WOOD & GRIEVE ENGINEERS

Morpeth Aged Care

Acoustic Report

Development Application

Prepared for:

Sue Atwill
Lend Lease

Prepared by:

Sean Matthews
Project No. 30916-4
\\WGE-SYD-FS-01\PROJECTS\30916-4\PROJECT DOCUMENTATION\ACOUSTICS\DESIGN\REPORTS\AC-RE-DA_001.DOCX

Date:
17 December 2018

Level 6, Building B, 207 Pacific Highway, St Leonards NSW 2065
T: (02) 8484 7000 **E:** sydney@wge.com.au **W:** www.wge.com.au

Revision

REVISION	DATE	COMMENT	APPROVED BY
01	06/08/2018	Draft issue	**ORFG**
02	09/08/2018	Final issue	**ORFG**
03	17/12/2018	Revised issue for DA	**ORFG**

WGE is a proud member of the Association of Australian Acoustical Consultants (AAAC).

AAAC members are competent and capable in the acoustic field. Members of the AAAC provide professional unbiased advices and recommendations in order to deliver practical innovative and cost effective solutions to their clients.

AAAC members are bind to a specific code of professional conduct which can be consulted on the AAAC website: http://www.aaac.org.au/au/aaac/ethics.aspx

Contents

1. Introduction

As part of the Development Application (DA) documentation process, Wood & Grieve Engineers have been engaged by Lend Lease Development to provide an acoustic assessment for the proposed aged care facility at 367 Morpeth Road, Morpeth, NSW

The proposed development will consist of:

- External car parking
- 108 bed residential aged care

This assessment discusses the noise impact from the development on the potentially nearest most-affected receivers of the development.

This assessment has been prepared considering the following documents:

- Maitland Development Control Plan (DCP) 2011
- NSW Noise Policy for Industry (NPI)
- NSW Road Noise Policy (RNP)
- AS/NZS 2107:2016 – Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors

This report provides:

- A statement of compliance with the Maitland City Council requirements for the proposed aged care development within the vicinity of the nearest potentially affected residential receivers.
- Recommendations for noise mitigation measures for the proposed development in order to meet the relevant criteria when compliance is not achieved.

This noise assessment is based on noise data collected by a combination of unattended noise measurements at representative locations around the site over 7 days during July 2018.

This report is based on our understanding of the proposed project, application of the relevant state guidelines and professional experience within the acoustic field.

2. Background

2.1 Information Sources

The following documentation has been used for the preparation of this report:

- Site drawings presenting the location of the proposed development in relation to the nearest receivers;
- Noise data collected on site through the use of noise loggers and a hand held spectrum analyser;
- Architectural drawings for DA provided by Jackson Teece dated 13/12/18:
    - 253824-MO-A-000-00(1)
    - 253824-MO-A-000-01(1)
    - 253824-MO-A-000-02(1)
    - 253824-MO-A-000-03(1)
    - 253824-MO-A-100-00(1)
    - 253824-MO-A-100-01(1)
    - 253824-MO-A-200-00(1)
    - 253824-MO-A-201-00(1)
    - 253824-MO-A-301-00(1)
    - 253824-MO-A-303-00(1)
    - 253824-MO-A-400-00(1)
    - 253824-MO-A-400-01(1)
    - 253824-MO-A-500-00(1)
    - 253824-MO-A-900-01(1)
    - 253824-MO-A-900-27(1)
    - 253824-MO-A-900-28(1)
    - 253824-MO-A-900-31(1)
    - 253824-MO-A-900-54(1)
- Seca Solution Traffic Impact Assessment dated 18 December 2018 (P0388 LL Morpeth residential aged care TIA)
- Seca Solution Review of Masterplan Impacts, Closebourne Village, Morpeth NSW dated 30 September 2015 (P0388 Review of Masterplan Impacts)

3. Project Overview

3.1 Site Description

The site is bound by Morpeth Road to the North, Tank Street to the East, and the existing Closebourne Village retirement community to the South and West. Across Morpeth Road and Tank Street are a mixture of residential and commercial properties. The site location, measurement positions and surrounding residential receivers are shown in Figure 1.

3.1.1 Potential Acoustic Issues

The acoustic issues relating to the development are as follows:

- Noise intrusion from vehicle movements from Morpeth Road and Tank Street to the internal spaces of the development
- Noise emissions from mechanical services from the development to the surrounding receivers
- Increase in traffic noise levels due to the additional vehicles on Morpeth Road and Tank Street
- Noise emissions from carpark operation and services vehicles on site to surrounding residential receivers

Figure 1: Overview of the site and measurement locations

Source: nearmap.com

4. Noise Survey

4.1 Instrumentation

The following equipment was used for the noise surveys:

- ARL Environmental Noise Logger ARL NL-42EX S/N 00221356;
- Hand-held sound spectrum analyzer B&K 2250, S/N 2709742;
- Sound Calibrator B&K Type 4231, S/N 2709826;

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

4.2 Unattended Noise Survey Results

This assessment will consider the method for determining the rating background level (RBL) for each period of the day in accordance with the NSW Noise Policy for Industry (NPI). The NPI defines background and ambient noise for the daytime, evening and night time periods as follows:

Day: is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.

Evening: is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.

Night: is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays**.**

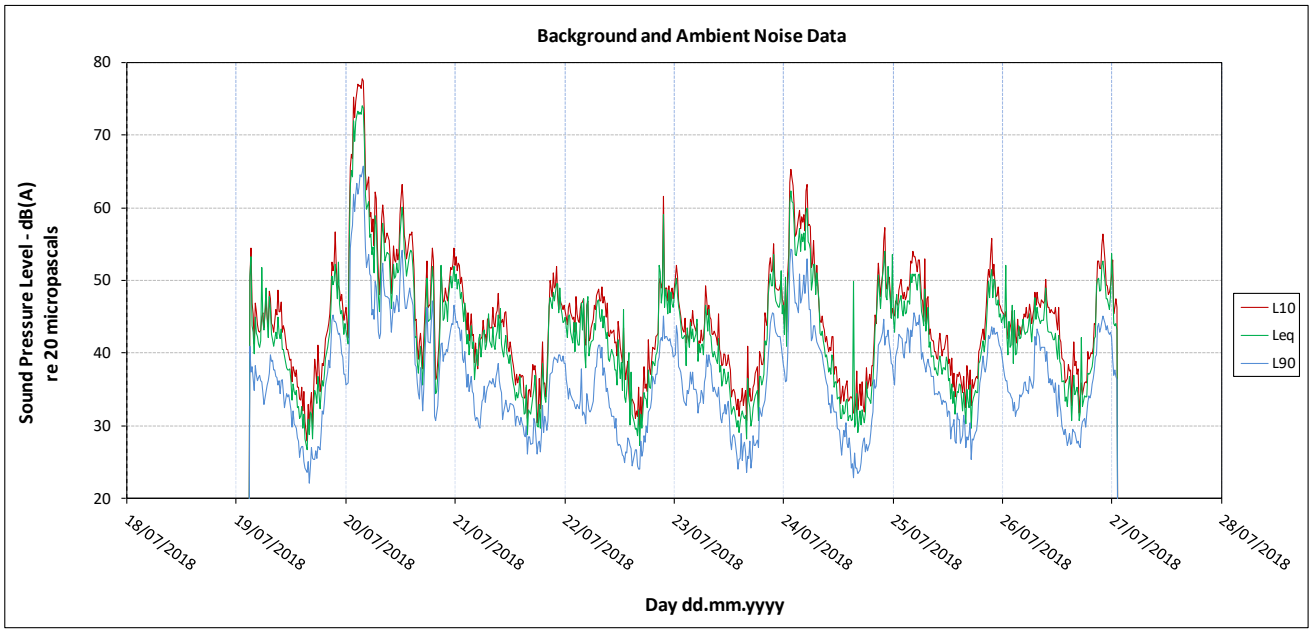
4.2.1 Background and Ambient Noise Monitoring

A noise logger was placed at position L1 as shown in Figure 1 to measure the background and ambient noise that is representative of the surrounding residential receivers. Logger L1 was installed from the 19th to the 27th of July 2018. The results for the unattended background noise survey is shown below in Table 1 (for the day, evening and night periods). Note that any rain affected data during the period of logging has been excluded from the calculations. Refer to Figure 2 for the noise data.

Table 1: Unattended noise measurements L1

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	59	46	44	33	32	30

Figure 2: Unattended noise monitor data L1



5. Noise and Vibration Criteria

5.1 Internal Noise Levels

5.1.1 Australia Standard (AS) 2107:2016

In the absence of any specific requirements from the Maitland City Council DCP in regards to internal noise levels for residential care, Australian Standard (AS) 2107:2016 – *'Acoustics- Recommended design sound levels and reverberation times for building interiors'* has been applied. AS2107:2016 specifies target noise levels for various internal spaces. Refer to Table 2 for the values corresponding to the spaces that are expected to be within the development due to external noise intrusion.

Table 2: Recommended noise levels according to AS/NZS 2107:2016

Type of occupancy / activity	Design Sound Level, L_{Aeq}, dB(A)
Sleeping areas	30 – 35
Dining rooms	40 - 45
Common rooms	40 - 45

5.2 Site Noise Emission

5.2.1 NSW Noise Policy for Industry

In the absence of any specific requirements in the Maitland City Council DCP, the NSW Noise Policy for Industry has been used to address noise emissions from the development to the surrounding sensitive receivers. The NSW NPI sets out noise criteria to control the noise emission from industrial noise sources. Mechanical and operational noise from the development shall be addressed following the guideline in the NSW NPI.

The calculation is based on the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established, the most stringent for each considered assessment period (day, evening, night) is adopted as the project-specific noise level (PSNL).

Intrusiveness Criteria

The NSW NPI states the following:

> *"The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the LAeq descriptor), measured over a 15minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold."*

The intrusiveness criterion can be summarised as L_{Aeq}, 15 minute $\leq$ RBL background noise level plus 5 dB(A).

Table 3: NSW NPI intrusiveness criteria

Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
Day (7:00am to 6:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	40*
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min} \leq$ RBL + 5	37
Night (10:00pm to 7:00am)	$L_{Aeq,15min} \leq$ RBL + 5	35

Note: *Minimum project intrusiveness noise level is 40dB(A) for day time, based on a minimum assumed RBL of 35dB(A)

Amenity Criteria

The NSW NPI states the following:

> *"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The recommended amenity noise levels have been selected on the basis of studies that relate industrial noise to annoyance in communities (Miedema and Voss, 2004).*

The applicable parts of Table 2.2: Amenity noise levels from Industrial Noise Sources – L_{Aeq}, dB(A) which are relevant to the project are reproduced below:

Table 4: NSW NPI amenity criteria for external noise levels

Type of Receiver	Noise amenity area	Time of Day	L_{Aeq}, dB(A)	Project amenity noise level $L_{Aeq,\ period}$
			Recommended amenity noise level	
Residential	Rural	Day	50	45
		Evening	45	40
		Night	40	35
Commercial	All	When in use	65	60
Place of worship	All	When in use	50*	45

Note: Rural area as defined in EPA NPI

*As per the NPI, where internal noise levels are specified the equivalent external levels can be 10dB above

'Modifying Factor' Adjustments

The NSW NPI also states:

> *"Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level."*

In order to take into account the potential annoying character of the noise an adjustment of 5 dB(A) for each annoying character aspect and cumulative of up to a total of 10 dB(A), is to be added to the measured value to penalise the noise for its potentially greater annoyance aspect.

Table C1 of Fact Sheet C of the NSW NPI (see Table 5 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Table 5: Table C1 from the NSW NPI – Modifying factor corrections

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method *(ISO1996.2-2007 – Annex D)*.	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB[2,3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note**: Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low Frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted $L_{eq,T}$ levels over same time period. Correction to be applied where the C minus A level is 15dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.
Intermittent Noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	One event in any assessment period.	0 to 20 dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A)[2] (excluding duration correction)	

1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.

2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

3. Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

5.3 Project-specific criteria (PSNL)

Refer to Table 6 for the NSW NPI criteria applicable to the mechanical and operational noise emissions from the proposed development. These project specific noise levels are in accordance with the requirements of the NSW NPI, and shall be assessed to the most affected point on or within the residential boundary. Note that as per the NSW NPI, 3dB correction is used to convert 'period' to a 15 minute assessment period if required.

Table 6: Project specific noise levels

Period	Descriptor	PSNL dB(A)
Residential receivers		
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	40
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	37
Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	35
Commercial Receivers		
When in use	$L_{Aeq,15min}$	63
Places of Worship		
When in use	$L_{Aeq,15min}$	48

5.4 Traffic Noise Generation Criteria

The L_{Aeq} noise level or the "equivalent continuous noise level" correlates best with the human perception of annoyance associated with traffic noise. Road traffic noise impact is assessed in accordance with the introduced NSW Road Noise Policy (Office of Environment and Heritage July 2011) which supersedes the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN, Department of Environment Climate Change and Water 1999). The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below:

Table 7: NSW Road Noise Policy – Traffic noise assessment criteria

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15\ hour}$ 60 (external)	$L_{Aeq,9\ hour}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,1\ hour}$ 55 (external)	$L_{Aeq,1\ hour}$ 50 (external)

In the event that the traffic noise at the site is already in excess of the criteria noted above, the NSW RNP states that the primary objective is to reduce the existing level through feasible and reasonable measures to meet the criteria above. If this is not achievable, Section 3.4.1 Process for applying the criteria – Step 4 states that for existing residences affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise should be limited to 2 dB above that of the corresponding 'no build option'.

5.5 Construction Noise Criteria

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (*ICNG July 2009*) by the NSW Office of Environment & Heritage (NSW OE&H). It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works. However, in undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW OE&H ICNG (July 2009) were specifically referenced. The noise limits are presented in Table 8 and are applicable to the development.

Table 8: NSW DECCW ICNG Construction Noise Criteria

Time of Day	**Management Level** $L_{Aeq,15min}$ *	**How to Apply**
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected RBL + 10dB	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 residences 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. • 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 in, 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) • 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 + 5dB	• 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.

* NOTE: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Source: Chapter 4 (Table 2 Sec 4.1.1) of NSW OE&H ICNG

5.6 Construction Vibration Criteria

The Office of Environment and Heritage (OEH) developed a document, "Assessing vibration: A technical Guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

5.6.1 Human Comfort – Continuous and Impulsive Vibration Criteria

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day. Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 9. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Table 9: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s2) 1-80Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and place of worship	Day or night time	0.020	0.014	0.040	0.028
Impulsive vibration					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and place of worship	Day or night time	0.64	0.46	1.28	0.92

Human Comfort – Intermittent Vibration Criteria

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Table 10: Acceptable Vibration Dose Values for intermittent vibration (m/s1.75)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

5.6.2 Structural Damage – Vibration Criteria

Ground vibration criteria are defined in terms of levels of vibration emission from construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity. Most commonly specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 "Structural vibration in buildings – Effects on structures" and British Standard BS7385-Part 2: 1993 "Evaluation and Measurement for Vibration in Buildings". Table 11 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn't occur.

Table 11: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	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	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
*For frequencies above 100Hz, at least the values specified in this column shall be applied					

Table 12 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 12: Transient vibration guide values for cosmetic damage

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

5.6.3 Vibration Objectives

Table 13 indicates the construction vibration criteria for the nearest residential properties to the development.

Table 13: Construction vibration criteria summary

Location	Period	Human Comfort Vibration Objectives			Building Damage Objectives – Velocity (mm/s)
		Continuous mm/s^2 (RMS)		Intermittent $m/s^{1.75}$ (VDV)	
		z-axis	x- and y-axis		
Residential	Daytime	10 – 20	7 - 14	0.20 - 0.40	5 (3 for Heritage)
	Night time	7 – 14	5 - 10	0.13 - 0.26	5 (3 for Heritage)

6. Noise Impact Assessment

6.1 External Glazing

The general limiting factor of the performance of a building façade in term of noise attenuation is the glazing. In this particular case of the proposed development, the traffic from Morpeth Road would place the greatest demand on the glazing for the development. In order to achieve the internal noise levels specified in AS2107:2016, the minimum recommended glazing selection for the façades of the proposed development has been presented in Table 14.

The ratings presented are based on the worst case scenario of external noise obtained from the noise predictions. The glazing thicknesses corresponding to the Rw ratings are presented below and should be considered as the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading, thermal requirements etc.

Table 14: Recommended acoustic performance of glazing system

Façade	Level	Occupancy	Glass System	Required Acoustic Rating of Glazing Assembly, Rw[1]
All	All	Bedrooms/Living	6mm float	31
All	All	Other	6mm float	31
The required acoustic rating of glazing assembly, refers to the acoustic performance of the glazing once installed on site (including the frame)				

During the detailed design stage of the project the acoustic performance of the glazing facade should be reviewed as the combined noise from external sources and mechanical services could result in the internal noise level exceeding the design sound level ($L_{Aeq,T}$ dBA).

[1] See Appendix 1 for Rw definition

7. Site Noise Emissions

7.1 Mechanical Services Noise

Noise sources from general operations at the site typically include mechanical services noise from air-conditioning equipment servicing the internal spaces of the development. These noise sources have been used to predict the worst case scenario noise impact of the proposed use of the site to nearby residential receivers. The main mechanical sources associated with the development will include:

- Condenser units located within ground floor plant areas

In order to assess the worst case scenario, it was assumed that all mechanical plant is running at any time throughout a 24hr period. The noise emissions from the units have been calculated to the most affected residential receiver. With all, the night time is the most stringent period for the noise generated by the operation of mechanical plant; therefore, this criterion was used as the noise target at the boundary of the nearest sensitive receivers for the project.

7.1.1 Proposed Noise Levels

Table 15 presents the proposed sound power level for the condenser units to achieve the noise criteria at the nearest receivers. Based on these levels the noise emissions from the development are expected to comply with the noise criteria to external receivers.

Table 15: Proposed sound power levels dB(A)

Item	SWL re 1pW (dB)								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall dB(A)
Condenser units	78	76	76	76	72	66	66	66	77

It is our opinion that the project specific noise levels at the boundaries of the surrounding receivers should be met if the requirements of Table 15 are satisfied. Note that this is a preliminary solution as the design is yet to be finalised; it is recommended that an updated acoustic report is conducted at a later juncture when more detailed information becomes available through further design.

Amelioration measures for the mechanical plant are to be considered during the design development stage so as to comply with the criteria outlined in Section 5. These amelioration measures could include but not limited to the following:

- Using inline fans
- Positioning and orientating mechanical plant away from nearby receivers
- Acoustic attenuators fitted to duct work
- Screening around mechanical plant
- Acoustic insulation within duct work

7.2 External Car Park Noise Assessment

The noise relating to the operation of the carpark has been assessed to the most affected residential receivers surrounding the site. The assessment has been conducted for the peak hour periods and night time. The peak hour traffic movements were based on the traffic assessment conducted by Seca Solution (refer to Section 2.1 for reference). To allow for staff car movements, this assessment has considered a maximum of 8 vehicles entering or exiting the carpark during the night in any 15 minute period.

The noise activities that have been used in the assessment are as follows:

- Car doors closing
- Movement of cars entering and exiting the carpark, within the site boundary

Table 16 presents a summary of the sound power levels of the noise sources, and Table 17 provides the predicted noise levels at the nearest noise-affected premises.

Table 16: Typical sound power levels of carpark noise sources

Noise Source	Typical SWL dB(A)
Car door closing	96
Car movement	88

Table 17: Predicted vehicle noise at receiver (with mitigation measures)

Receiver Location	Predicted Noise Level $L_{Aeq,15min}$ - dB(A)	Criteria dB(A)	Compliance (Yes/No)
Nearest noise-affected premises	36	38 (day time)	Yes
	35	35 (night time)	Yes

Table 18: Predicted vehicle noise at receiver for sleep disturbance (with mitigation measures)

Receiver Location	Predicted Noise Level L_{AFmax}- dB(A)	Sleep Disturbance Criteria dB(A)	Compliance (Yes/No)
Most affected residential receiver	42	45	Yes

Based on this assessment, and provided the acoustic mitigation measures as detailed below are implemented, the noise emissions from the operation of the car park and driveway on site are expected to meet the requirements of the NSW NPI.

7.3 Service Vehicles Noise Assessment

An acoustic assessment for the garbage and other service vehicles has been conducted to determine the noise levels to the nearest noise sensitive receivers. The service vehicles are assumed to be either medium rigid trucks and garbage trucks with no more than 1 vehicle in any 15 minute period. The assessment has been conducted only for trucks entering and existing the site, and operating at the loading dock. The noise emissions from the service vehicles using the existing road network for access to the retirement village has not been conducted. The noise levels used within the assessment are shown below in Table 19.

Table 19: Typical sound power levels of service vehicles

Noise Source	Typical SWL dB(A)
Garbage truck unloading bins	99
Medium rigid truck	95

The noise emissions have been calculated to the boundary of the surrounding residential receivers. Using the assessment methods outlined above, the predicted noise levels at the nearest noise-affected premises are summarized below in Table 20. The following assumptions have been made:

- Any one service vehicle within a 15 minute period
- All service trucks including waste collection will be restricted to entering and exiting and operating during the day time period (7:00am – 6:00pm)

Table 20: Predicted noise levels (with mitigation measures)

Receiver Location	Predicted Noise Level $L_{Aeq,15min}$ - dB(A)	Day time criteria $L_{Aeq,15min}$ - dB(A)	Compliance (Yes/No)
Nearest noise-affected premises	39	40	Yes

Based on this assessment, the noise from service vehicles on site is expected to comply with the day time criteria from the NSW NPI.

The following management measures should be adopted during waste collection:

- Works are carried out in the quietist reasonable and practicable manner
- The equipment used to carry out the work is the quietest reasonably available
- Vehicles must turn engines off while loading and unloading activities are occurring

7.4 Road Traffic Generation Assessment

For the road traffic noise assessment, traffic numbers and generated vehicles was based on the information provided by Seca Solution (refer to section 2.1 for reference). This data has been used to calculate the expected noise increase due to traffic associated with the development onto Morpeth Road. This assessment has considered all generated vehicles moving in the same direction on Morpeth Road. Tank Street also has a higher existing vehicle count, therefore this assessment on Morpeth Road presents worst case scenario for road traffic noise increase. The results are summarized in Table 21. No noise assessment has been conducted on the road network which provides access to the existing retirement village as these are not local roads, and will be used for vehicles entering and exiting the site, and for the future retirement village masterplan.

Table 21: Existing and predicted traffic flow volumes (peak hour)

Local Road	Existing Vehicles AM peak	Existing Vehicles PM peak	Predicted Increase AM peak	Predicted increase PM peak	Predicted noise increase AM peak	Predicted noise increase PM peak
Morpeth Road	297	321	43	43	0.6	0.5

Based on this assessment, the increase in road traffic noise on Morpeth Road would be less than 1dB. As such the development is expected to comply with the requirements of the NSW RNP in regards to the 2dB relative increase in noise levels.

8. Conclusion

An acoustic assessment for the proposed aged care facilities at Morpeth, NSW has been conducted. This document forms part of the documentation package to be submitted to local authorities as part of the DA process.

This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in Section 5. In terms of noise criteria we have provided the following:

- Internal noise levels in accordance with AS2107:2016
- Noise criteria for emissions from the development in accordance with the NSW NPI
- Construction noise and vibration criteria

Glazing for the proposed development has been provided in order to achieve internal noise levels in accordance with AS2107. The glazing is presented in Section 6.1.

Maximum sound power levels for the condenser units has been provided including acoustic mitigation measures in order to meet the requirements of the NSW NPI at the most affected residential receivers.

A noise assessment for vehicle movements to and from the carpark including service vehicles such as a garbage trucks has been conducted. The assessment was conducted to as per the criteria from the NSW NPI and assessed at the most affected residential receivers.

Even though no assessment can be considered as being thorough enough to preclude all potential environmental impacts, having given regard to the above listed conclusions, it is the finding of this assessment that the development application should not be refused on the grounds of excessive noise generation.

APPENDIX A Glossary of Acoustic Terms

NOISE	
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.

LAmax	The maximum A-weighted sound pressure level measured over a period.
LAmin	The minimum A-weighted sound pressure level measured over a period.
LA1	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA10	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA90	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq	The A-weighted "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
LAeqT	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R-w:	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.