildings

The ICNG provides guidance on addressing impacts to non-residential noise sensitive assessment locations. Noise sensitive locations are those on properties other than the site itself, however a conservative approach is adopted by assessing onsite sensitive uses in the same way. In this case, the site is surrounded by noise sensitive hospital uses. Table 3 of the ICNG includes assessment noise levels for hospital wards and operating theatres. These objectives are dictated in terms of the internal noise level. In the absence of specific noise criteria for other uses, EMM has taken guidance from the recommended maximum levels provided in Australian Standard AS2107:2016 'Acoustics – Recommended design sound levels and reverberation times for building interiors' which is consistent with the approach of the ICNG.

Table 4.4 NMLs for non-residential hospital receivers

Type of occupancy / activity	Recommended noise level, dB $L_{Aeq\ 15min}$	
	Internal (AS2107)	External[1]
Hospital wards and operating theatres (ICNG)	45	65
Consulting rooms	45	65
Dental clinics	45	65
Office areas (ICNG)	n/a	70[2]
Waiting rooms, reception areas	50	70

Note: 1. The external noise target for uses within the Nepean Hospital grounds has been based on the internal noise level plus 20 dB to account for a closed façade which will typically be the case for clinical areas.

2. External noise target for office areas is based on the ICNG.

4.2.3 Project construction residential NMLs

The construction NMLs for residential assessment locations have been based on the RBLs provided in Table 3.1. The NMLs for standard construction hours adopted for this assessment were derived in accordance with the ICNG for all assessment locations and are presented in Table 4.5.

Table 4.5 Project construction noise management levels

Period	RBL, dB(A)[1]	NML, $L_{Aeq,15min}$, dB	HNL[2]
Day (standard ICNG hours)	48	58	75

Notes: 1. Based on the day period RBL established in Table 3.1.
2. HNL – highly noise affected level.

It is noted that given distance and intervening structures on the Nepean Hospital campus, construction noise impacts to residential dwellings on Parker Street is expected to be negligible, and hence Derby Street and Somerset Street residences will be the key assessment locations.

4.3 Construction vibration

4.3.1 Human comfort

Potential vibration impacts on surrounding receivers associated with the construction works are to be addressed in accordance with the Department of Environment and Conservation (DEC) Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006) (the guideline).

The guideline presents preferred and maximum vibration values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended that the operator negotiate directly with the affected community.

4.3.2 Structural cosmetic damage

Potential vibration impacts on surrounding structures are to be addressed in accordance with German Standard DIN 4150-2016 'Vibration in buildings – Part 3: Effects on structures'. DIN 4150 provides the strictest guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, or maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 4.6.

For residential and commercial type structures, the standard recommends safe limits as low as 5 mm/s and 20 mm/s respectively. These limits increase with frequency values above 10 Hz. The operational frequency of construction plant typically ranges between 10 Hz to 30 Hz, and hence according to DIN 4150, the safe vibration guide limit range for dwellings is 5 to 15 mm/s. For reinforced commercial type buildings, the limit is as low as 20 mm/s, while for heritage or sensitive structures the lower limit is 3 mm/s.

Table 4.6 Structural damage guideline values of vibration velocity – DIN4150

Line*	Type of Structure	Vibration Velocity in mm/s			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		1Hz to 10Hz	10Hz to 50 Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	5 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Notes: 1. "Line*" refers to curves in Figure 1 of DIN4150.
2. For frequencies above 100Hz the higher values in the 50Hz to 100Hz column should be used.

These levels are "safe limits", for which damage due to vibration effects is unlikely to occur. "Damage" is defined in DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

4.3.3 Vibration impacts to sensitive hospital equipment

The demolition of the existing carpark will likely involve some hammering of the subsisting asphalt. This may have the potential to have some minor vibration impacts on existing clinical uses within the Sexual Health and Court Building to the west of the site. It should be confirmed with potentially affected stakeholders whether there is any vibration sensitive equipment, and if so, impacted from construction vibration considered more specifically.

Equipment manufacturers will typically include specific vibration requirements for their equipment and should be considered as part of the main contractor works. In the absence of specific criteria, guidance is taken from the vibration curves recommended by the American Society of Heating, Refrigeration and Air-conditioning (ASHRAE).

Chapter 49 of the ASHRAE Handbook 2019 provides guidance on recommended vibration curves for various equipment types and sensitivities. Equipment types are provided in Table 4.7.

Table 4.7 Equipment vibration limits

Equipment requirements/type	RMS[1] velocity mm/s	Vibration curve
Microscopes up to 100x magnification; operating theatres	0.1	Operating room
Microscopes up to 400x magnification; optical and other precision balances	0.051	VC-A
Microsurgery, eye surgery, neurosurgery; bench microscopes greater than 400x; optical equipment on isolation tables	0.025	VC-B
Electron microscopes up to 30 000x magnification; microtomes; MRI	0.013	VC-C
Electron microscopes at magnification greater than 30 000x; mass spectrometers; cell implant equipment	0.0054	VC-D

Notes: 1. Root mean squared (RMS).

The vibration curves recommended in the ASHRAE handbook are reproduced in Figure 4.1. Structural vibration from construction is not to exceed 0.2 mm/s RMS for wards and 0.4 mm/s RMS for general office areas.

The project will be a freestanding building and as such structure borne noise impacts from construction works are expected to be negligible.

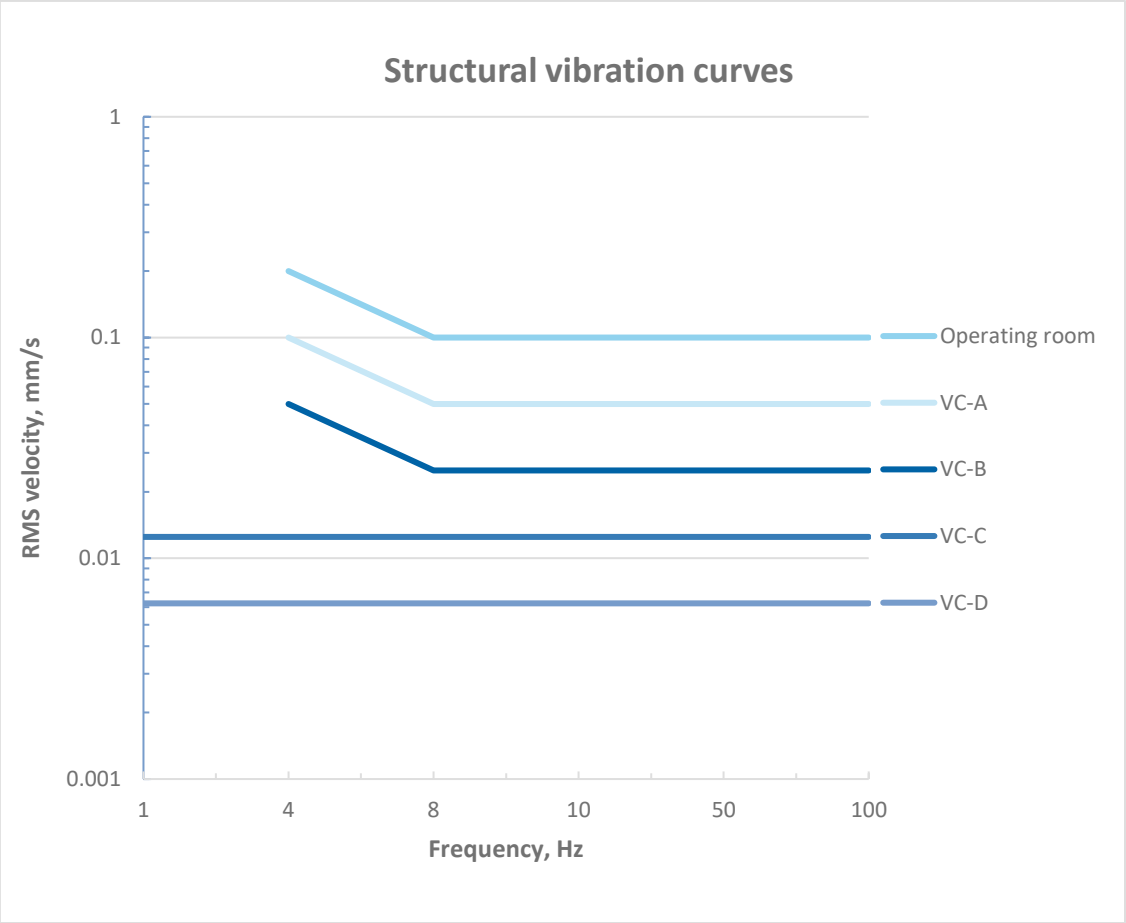

Figure 4.1 ASHRAE 2019 structural vibration criterion curves

5 Construction noise and vibration impact assessment

A preliminary assessment of noise and vibration impacts from the typical construction has been undertaken. At this stage, a detailed construction methodology has not been developed. As such, noise predictions are based on the likely worst-case plant that may be deployed on site.

5.1 Demolition and construction phase works

Demolition works associated with the project will likely include:

- demolition of the existing low-set Nepean 1 & 2 buildings;
- demolition of the existing fleet carpark and removal of waste; and
- detailed excavation.

The general construction phase of the project will typically include:

- foundation / footing works;
- formwork and concrete pour;
- external wall and roof framing;
- installation of the building façade including cladding and glazing installation;
- internal partitioning;
- mechanical, hydraulic and electrical services; and
- external landscaping and finishes works.

5.2 Construction noise modelling

Equipment sound power levels have been adopted from:

- the Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*;
- AS 2436-2010 "Guide to noise and vibration control on construction, demolition and maintenance sites"; and
- Roads and Maritime Services (RMS) 2016 *Construction and maintenance noise estimator*.

Otherwise, data was sourced from an EMM database of similar equipment which is based on measurements at other construction sites as indicated.

Acoustically significant construction plant and processes were considered in the model within the working areas and typical worst-case scenarios and utilisation were adopted. A detailed analysis of equipment should be undertaken as part of the main works contractor's construction noise and vibration management plan once detailed information of plant equipment is established.

The loudest typical construction plant utilised for the assessment is presented in Table 5.1.

Table 5.1 Construction phase and equipment sound power levels

Construction phase	Construction appliance	Sound power level, dB $L_{Aeq\ 15min}$
Demolition works	Pneumatic hammer[3]	113
	Soff cut saw[3]	105
	Excavator dumping rubble[1]	113
	Bobcat[3]	104
	Dump truck[3]	110
	Cumulative noise level	**117**
Construction phase	Forklift[2]	106
	Hand tools (electric)[2]	102
	Angle grinder (grinding steel)[1]	108
	Welder[2]	105
	Cumulative noise level	**112**

Notes: 1. Noise level adopted from DEFRA noise database.
2. Adopted from AS2436.
3. RMS Construction and maintenance noise estimator.

5.3 Predicted noise levels

The proponent will manage construction noise levels where exceedances of NMLs have been identified. The construction noise management methods will be detailed in a construction noise and vibration management plan (CNVMP) as discussed further in Section 5.4.

The ICNG recommends the following where NMLs are predicted to be exceeded:

- application of feasible and reasonable work practices to minimise noise; and
- inform potentially impacted residents or other noise sensitive receivers (ie hospital users) of the nature of the works to be carried out, expected noise levels and duration and relevant contact details.

Noise predictions have been presented for the most affected assessment location for a given locality (eg Somerset and Derby Street assessment locations or the nearest façade having windows for on-campus receivers). Predicted noise levels are presented for cumulative noise from construction equipment. The loudest typical works during demolition and construction are provided in Table 5.1.

5.3.1 Demolition works

Demolition works will occur for the existing low-set buildings on the CAMHS site and the existing carpark on the TAM site to make way for the project foundations.

The multi-deck carpark between the project and Somerset Street assessment locations will likely provide some screening, however this cannot be readily quantified and as such has not been considered in the prediction. Noise predictions from the demolition works are provided in Table 5.2.

Table 5.2 Predicted noise levels during demolition

Project area	Location	Land use	Predicted construction noise level, dB $L_{Aeq\ 15min}$	'Noise affected' NML, dB $L_{Aeq\ 15min}$[1]	'Highly noise affected' level, dB $L_{Aeq\ 15min}$[2]
TAM	R1	Residential	62	58	75
	R2	Hospital / healthcare	67	65	N/A
	R3	Hospital / healthcare	66	65	N/A
	R4	Residential	70	58	75
	R5	Hospital / healthcare	70	65	N/A
	R6	Residential	68	58	75
	N1	Hospital / healthcare	68	65	N/A
	N2	Hospital / healthcare	80	65	N/A
	N3	Hospital / healthcare	77	65	N/A
	N4	Hospital / healthcare	61	65	N/A
	N5	Office	50	70	N/A
	N6	Hospital / healthcare	61	65	N/A
CAMHS	R1	Residential	61	58	75
	R2	Hospital / healthcare	63	65	N/A
	R3	Hospital / healthcare	61	65	N/A
	R4	Residential	58	58	75
	R5	Hospital / healthcare	61	65	N/A
	R6	Residential	62	58	75
	N1	Hospital / healthcare	71	65	N/A
	N2	Hospital / healthcare	70	65	N/A
	N3	Hospital / healthcare	50	65	N/A
	N4	Hospital / healthcare	55	65	N/A
	N5	Office	72	70	N/A
	N6	Hospital / healthcare	74	65	N/A

Notes: 1. Noise affected level based on RBL + 10 dB in accordance with the ICNG.
2. Highly noise affected level based on 75 dBA in accordance with the ICNG.

Noise predictions indicate that construction noise levels during demolition works:

- may exceed the 'noise affected' NMLs at all residential assessment locations. The 'highly noise affected' level is not expected to be exceeded during the demolition phase; and
- some minor exceedances (up to 5dB) of surrounding hospital / healthcare uses may also be experienced.

It is noted that the demolition works are expected to be short in duration given:

- the absence of significant structures on the project site; and
- new structures will not accommodate sublevel floors (eg no major excavation).

On-campus assessment locations which may experience levels exceeding associated NMLs include Oral Health, Sexual Health and Court Building. Possible mitigation measures are discussed in Section 5.4. Noise mitigation measures and strategies should be formulated as part of the detailed construction noise and vibration management plan.

5.3.2 General construction works

Noise predictions associated with the general construction works are provided in Table 5.3. Construction hoarding has not been considered in the assessment however would likely provide some benefit given the single level construction of the development. The multi-storey residential development at 48-56 Derby Street, Kingswood will overlook any such hoarding and as such any reductions afforded by the hoarding for some receivers would not be realised for this receiver.

Table 5.3 Predicted construction noise levels during construction

Project area	Location	Land use	Predicted construction noise level, dB $L_{Aeq\ 15min}$	'Noise affected' NML, dB $L_{Aeq\ 15min}$[1]	'Highly noise affected' level, dB $L_{Aeq\ 15min}$[2]
TAM	R1	Residential	59	58	75
	R2	Hospital / healthcare	63	65	N/A
	R3	Hospital / healthcare	62	65	N/A
	R4	Residential	65	58	75
	R5	Hospital / healthcare	65	65	N/A
	R6	Residential	63	58	75
	N1	Hospital / healthcare	64	65	N/A
	N2	Hospital / healthcare	75	65	N/A
	N3	Hospital / healthcare	72	65	N/A
	N4	Hospital / healthcare	56	65	N/A
	N5	Office	48	70	N/A
	N6	Hospital / healthcare	57	65	N/A
CAMHS	R1	Residential	56	58	75
	R2	Hospital / healthcare	58	65	N/A
	R3	Hospital / healthcare	56	65	N/A

Table 5.3 Predicted construction noise levels during construction

Project area	Location	Land use	Predicted construction noise level, dB $L_{Aeq\ 15min}$	'Noise affected' NML, dB $L_{Aeq\ 15min}$[1]	'Highly noise affected' level, dB $L_{Aeq\ 15min}$[2]
	R4	Residential	53	58	75
	R5	Hospital / healthcare	56	65	N/A
	R6	Residential	57	58	75
	N1	Hospital / healthcare	66	65	N/A
	N2	Hospital / healthcare	65	65	N/A
	N3	Hospital / healthcare	45	65	N/A
	N4	Hospital / healthcare	50	65	N/A
	N5	Office	67	70	N/A
	N6	Hospital / healthcare	69	65	N/A

Notes: 1. Noise affected level based on RBL + 10 dB in accordance with the ICNG.
2. Highly noise affected level based on 75 dBA in accordance with the ICNG.

Noise predictions indicate that construction noise levels during construction works:

- may exceed the 'noise affected' NMLs at all residential assessment locations. The 'highly noise affected' level is not expected to be exceeded during the construction stage; and
- the NMLs for surrounding hospital / healthcare uses would likely be met.

On-campus assessment locations which may experience levels exceeding associated NMLs include the Sexual Health and Court Building. Possible mitigation measures are discussed in Section 5.4. Noise mitigation measures and strategies should be formulated as part of the detailed construction noise and vibration management plan.

5.4 Construction noise and vibration mitigation

Mitigation measures which may be employed to further minimise noise impacts from the construction of the project are discussed in this section. These can include physical measures, such as acoustic screens or shrouds, or noise management measures such as scheduling, alternative plant, community consultation and the like.

5.4.1 Stakeholder and community consultation

Community consultation and complaints handling procedures and stakeholder disruption notice procedures should be developed such that noise affected receivers may be kept apprised of:

- construction timeline;
- expected noisy works which may extend into the evening; and
- readily available avenues to address noise complaints.

5.4.2 Site hoarding

Site hoarding may provide some benefit to single level noise sensitive uses. Assessment locations which incorporate a second storey or more, will likely overlook such hoarding. Entry and exit points in site hoarding should be considered such that direct lines of sight to noise sensitive uses are minimised.

5.4.3 Temporary noise barriers

Temporary noise barriers may be incorporated around particularly noisy static equipment to minimise noise being transmitted to surrounding noise sensitive locations. This will typically be enacted by retaining the existing site hoarding as practically possible.

5.4.4 Scheduling of works

Noisy works may be scheduled to times which are more mutually agreeable to surrounding noise receptors. This can also include scheduling works such that multiple pieces of noisy plant equipment are not being utilised in close proximity to a particular sensitive receptor.

5.4.5 Plant and equipment

Additional measures for plant and equipment include:

- where possible, choose quieter and less vibration intensive plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- operate plant and equipment in the quietest and most efficient manner; and
- regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

5.4.6 Work practices

Work practice methods include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- regular identification of noisy activities and adoption of improvement techniques;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby hospital stakeholders or residents;
- locating vehicles to minimise noise (ie in shielded areas where possible);
- where possible, avoid the use of equipment that generates impulsive noise (ie hammering);
- minimise the movement of materials and plant and unnecessary metal-on-metal contact; and
- minimise truck movements.

6 Operational noise impacts

Operational noise generated by the project will be generally associated with the following noise sources:

- vehicle deliveries via the TAM internal driveway;
- mechanical plant operation; and
- TAM workshop activity noise.

Noise predictions have been provided for uses external to the hospital campus to meet the requirements of the NPfI.

6.1 Vehicle deliveries to TAM building

Vehicles will access the project to deliver materials via the internal driveway separating the office block from the workshop. Vehicles will enter the driveway via Derby Street, loop around the workshop building and exit back via Derby Street. It is expected that medium rigid vehicles will utilise the driveway.

Modelling assumptions for driveway vehicle movements are provided in Table 6.1. It has been conservatively assumed that each workshop will receive a delivery in a 15-minute period (ie eight vehicle movements).

Table 6.1 Vehicle movements

Vehicle type	Movements (15minute period)	Vehicle SWL, dBA	Vehicle speed, km/h
Medium rigid vehicle (MRV)	8	95	10

The prediction of vehicle noise has been addressed cumulatively with workshop noise in Table 6.2 and Table 6.3.

6.2 Mechanical plant

A detailed review of mechanical plant cannot be undertaken at this stage given that the mechanical design is only in its infancy. A detailed review is generally conducted during the detailed design and construction phases of the project. However, an in-principle assessment of operational noise impacts has been undertaken to discuss potential mitigation measures which may be employed to reduced mechanical noise emissions from the site.

The prediction of mechanical noise associated with the TAM project has been addressed cumulatively with workshop noise in Table 6.2 and Table 6.3. A detailed review of mechanical plant should be undertaken as part of the detailed design and construction phases to ensure that cumulative noise emissions comply with the PNTLs provided in Table 4.1 and Table 4.2.

6.2.1 TAM development

Mechanical plant is proposed to be installed in the following locations:

- three air-conditioning condensers are proposed on the western side of the office structure adjacent to the Sexual Health and Court Building;

- three air-conditioning condensers are proposed on a rooftop platform over the workshops. These condensers are assumed to be in operation only when the workshop façades are closed;
- a compressor plant room is located beneath the air-conditioning platform.

A SWL of 80dB L_{Aeq} for each condenser unit has been adopted. A sound power level of 90dB L_{Aeq} has been considered for the compressor plant room. It is assumed that any intake air path via the eastern façade will be acoustically treated.

6.2.2 CAMHS development

Mechanical plant is proposed to be installed in the following locations:

- a small bank of condenser units is to be located in the northwest corner adjacent to the loading dock ramp;
- a small bank of condenser units is to be located along the southern façade of the development facing the court building; and
- in-line fans are to be located on the roof of the development.

A SWL of 80dB L_{Aeq} for each condenser unit has been adopted. Fans have been assessed using a sound power level of 85dB L_{Aeq}.

6.3 Workshop activity noise

The project will include workshops which will cater for a vast array of maintenance activities including:

- gardening;
- carpentry and machinery;
- painting;
- plumbing;
- welding;
- fitting; and
- electrical.

It is anticipated that workshop activities will relate to minor repairs using hand-held and benchtop fixed manual and electrical tools which would generate relatively moderate noise emissions. Specific activities within each workshop are unknown at this stage and as such a worst-case scenario has been used to address noise from the operation of each workshop.

Noise breakout from the workshop has been assessed based on the following assumptions:

- each workshop includes an acoustically absorptive ceiling which has been factored into the calculation of noise within the workshop; and

- noise breakout has been based on sheet metal roofing for the roof and walls. No internal lining (eg plasterboard) has been considered at this stage.

The assessment of noise has been undertaken to determine two scenarios, namely:

- whether typical worst-case appliances could be used with doors open sufficient for natural ventilation purposes and what appliances could be used under such conditions; and
- whether typical worst-case appliances can meet noise requirements with windows and doors closed.

Naturally ventilated modelling has been undertaken assuming the following:

- the eastern façade windows are open to an extent no greater than 2.5% of the floor area; and
- the western façade roller door and other façade openings open to an extent no greater than 10% of the floor area.

The maximum internal sound pressure level that may be realised in each workshop with the façade open as per above is 85dB $L_{Aeq\ 15min}$ to meet noise requirements at all surrounding noise sensitive receivers. This assumes that this noise level is being generated in each workshop simultaneously for the full 15-minute assessment period. It is noted that this occurrence is unlikely to occur in practice.

6.4 Predicted noise levels

Noise predictions assuming the conditions with the façade open sufficient for ventilation purposes is provided in Table 6.2.

Table 6.2 Predicted noise from workshop operations (façade open)

Receiver	Use	Predicted noise level, dB $L_{Aeq\ 15min}$	PNTL, dB $L_{Aeq\ 15min}$
R1	Residential	45	53
R2	Hospital / healthcare	50	63
R3	Hospital / healthcare	48	48[1]
R4	Residential	51	53
R5	Hospital / healthcare	47	63
R6	Residential	44	53

Notes 1. The Somerset Private Hospital incorporates hospital wards and has been addressed as such.

The maximum sound pressure level of 85dB $L_{Aeq\ 15min}$ would likely be exceeded for appliances with a sound power level (SWL) exceeding 99dB $L_{Aeq\ 15min}$. Equipment exceeding this level will generally be attributed to cutting and grinding equipment. A list of such appliances which would likely exceed this SWL includes circular blade saws, mitre saw, angle or bench grinders and reciprocating saws. Where such appliances are to be used, the workshop façade is to be closed (windows and doors).

Noise predictions of a worst-case plant appliance assuming the façade is closed is provided in Table 6.3. This has been based on an angle grinder (SWL 108dB L_{Aeq}) which will represent the typical worst-case appliance to be utilised within each space. It has been conservatively assumed that the angle grinder will be utilised for a continuous 15-minute period in each workshop simultaneously.

Table 6.3 Predicted noise from workshop operations (façade closed)

Receiver	Use	Predicted noise level, dB $L_{Aeq\ 15min}$	PNTL, dB $L_{Aeq\ 15min}$
R1	Residential	39	53
R2	Hospital / healthcare	43	63
R3	Hospital / healthcare	42	48[1]
R4	Residential	45	53
R5	Hospital / healthcare	46	63
R6	Residential	44	53

Notes 1. The Somerset Private Hospital incorporates hospital wards and has been addressed as such.

The CAMHS facility will be operational during the night-time period, albeit at a reduced capacity. Accordingly, noise during the night-time period has been assessed for mechanical plant servicing the CAMHS facility. Predicted noise levels based on reasonable assumptions of source noise are presented in Table 6.4.

Table 6.4 Predicted noise from CAMHS mechanical (night period)

Receiver	Use	Predicted noise level, dB $L_{Aeq\ 15min}$	PNTL, dB $L_{Aeq\ 15min}$
R1	Residential	40	38
R2	Hospital / healthcare	41	63
R3	Hospital / healthcare	39	48[1]
R4	Residential	36	38
R5	Hospital / healthcare	42	63
R6	Residential	43	38

Notes 1. The Somerset Private Hospital incorporates hospital wards and has been addressed as such.

Based on the source noise levels presented in Section 6.2.2, predicted noise levels indicate that additional acoustic treatment would be required to mechanical plant to meet noise emission objectives. Noise predictions indicate that the primary source of exceedance is associated with rooftop fans, given that condensers will be largely screened from noise affected receiver locations. Additional acoustic treatment to the rooftop fans could include internally lined discharge duct or an acoustic attenuator.

7 Recommendations

The following recommendations are provided in order to minimise construction noise and vibration impacts and to ensure that ongoing operational noise does not have an ongoing impact on surrounding noise sensitive uses.

7.1 Construction noise and vibration

In-principle noise mitigation strategies to address construction noise and vibration are discussed in Section 5.4. A detailed construction noise and vibration management plan should be prepared as part of the main contract works to ensure that potential impacts to surrounding noise sensitive receivers are minimised as practicable.

7.2 Operational noise

7.2.1 Mechanical plant

A detailed review of mechanical plant should be undertaken as part of the detailed design and construction phases to ensure that cumulative noise emissions comply with the PNTLs provided in Table 4.1 and Table 4.2.

Noise from the compressor enclosure will likely require acoustic treatment to the air intake path where it is drawn from the eastern façade. This may include internally lined duct work, an attenuator or acoustic louvre.

Any additional ventilation or extraction equipment (eg dust extraction) is to be acoustically treated to meet a noise target 10dB below the PNTLs at receivers.

7.2.2 Workshop operation

Noise within each workshop should not exceed 85dB L_{Aeq} with the façade open. This would include an open façade not exceeding the following:

- the eastern façade open in each workshop to an extent no greater than 2.5% of the floor area; and
- the western façade open in each workshop to an extent no greater than 10% of the floor area.

Where noisy works are to be undertaken (eg cutting or grinding) the workshop façade is to be closed (windows and doors).

8 Conclusion

EMM has prepared an assessment of potential noise and vibration impacts associated with the construction and operation of the proposed CAMHS and TAM facilities to be constructed in the southeast corner of the Nepean Hospital campus.

Noise associated with demolition and construction may result in some exceedance of project NML for residential assessment locations surrounding the site. Predicted noise levels do not exceed the 'highly noise affected' management level.

Construction noise predictions indicate some exceedances of the project construction NMLs at commercial and healthcare uses within and external to the Nepean Hospital campus. Construction noise mitigation and management strategies have been included in this report for consideration.

A detailed construction noise and vibration management plan is to be prepared as part of the main works contract to ensure that all feasible and reasonable treatments and management measures are considered to minimise construction noise and vibration from the project. This review would be undertaken once a detailed methodology for the works is established.

An assessment of noise from operational noise sources, such as the workshops and mechanical plant has been undertaken. Recommendations and noise management limits have been provided to ensure that noise from the operation of the workshops meet the PNTLs with the façade open and closed.

A detailed assessment of mechanical plant is to be undertaken during the detailed design to confirm compliance with NPfI noise limits.