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Noise Management Plan

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REVISIONS

Revision	Date	Purpose	Prepared By	Approved By
R01	24/06/2022	For Information	Helen Tuttle	Jerremy Lofts
R02	14/09/2022	For Information	Helen Tuttle	Jerremy Lofts
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Review Panel	
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1 Introduction

Block 9 Section 132 Casey, ACT is the proposed location for a mixed-use development consisting of Commercial tenancies on Lower and Upper Ground Levels, Commercial and Residential on Level 1 and five to six (5-6) storeys of residential accommodation above, with two (2) levels of underground carpark.

Figure 1 shows the proposed site plan for the development.

Figure 1 Proposed Site Plan

ACOR is pleased to provide a Noise Management Plan (NMP) for the proposed development. This assessment has been undertaken with reference to the following standards and codes:

- The ACT Territory Plan.
- The ACT Commercial Zones Development Code.
- The Casey Precinct Map and Code.
- The ACT Environment Protection Regulation (2005), Part 3 Noise.
- The ACT *Commercial Waste Industry Code of Practice* (CWIC).
- The Roads ACT Noise Management Guidelines (NMG).
- AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors.

2 Design Requirements

2.1 Territory Plan Requirements

The Territory Plan identifies the site as being within a CZ1 Core Zone within the Casey Precinct, as shown in Figure 2.

It is bounded by:

- CZ1 Core Zone and limited PRZ1 Urban Open Space to the North;
- PRZ1 Urban Open Space to the East and to the South across Clarrie Hermes Drive;
- CZ1 Core Zone, Roadways to the East.

The site is within the Casey Precinct Map, where it is identified as a block potentially affected by noise from external sources.

Therefore, based upon this zoning and the nature of the proposed development, the Commercial Zones Development Code and Multi Unit Housing Development Code will be applicable to this development.

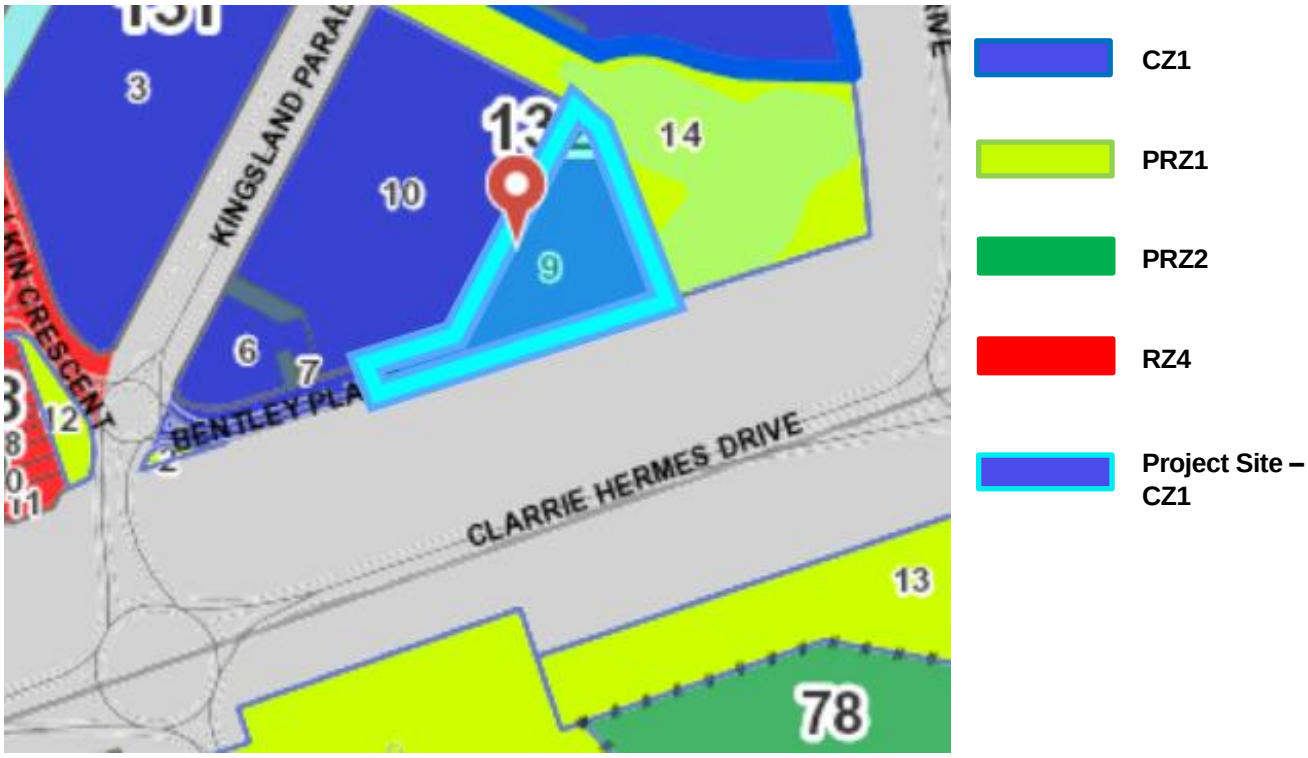

Figure 2 Territory Plan Zoning

Source: app.actmapi.act.gov.au

Section 6.1 Rule 23 of the Commercial Zones Development Code is provided in Table 1.

Rules	Criteria
6.1 Potentially noisy uses	
R23 This rule applies to any of the following: a) club b) drink establishment c) emergency services facility d) hotel e) indoor recreation facility f) industry (except light industry) g) indoor entertainment facility h) outdoor recreation facility i) restaurant Development complies with a noise management plan prepared by a suitably qualified person and endorsed by the Environment Protection Authority (EPA). The noise management plan will detail the proposed design, siting and construction methods that will be employed to ensure compliance with the Noise Zone Standard as detailed in the Environment Protection Regulation 2005, based on the estimated noise levels when the facility is in use. **Note:** A condition of development approval may be imposed to ensure compliance with the endorsed noise management plan.	This is a mandatory requirement. There is no applicable criterion.

Table 1 Commercial Zones Development Code, Rule 23

Based upon ACOR's discussions with the Environment Protection Authority (EPA), it is understood that it is acceptable to comply with the AS/NZS 2107:2000 recommended maximum noise level within residential apartments when considering road traffic noise intrusion. Meeting the recommended satisfactory level is only required when considering mechanical noise intrusion and noise from music (such as nearby commercial premises noise).

Rules	Criteria
6.9 Noise Attenuation – External Sources	
R67 Where a block has one or more of the following characteristics: a) Identified in a precinct code as being potentially affected by noise from external sources b) Adjacent to a road carrying or forecast to carry traffic volumes greater than 12,000 vehicles per day c) Located in a commercial zone d) Adjacent to a commercial or industrial zone Dwellings shall be constructed to comply with the relevant sections of the following: a. AS/NZS 2107:2000 – Acoustics – Recommended design sound levels and reverberation times for building interiors (The relevant satisfactory recommended interior design sound level) b. AS/NZS 3671 – Acoustics – Road traffic noise intrusion building siting and construction For other than road traffic noise, compliance with this rule is demonstrated by a noise management plan prepared by a member of the Australian Acoustical Society with experience in the assessment of noise, and	This is a mandatory requirement. There is no applicable criterion.

Rules	Criteria
endorsed by the EPA. For other than road traffic noise, the noise level immediately adjacent to the dwelling is assumed to be the relevant noise zone standard specified in the ACT Environment Protection Regulation 2005. For road traffic noise, compliance with this rule is demonstrated by an acoustic assessment and noise management plan, prepared by a member of the Australian Acoustical Society with experience in the assessment of road traffic noise and endorsed by the Transport Planning and Projects Section in ESDD. **Note:** A condition of development approval may be imposed to ensure compliance with the endorsed noise management plan.	

Table 2 Multi Unit Housing Development Code, Rule 67

It is understood that it is acceptable to comply with the AS/NZS 2107:2016 noise level within residential apartments when considering road traffic noise intrusion. Meeting the recommended satisfactory level of AS/NZS 2107:2000 is only required when considering mechanical noise intrusion and noise from music (such as nearby commercial premises noise). Furthermore, as AS/NZS 2107:2000 has been superseded by AS/NZS 2107:2016, ACOR considers that designing to the most recent 2016 version of the standard is appropriate.

2.2 ACT Environment Protection Regulation 2005 – Part 3 Noise

The Australian Capital Territory Environment Protection Regulation (2005), Part 3 *Noise* sets environmental noise limits based upon noise zones. A detailed description of the Noise Zones and Noise Standards is located in Schedule 2 of the Regulation. The zones are based upon the Territory Plan in the ACT and associated LEP zones in NSW where the site borders NSW. The zoning and noise limit requirements are shown in Table 3.

Item	Noise Zone	ACT Land	NSW Land	Noise Standard (LA10, dBA)	
				Day	Night
1	Zone A	land in an industrial zone	land in the Queanbeyan city industrial zone	65	55
2	Zone B1	Land in the city centre or a town centre		60	50
2-1	Zone B2	Land in the Central National Area (City Hill Precinct)	Land in the Queanbeyan city business zone	60	50
3	Zone C1	Land in a group centre		55	45
3-1	Zone C2	Land in a corridor site or an office site		55	45
		Land in the Central National Area (Parliamentary Zone and Other Areas).			
4	Zone D	land (other than land in the city centre, town centres and group centres) in a commercial CZ4 zone		50	35
5	Zone E	land (other than land in the city centre, town centres and group centres) in – a restricted access recreation zone a broadacre zone		50	40

Item	Noise Zone	ACT Land	NSW Land	Noise Standard (LA10, dBA)	
				Day	Night
6	Zone F	land (other than land in the city centre, town centres and group centres) in – a commercial CZ5 zone a TSZ2 services zone a community facility zone a leisure and accommodation zone	land in the Queanbeyan city special uses zone	same as the noise standard for the adjoining noise zone with the loudest noise standard for the time period	
7	Zone G	all other land, other than that land in the Central National Area (Fairbairn)	Other NSW land	45	35

Table 3 ACT Noise Zones

In each case, the following applies:

- For all zones except Zone B1 and Zone C1:
  - Day is defined as Monday-Saturday 7am-10pm, Sunday and public holiday 8am-10pm
  - Night is defined as Monday-Saturday 10pm-7am, Sunday and public holiday 10pm-8am
- For Zone B1 and Zone C1:
  - Day is defined as Monday-Thursday 7am-10pm, Friday and Saturday 7 am to 12 am, Sunday and public holiday 8am-10pm
  - Night is defined as any other time
- The compliance point for leased land is any point as near as practicable to the boundary of the parcel of land.
- The compliance point for unleased land is any point as near as practicable to 5 metres from the source of the noise.
- The compliance limit for units within the same lease boundary is 5 dBA lower than the Zone Noise Standard for the appropriate time period.
- The compliance point for units within the same lease boundary is any point within any unit in the units plan, other than the unit generating the noise.
- The noise standard on the boundary between 2 or more noise zones is the average of the noise standards for the noise zones for the time when the noise is emitted, rounded up to the nearest dBA.
- The Noise Standard limit is to be used as an assessment limit for noise from all noise sources on the site, excluding the following:
  - A train;
  - An aircraft;
  - A person using his or her body (without any form of mechanical or electronic Commonwealth jurisdiction amplification);
  - An animal;
  - A motor vehicle being driven on a road unless it is being used in reliability tests or speed trials and has been exempted under the road transport legislation from the provisions of that legislation about attaching silencers to the exhaust pipes of motor vehicles, rules of the road and speed limits during the trials or tests.
- Other exclusions apply for special cases. In this case, none of the exclusions are considered relevant to the proposed development.

The site is located within a CZ1 Core Zone, which is Noise Zone C1, and is bounded by is Noise Zone C1 to the North and West, and Noise Zone G to the North (partial) East and South. Based upon the foregoing, the appropriate noise limits for the site would be as shown in Table 4.

Location	Noise Zone	Noise Standard (L10 dBA)	
		Daytime	Night-time
North (CZ1) and West Site Boundaries	Zone C1	55	45
North (PRZ1), South and East Site Boundaries	Zone C1 adjoining Zone G	50	40
All units within the same units plan	Zone C1	50	40

Table 4 Site Specific Noise Standards

It is important to note that a road or road related area cannot be considered an affected place for the purpose of noise assessments. Where there is an intervening road, ACOR considers the appropriate compliance location to be the nearest leased boundary on the opposite side of the road to the project site.

2.3 Commercial Waste Collection

Noise associated with commercial waste collection has the ability to cause disturbance to residential areas in the vicinity of the collection point. For this reason, the Environment Protection Act 1997, Instrument No. 238 of 1998 *ACT Commercial Waste Industry Code of Practice* (CWIC) was introduced. The CWIC states that:

> *"Provided the other conditions specified in this agreement are met, commercial wastes collected during the hours specified in Table 1 will not be required to comply with the Zone Noise Standard, as permitted under Environment Protection Regulation 29.*

The CWIC Table 1 is as shown in Table 5.

Noise Zone	***Operating Hours***
Zone A	*Any time*
Zone B	*2 am to 10 pm*
Zone C and F (excluding Manuka and Kingston Group Centres)	*6 am to 10 pm*
Manuka and Kingston Group Centres	*5 am to 10 pm*
All Other Zones	*7 am to 10 pm*

Table 5 CWIC Table 1 Noise Zones and Operating Hours

This site is located within Noise Zone C1. Therefore, waste collection can occur from 6 am to 10 pm. Due to the location of the Waste Removal Area, limiting garbage collection to between 8am and 10pm is, however, considered by ACOR to be a suitable time frame for garbage collection as it will not result in sleep disturbance to nearby noise sensitive receivers during the night-time hours.

2.4 Roads ACT Noise Management Guidelines (2018)

This will be considered to be a new development on an existing road. This being the case, the following noise limits will apply to the development:

Proposed noise sensitive developments located adjacent to arterial or major collector roads are to be planned, designed and constructed to standards that provide: external noise levels based on the existing conditions at the receiver below the maximum levels set out in (NMG) Table 1.2, or: internal noise levels that meet the Australian Standard AS2170 (ACOR believes this is a misprint and should read AS 2107).

Table 1.2 of the NMG is shown in Table 6

Land Uses	**Target Noise Level[1]**
residential and community facilities (from Table 1.1) daytime LAeq (15 hour) dB(A)	60
residential night-time LAeq(9hour) dB(A)[1]	55

Table 6 ACT Noise Management Guidelines Road Noise Limits

Notes:

1. *The acceptable traffic noise levels incorporate an allowance for reflection from the façade of the building under investigation. Measurements and predictions should be taken at one metre forward of the building façade. In cases where the building is not yet built, ,measurements should be taken at a distance of one metre in front of the proposed building façade, and 2.5 dB(A) added to the measurement to allow for future façade reflection. Measurements should be taken at a height of 1.2-1.5 metres above ground level or the known floor level.*
2. *Note that, for second and subsequent levels of a building, additional set-back distance is required to achieve the required criterion value in the table owing to the reduction in sound energy from ground attenuation over soft ground. A combination of set-back distance and other measures (eg. Use of appropriate insulation materials in construction) to meet guideline requirements.*

2.5 AS 3671:1989 Acoustics - Road Traffic Noise Intrusion Building Siting and Construction

Ultimately, the goal of AS 3671 is to achieve AS/NZS 2107:2016 internal noise levels within the building. This being the case, the façade should be designed to achieve the AS/NZS 2107:2016 recommended satisfactory noise level.

To determine whether an assessment is required under AS3671, the distance of the site from the nearest major road and the number of vehicles per day that travel on the road are important. These two factors will be critical in determining the likely noise level of the road. Other factors that will also influence road traffic noise levels are the road surface, intervening barriers, posted speed limit, actual vehicle speeds, traffic mix (percentage of heavy vehicles).

AS3671 addresses road traffic noise levels by determining a category of construction based upon the external road traffic noise level. Appendix A of AS 3671 provides the information pertaining to residential development shown in Table 7:

Type of Building	**Traffic noise level ($L_{Aeq,T}$) dB(A)**			
	Category 1	Category 2	Category 3	Category 4
Residential buildings (private houses, hotels)	≤45	>45 ≤ 60	>60 ≤ 75	>75

Table 7 AS3671:1989 Construction Categories

The AS 3671 construction categories are as follows (From Clause 3.2 of AS 3671):

- Category 1 – Standard Construction; openings, including open windows and doors may comprise up to 10% of the exposed facade. Traffic noise reduction of approximately 10 dB(A) is expected.
- Category 2 – Standard construction, except for lightweight elements such as fibrous cement or metal cladding or all glass facades. Windows, doors and other openings must be closed. Traffic noise reduction of approximately 25 dB(A) is expected.
- Category 3 – Special construction, chosen in accordance with Clause 3.4 of AS 3671. Windows, doors and other openings must be closed. Traffic noise reduction between 25 and 35 dB(A) is expected.
- Category 4 – Traffic noise reduction greater than 35 dB(A) is required; special acoustic advice should be sought.

2.6 AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors

Recommended noise levels are $L_{Aeq,\,T}$ values for the building unoccupied but ready for occupancy and the recommended reverberation times are for the occupied building. The recommended goals for a residential dwelling near a major road considered relevant to this development are summarised in Table 8.

Type of Occupancy		Recommended Design Sound Level Range[1] $L_{Aeq,t}$ dB(A)	Recommended Reverberation Time (T), s
Houses and apartments in inner city areas or entertainment districts or near major roads			
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	N/A
	Living areas	35 to 45	N/A
	Sleeping areas (night time)	35 to 40	N/A
	Work areas	35 to 45	N/A
Municipal Buildings / Shop Buildings			
	Restaurants	40 to 50	See Note 1
	Small Retail Stores (general)	< 50	See Note 1
	Specialty Shops	< 45	See Note 1
	Enclosed Carparks	<65	N/A

Table 8 AS/NZS 2107:2016 Summary

Notes:

1. *Reverberation times should be minimised for noise control.*

2.7 Construction Noise

2.7.1 Construction Noise Limits

In accordance with the ACTEPR (2005), Section 29, the following applies:

Noise—other exceptions

Under section 25 (1), noise is not taken to cause environmental harm in an affected place if it is noise mentioned in schedule 2, table 2.3, column 2 and the conditions (if any) mentioned in column 3 for the noise are met.

In accordance with the ACTEPR (2005), Schedule 2, Part 2.3, the noise limits relating to noise emitted in the course of building work "*for which a building approval under the Building Act 2004, division 3.3 is required*", relevant to this particular site, the conditions relating to Section 29 are as follows:

(a) all of the following:

(i) the noise is emitted from a place other than a place in noise zone A or B; and

(ii) the building work will not be finished within 2 weeks of the day it started; and

(iii) all relevant noise reduction measures mentioned in AS 2436, as in force from time to time, are implemented; and

(iv) the noise is emitted between 7 am and 6 pm Monday to Saturday, excluding public holidays

This effectively means that the noise zone standards can be exceeded between the hours of 7 am and 6 pm, Monday to Saturday, excluding public holidays, but the noise zone standards must be met at all other times.

Therefore, the noise limits shown in Table 9 will apply to construction noise emissions at the site.

Location	**Noise Standard (L10 dBA)**		
	7 am to 6 pm, Monday to Saturday, excluding public holidays	**6 pm to 10 pm, Monday to Saturday, excluding public holidays, 8 am to 10 pm Sunday and public holidays**	**All other times**
North (CZ1) and West Site Boundaries	Exempt	55	45
North (PRZ1), South and East Site Boundaries	Exempt	50	40

Note*: A road or road related area cannot be considered an affected place for the purpose of noise assessments. Where there is an intervening road ACOR considers the appropriate compliance location to be the nearest leased boundary on the opposite side of the road to the project site.

Table 9 Development Specific Construction Noise Limits

2.7.2 AS2436 – 2010 Noise from Construction Work

AS2436 – 2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* provides a series of recommendations to minimise noise and vibration from construction activities. The engineering principles commonly used to control noise fall into the following broad categories:

1. Controlling noise at the source. This includes selecting quiet equipment where possible and maintaining the equipment in accordance with manufacturers specifications.
2. Controlling the spread of noise. This includes siting potentially noisy equipment in a location that minimises noise spill to adjoining sites and providing shielding, where necessary, to further reduce noise from equipment.
3. Controlling noise at the receiver. This includes providing acoustic shielding near the residences. Where this is insufficient, further noise mitigation may be necessary to achieve a satisfactory outcome for the residents.

The principle control measure should always be to control the noise at the source, followed by controlling the spread of noise and then finally controlling noise at the receiver should be the last option chosen of all other options are not sufficient to reduce noise to within acceptable levels.

2.8 Building Vibration Criteria

2.8.1 Human Comfort

Vibration can potentially impact on the quality of life or working efficiency. Individuals can detect building vibration values that are well below those that can cause any risk of damage to the building or its contents. The level of vibration that affects amenity is lower than that associated with building damage. To protect the health and wellbeing of the community, NSW DEC has developed a guideline to aid in protecting people from values of vibration above preferred and maximum values felt inside buildings.

The recommended vibration criteria for Human Comfort are based on the NSW DEC Assessing Vibration: A Technical Guideline (2006). The criteria for continuous and impulsive vibration are summarized in Table 10.

Continuous vibration is defined as the vibration that 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 acceleration values presented in Table 10.

Impulsive vibration is a rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that 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 and the recommended criteria is provided in Table 10.

Location	**Assessment Period***	**Preferred weighted RMS values (m/s^2)**		**Maximum weighted RMS values (m/s^2)**	
Continuous Vibration					
		z-axis	x and y axes	z-axis	x and y axes
Residences	Daytime (7am to 10pm)	0.010	0.0071	0.020	0.014
	Night-time (10pm to 7am)	0.007	0.005	0.014	0.010
Offices, Schools, Educational Institutions and Places of Worship	Day or Night-time	0.020	0.014	0.040	0.028
Impulsive Vibration					
Residences	Daytime (7am to 10pm)	0.30	0.21	0.60	0.42
	Night-time (10pm to 7am)	0.10	0.071	0.20	0.14
Offices, Schools, Educational Institutions and Places of Worship	Day or Night-time	0.64	0.46	1.28	0.92
* Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am					

Table 10 Vibration criteria for Human Comfort – Continuous and Impulsive Vibration

Perception of vibration will depend on the vibration magnitude and its duration of exposure. In addition to the continuous and impulsive vibration, people can be subjected to Intermittent vibration. It is defined as 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. It may originate from impulse sources (e.g. pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by). This type of vibration is assessed on the basis of Vibration Dose Values (VDV) which is used to evaluate the cumulative effects of intermittent vibration. As per the recommendations of the NSW DEC Assessing Vibration: A Technical Guideline (2006), the recommended criteria for intermittent vibration are summarized in Table 11.

Location	Assessment Period*	Preferred weighted RMS values ($m/s^{1.75}$)	Maximum weighted RMS values ($m/s^{1.75}$)
Intermittent Vibration			
Residences	Daytime (7am to 10pm)	0.20	0.40
	Night-time (10pm to 7am)	0.13	0.26
Offices, Schools, Educational Institutions and Places of Worship	Day or Night-time	0.40	0.80

Table 11 Acceptable vibration dose values for Intermittent Vibration

2.8.2 Structural Damage

Currently there are no Australian Standards specifying the acceptable level of vibration limits for structural integrity due to ground vibration.

2.8.2.1 Cosmetic Damage

Recommended vibration criteria for cosmetic damage are based on the British Standard BS 7385-2:1993 "Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration" BS 7385-2:1993 recommends the lower value of vibration limits, above which cosmetic damage could occur, presented in Table 12.

Type of Building	Peak component particle velocity (PPV) in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial	50mm/s at 4 Hz and above	50mm/s at 4 Hz and above
Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4 Hz increasing to 20mm/sec at 15 Hz	20mm/s at 15 Hz increasing to 50mm/sec at 40 Hz and above.

Table 12 Acceptable vibration dose values for Intermittent Vibration

The recommended values relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the recommended values in Table 12 may need to be reduced by up to 50 %.

2.8.2.2 Structural Damage

Vibration criteria for structural damage, as recommended in German Standard DIN 4150-Part 3 Effects on Structures, is adopted and recommended for vibration assessment for structural integrity. The DIN 4150 Part 3 prescribes maximum allowable vibration velocities measured at the foundation of the buildings, which do not affect the structural integrity of the buildings. Based on the Standard, the maximum allowable ground vibration velocity deemed acceptable for different types of buildings is shown in Table 13.

Type of Structure	Guideline values for $v_{i,max}$ in mm/s				
	Foundation, all directions (i=x,y,z) at a frequency of			Topmost floor, horizontal direction (i=x,y)	Floor Slabs, vertical direction (i=z)
	1 Hz to 10 Hz	10 to 50Hz	50 to 100Hz	All frequencies	All frequencies
Buildings used for commercial purposes, industrial buildings and buildings of similar design (Industrial)	20	20 to 40	40 to 50	40	20
Dwellings and buildings of similar design and/or occupancy (Residential)	5	5 to 15	15 to 20	15	20
Structures that, because of their particular sensitivity to vibration, cannot be classified under the above two classifications and are of great intrinsic value (e.g. listed buildings under preservation order). (Heritage)	3	3 to 8	8 to 10	8	20

Table 13 Guideline values for vibration velocity for evaluating the effects of short-term vibration on structures (DIN 4150)

2.8.2.3 Human Comfort for Continuous and Shock-Induced Vibration

Vibration transfer within a building has the potential to adversely affect the occupants. The building structure must be designed to achieve appropriate levels of vibration to minimise such adverse effects.

The concept of using base curves to assess human comfort has been adopted from Australian Standard 2670.2:1990. NB - *Please note that this standard was superseded by AS ISO 2631.2:2014, however, it is accepted practice within the Australian market to adopt the multiplying factors as presented in Table 2 Appendix A (2670.2:1990) for building vibration from human comfort.*

A base curve marks the threshold of human perception and is defined in one-third octave bands from 1 Hz to 80 Hz. Vibration levels below the base curves typically do not result in adverse comments or complaints from occupants.

The vibration criteria for different occupancy types are obtained by multiplying the base curve by a factor. Multiplying factors for different occupation types on the recommendations in AS 2670.2:1990 are listed in Table 14.

Place	Time of Day	Continuous or Intermittent Vibration	Transient vibration excitation with several occurrence per day
Residential, Guest Rooms	Day	2 to 4	30 to 90
	Night	1.4	1.4 to 20

Table 14Multiplying factors for building vibration with respect to human response

3 Noise Impact Assessment

ACOR has undertaken a preliminary road traffic noise assessment to determine the likely level of noise intrusion into the buildings from road traffic noise from surrounding roads. This includes a preliminary assessment of the façade for DA documentation.

3.1 Noise Monitoring

Operator attended noise monitoring was conducted at the site on Thursday 2 June 2022 between 11.30am and 1.00 pm, consistent with the lunchtime noisy period at nearby roads and businesses. Measurements were taken on the southern site boundary, approximately 65m from the existing nearest trafficable lane of Clarrie Hermes Drive, with direct line of site to the road. Measurements were taken approximately 1.5 metres above natural ground level. Figure 3 shows the measurement position, and the monitoring results are presented in Table 15.

Figure 3 Noise Measurement Position

Location	Measured Noise Level (dBA)			
	LA90	LAeq	LA10	LA1
Clarrie Hermes Drive boundary of site (approx. 11:38am to 12:38pm)	49	55	58	62
Clarrie Hermes Drive boundary of site (approx. 12:38pm to 1:08pm)	48	55	58	62

Table 15 Operator Attended Noise Monitoring Results

The dominant noise source was road traffic noise, and the Leq was consistent over the measurement period.

Road traffic noise from Clarrie Hermes Drive, and to a lesser extent (because of distance) Horse Park Drive, is expected to dominate. The measurement location on the southern site boundary was 65m from the nearest

trafficable lane of Clarrie Hermes Drive. In the future, this road will be widened, and may therefore come closer to the façade of the development. In addition, the volume of traffic will then increase. To take this into account, an increase of 1dB for the road being 15m closer to the development, and an increase of 3dB for a doubling of traffic volume has been allowed for in our calculations.

Measurements were undertaken in free-field conditions, so 2.5 dBA needs to be added to account for the façade reflection off the new building. ACOR has also found that a typical difference between daytime and night-time is in the order of 5 dBA. Therefore, the night-time assessment level is set at 5dBA less than the daytime level.

ACOR has therefore used a façade corrected Leq daytime noise level of Leq 62 dBA and night-time noise level of Leq 57 dBA for evaluation of the road traffic noise intrusion into the development. Due to the layout of the development and the proximity of the facades to the site boundaries, this has been used as the façade incident noise levels for all facades.

3.2 Assessment Against Roads ACT Noise Management Guidelines (2018)

An assessment of ground floor noise levels against the NMG is shown in Table 16.

Land Uses	**Target Noise Level[1]**	**Assessment Noise Level**		**Complies**
Residential Daytime $L_{Aeq\ (15\ hour)}$ dB(A)	60	Clarrie Hermes Drive façade/All facades	62	No
Residential Night-time $L_{Aeq(9hour)}$ dB(A)[1]	55	Clarrie Hermes Drive façade/All facades	57	No

Table 16Assessment Against ACT NMG

1. *The acceptable traffic noise levels incorporate an allowance for reflection from the façade of the building under investigation. Measurements and predictions should be taken at one metre forward of the building façade. In cases where the building is not yet built, measurements should be taken at a distance of one metre in front of the proposed building façade, and 2.5 dB(A) added to the measurement to allow for future façade reflection. Measurements should be taken at a height of 1.2-1.5 metres above ground level or the known floor level.*

In this case, the site does not comply with the NMG external noise level requirements for dwellings and therefore requires a detailed façade assessment. (As the assessment noise levels used are $L_{Aeq(1\ hour)}$, this represents a worst-case $L_{Aeq(15\ hour)/\ (9\ hour)}$, and due to the small exceedances, it is possible that these values would comply; however we have nevertheless carried out a detailed preliminary façade assessment.)

Given the location relative to the road, and the relative difference between daytime and night-time noise levels, ACOR considers the appropriate noise levels to use are the $L_{Aeq(1\ hour)}$ daytime and $L_{Aeq(1\ hour)}$ night-time noise levels. An assessment is provided in Table 17.

Type of Occupancy	Recommended Design Sound Level Range[1] $L_{Aeq,t}$ dB(A)	Assessment Noise Level (Leq, dBA)	Noise Reduction Required (dBA)	AS 3671 Construction Category
Houses and apartments in inner city areas or entertainment districts or near major roads				
Clarrie Hermes Drive façade/All facades				
Living areas	35 to 45	62	17-27	3
Sleeping areas (night time)	35 to 40	57	17-22	2
Work areas	35 to 45	62	17-27	3

Table 17Façade Assessment

Notes:

1. *Reverberation times should be minimised for noise control.*

Based on this assessment the façades of the units are AS3671 Category 3. This is defined as follows:

- Category 3 – Special construction, chosen in accordance with Clause 3.4 of AS3671. Windows, doors, and other openings must be closed. Traffic noise reduction between 25 and 35 dB(A) is expected.

3.3 Preliminary Recommendations

These are preliminary recommendations for the development based on nominal window sizing. ACOR has assumed large windows to assess a worst-case situation. Therefore, these recommendations are not for construction. Prior to construction, specific calculations relating to each specific window in each specific situation should be assessed to confirm whether these recommendations are adequate for the development.

The weakest element of any facade tends to be the glazing. This is especially the case since the upgrading of the BCA, Section J thermal efficiency section which typically requires building facades to be fully insulated. This being the case, we have undertaken a preliminary assessment of the glazing for the proposed development to determine whether an upgrade to the glazing will be necessary to satisfy AS/NZS 2107:2016 recommended design sound levels for occupied areas.

This assessment has been undertaken assuming a standard, furnished room with a reverberation time not exceeding 0.5 seconds.

- All residential glazing is to be minimum 6.38 mm thick laminated glass with a minimum acoustic rating of Rw 33, or Viridian DGU with minimum 6 mm thick float glass and 6.38 mm thick laminated glass with a 12 mm spacer between with a minimum acoustic rating of Rw 33, or acoustic equivalent.
- If an alternate glazing is proposed, the proposed double-glazing solution must be checked by a suitably qualified acoustic consultant to ensure it meets the minimum acoustic requirements for this location.
- All solid facades to have an acoustic rating not less than Rw 50.
- All doors with exposure to Clarrie Hermes Drive, Horse Park Drive, the carpark to the north-west or the Waste Removal/Commercial Short Term Stay Park area to be fitted with acoustic seals to achieve an acoustic rating not less than Rw 30.
- The framing system must not degrade the performance of the glazing by more than 2dB. Any framing system must achieve a positive acoustic seal when closed. Any leaks, gaps, cracks or weep holes can significantly degrade the performance of the glazing.

These recommendations are not for construction, and a full façade assessment should be carried out at detailed design stage, including a review of glazing, external walls, and roof construction.

4 Noise Emissions from the Site

As stated above, for any noise sources in this development, the Zone Noise Standards set the noise limits of L_{10} 40 dBA night-time and L_{10} 50 dBA daytime at North (PRZ1), South and East lease boundaries, and L_{10} 45 dBA night-time and L_{10} 55 dBA daytime at North (CZ1) and West lease boundaries.

It is an EPA requirement that "all tenancies within the block must comply at all times with a Noise Management Plan endorsed by the Environment Protection Authority". It is generally required by the EPA that this statement be written into the Crown Lease to ensure compliance is achieved.

It is also an EPA requirement that the building be constructed to mitigate noise from all allowable lease purposes at the likely highest noise level. This means that the DA documentation will need to reflect the recommendations of this report, and all noise mitigation will need to be implemented.

We understand in this instance that the potentially noisy uses of Drinks Establishment and Gym (Indoor Recreation Facility) are not proposed and are intended to be removed from the Crown Lease. We understand that the block is still part of a Holding Lease, and the final Crown Lease has not yet been issued, but when it is, the intention is to have the Crown Lease exclude Drinks Establishment and Gym.

As the Crown Lease will then allow for only restaurant use as a noisy use, this is assessed as part of this NMP.

ACOR expects there will be three primary concerns relating to these noisy activities. These will be:

1. Noise from music being played within commercial premises.
2. Noise from waste collection activities.
3. Noise from mechanical equipment.

Each of these concerns will be addressed in turn.

4.1 Noise from Music

Noise from music is a concern typically for restaurants. The Crown Lease does allow for such noisy uses, so they need to be assessed.

The requirement is to achieve a noise level that does not exceed the following:

1. In accordance with the ACT EPR (2005):
    a. A noise level not more than L_{A10} 40 dBA of a night-time and L_{A10} 50 dBA of a daytime.

ACOR understands that it is an EPA requirement to assess this use assuming internal noise levels of:

- L_{A10} 85 dBA for a restaurant.

This notwithstanding, the work health and safety noise limit is $L_{Aeq(8hour)}$ 85 dBA, and this is the level that the majority of the population are likely to suffer from some hearing loss. ACOR does not condone noise levels in excess of WHS guidelines, and we always recommend complying with WHS requirements, including noise level limits.

For restaurants, mood music is expected, which does not have a significant bass component. Based on this assumption, the frequency content used for the assessment is shown in Table 18. This is the internal reverberant sound pressure level at 1 metre inside the façade and side walls of the tenancy, and 1 metre from the ceiling.

Description	Internal, Reverberant Sound Pressure Levels (L10, dB)							Total L10	
	63	125	250	500	1000	2000	4000	dB	dBA
Restaurant	80	80	80	80	80	80	75	88	85

Table 18 Music Noise Level Assumption

The actual reduction will be highly dependent upon the style of music and the frequency content. As all songs are different, this assessment should be considered indicative only.

Where recommendations on noise limiting are made, the noise limits must take into account these octave band spectral limits, adjusted down to reflect the recommended limits. For example, each octave band must be reduced by the same amount as the total reduction in the A weighted recommended noise limit.

4.1.1 Assumptions - Restaurant

The following is assumed:

1. Minimum 200 mm thick concrete slab, 13mm plasterboard ceiling suspended using acoustic isolation hangers.
2. Glazing is sealed and minimum 10.38mm laminated glazing or acoustic equivalent.
3. Doors to the establishment will be closed when loud music is played on the premises.

4.1.2 Assessment

The EPA require restaurants to be assessed with an internal noise level of L_{A10} 85 dBA, when the venues are operating.

The assessment assumes a compliance point 3m from the façade at the site boundaries as the site boundaries are so close to the building façades, and in accordance with the ACT EPA Noise Measurement Manual, 2009, noise measurements should be taken “where feasible, 3 metres from any large plane surface”. So, these are the expected measurement points in accordance with ACT Noise Measurement Manual methodology. This said, the site is surrounded by carparks, retail, open parkland with a pond, and playing fields across a busy road, and the nearest residential receiver locations are >100m away, so this is considered to be a conservative assessment in an area where the likelihood of complaint is minimal.

Based on this noise level and the spectral components assumed in Table 18, the predicted noise levels at the tenancies above and nearest site boundaries are shown in Table 19.

Noise from……	Noise limits at nearest compliance points		Expected noise level at the nearest site boundary or internally to above (dBA) with L10 85 dBA internal noise level, according to Restaurant Usage		Criterion achieved? Day/Night
Restaurant (Façade Closed - minimum 10.38 lam. or acoustic equivalent)	Day Night	L10 55 L10 45	Nearest Site Boundary, North (CZ1) and West Site Boundaries	L10 48	Y/N
		L10 50 L10 40	Nearest Site Boundary, all other Boundaries	L10 48	Y/N
		L10 50 L10 40	Outside Residential Above	L10 50* (38-40dBA inside) L10 <40* (if the floor above overhangs the retail)	Y*/N* Y*/Y*
			Outside Nearest Residential within Development	*L10 54*	*N/N*
			Outside Residential Development >3m from Restaurant	*L10 50*	*Y/N*
			Outside Residential Development >10m from Restaurant	*L10 40*	*Y/Y*
		LAeq 35-40 dBA for Sleeping Areas	In Residential above through ceiling	27 dBA (assuming minimum 200mm conc. slab with 13mm plasterboard ceiling suspended using acoustic isolation hangers from the Soffit of the restaurant)	Y

Table 19 Predicted Noise Levels – based on 10.38 lam. glazing

Note * - We have assessed noise levels to outside the residential above; noise levels inside through an open window will be 10-12dB less than this and meet AS/NZS 2107:2016 internal noise criteria.

Based on this assessment, use of the restaurant can comply with the Noise Zone Standards of a daytime as long as the façade of the restaurant is closed, with minimum 10.38mm laminated glass, or acoustic equivalent, provided the Restaurant is in a tenancy which is more than 3m from the façade of the nearest residential unit within the development. Due to the extended daytime hours for this Zone, it may not be necessary for a restaurant to operate outside the daytime hours.

Based on the noise levels and the spectral components assumed in Table 18, the predicted noise levels at the tenancies above and nearest site boundaries with an upgraded glazing (minimum 10/12/6.38 DGU or acoustic equivalent) are shown in Table 20.

Noise from……	Noise limits at nearest compliance points		Expected noise level at the nearest site boundary or internally to above (dBA) with L10 85 dBA internal noise level, according to Restaurant Usage		Criterion achieved? Day/Night
Restaurant (Façade Closed - minimum 10/12/6.38 double glazing unit or acoustic equivalent)	Day Night	L10 55 L10 45	Nearest Site Boundary, North (CZ1) and West Site Boundaries	L10 44	Y/Y
		L10 50 L10 40	Nearest Site Boundary, all other Boundaries	L10 44	Y/N
		L10 50 L10 40	Outside Residential Above	L10 47* (35-37dBA inside) L10 <37* (if the floor above overhangs the retail)	Y*/N* Y*/Y*
			Outside Nearest Residential within Development *Outside Residential Development >3m from Restaurant* *Outside Residential Development >10m from Restaurant*	*L10 51* *L10 47* *L10 37*	*N/N* *Y/N* *Y/Y*
		LAeq 35-40 dBA for Sleeping Areas	In Tenancies above through ceiling	27 dBA (assuming minimum 200mm conc. slab with 13mm plasterboard ceiling suspended using acoustic isolation hangers from the Soffit of the restaurant)	Y

Table 20 Predicted Noise Levels with Upgraded Glazing (minimum 10/12/6.38 DGU)

Note * - We have assessed noise levels to outside the residential above; noise levels inside through an open window will be 10-12dB less than this and meet AS/NZS 2107:2016 internal noise criteria.

Therefore, based on the above assessments, use of the restaurant can comply with the Noise Zone Standards of a *daytime* (which in this case for Zone C1 is defined as Monday-Thursday 7am-10pm, Friday and Saturday 7 am - 12 am, Sunday and public holiday 8am-10pm) as long as the façade of the restaurant is closed, with *minimum 10.38mm laminated glass, or acoustic equivalent*, provided the Restaurant is in a tenancy which is *more than 3m* from the façade of the nearest residential unit within the development with a direct line of sight.

Should a restaurant wish to operate outside of these hours, use of the restaurant can comply with the Noise Zone Standards of a *night-time* as long as the façade of the restaurant is closed, with double glazing consisting of *10mm glass and 6.38 mm laminated glass with a 12 mm gap between, or acoustic equivalent*, provided the Restaurant is in a tenancy which is on the *West boundary*, and *more than 10m* from the façade of the nearest residential unit within the development with a direct line of sight.

We would recommend there be no adjoining wall between a restaurant and a residential apartment, however our calculations indicate that should this occur, such as in the north-east corner on Level 1, a discontinuous wall of minimum 190mm solid core blockwork (min. 2100kg/m^3) with a minimum 20mm air gap to a separate stud with minimum 13mm plasterboard and acoustic insulation in the cavity should comply. For the above reasons, however, ACOR recommends not locating a Restaurant in the 'corners' of the triangle, especially the north-east corner.

In addition, this being the case, ACOR recommends the following:

1. If music is to be played, sound lock entries and a façade upgrade will be required.
2. Music is only to be played in the premises when the façade is closed.

Refer to the “recommendations” section of this report for further recommendations to minimise noise intrusion to noise sensitive premises and more specific details of upgrades required.

4.2 Commercial Short Term Stay Park Area

There is a Commercial Short Term Stay Park area adjacent to the Waste Removal area, on the upper ground level to the south of the site, which is partially enclosed/screened from many of the residential areas. We understand there are to be no large commercial tenancies, and only small specialty shops which would be served by this carparking space. Thus, the vehicles using this space are likely to be cars, small vans, and light rigid vehicles. There are to be no articulated vehicles. In addition, the use of this space is likely to be infrequent.

The largest vehicle likely to be using this area is then the garbage truck, which is exempt from noise limits for garbage collection as long as the requirements of the 1998 *ACT Commercial Waste Industry Code of Practice* are met (see Section 2.3).

The primary goal of a noise management plan is to allow the development to operate so as to not encroach upon the acoustic amenity of potentially noise sensitive areas that may be near the proposed site. This, in part, means compliance with the ACTEPR(2005) should be achieved and consideration should also be given to noise sources not regulated by the ACTEPR(2005), such as non-amplified speech. This is particularly the case where nearby receivers are residential.

The proposed layout situates the Waste Removal/ Commercial Short Term Stay Park area to the south of the site. Vehicles enter the site, travel under residential apartments, and the area is partially under these apartments and partially under a slab separating this area from the internal courtyard. Garbage vehicles then travel under the apartments along a road to the east, allowing reversal into the Waste Removal bay. Although difficult to tell from the drawings, the perspectives show that the Waste Removal/Commercial Short Term Stay Park area itself is well screened from residential areas, but the service road is in clear view of some residential apartments. The plan and elevation are shown in Figure 4 and the perspectives are shown in Figure 5.

Figure 4 Waste Removal/Commercial Short Stay Parking Area.

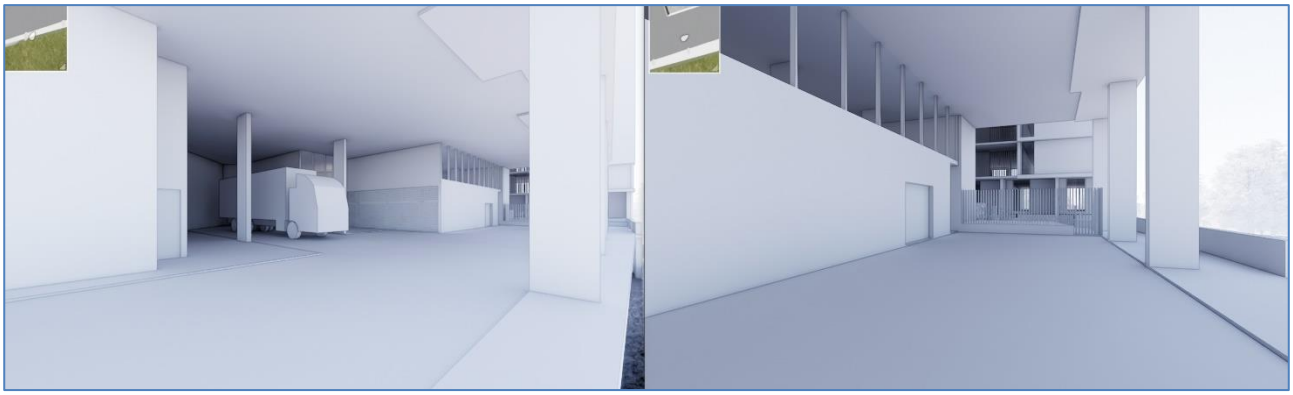

Figure 5 Waste Removal/Commercial Short Stay Parking Area showing Garbage Truck Perspective Views

For this reason, we would recommend the following, for the improvement of the amenity of the occupants, although not necessary:

- that the underside of the soffit of the covered area be treated with acoustic absorption to the ceiling and walls that has a noise reduction coefficient (NRC) not less than 0.95.

Consideration could also be given to screening the residential apartments/adaptive commercial apartments to the eastern end of the service road from the service road by enclosing it to the east. Although not required, it is our experience that noise complaints are more likely when receivers can visually see the source of the noise, and additional screening is likely to minimise complaints for this reason.

4.2.1 Waste Removal/Commercial Short Term Stay Park Area Vibration

As only small specialty shops are proposed to be served by this carparking space, and the vehicles using this space are likely to be cars, small vans and light rigid vehicles (i.e. no articulated vehicles), there are likely to be no activities such as fork-lift and pallet drops, and therefore no issue with impact noise or vibration from these activities associated with the use of the commercial carparking space.

As previously stated, the largest vehicle likely to be using this area is the garbage truck, which is exempt from noise limits for garbage collection as long as the requirements of the 1998 *ACT Commercial Waste Industry Code of Practice* are met (see Section 2.3). It is possible however that the use of the Waste Removal area may include a Waste Hoist or a Compactor, and that the heavy garbage truck may cause structure-borne noise and vibration to the units above. For this reason, and for the amenity of the residents above, this risk could be managed by the design, and assessed by a vibration expert during the design stage. Any potential vibration isolation of this area could include Waste Removal area floors, columns and walls being isolated from the ground or from the main structural foundations with, for example, an elastomeric base isolation system, such that there is no rigid connection between the floor surfaces and the structural floor, walls and columns. Specific design solutions can be determined during the design process.

ACOR would also recommend using waste bins with nylon rollers, in order to reduce the noise involved with rolling the bins across the floor.

4.3 Noise from the Underground Carpark

Noise emissions from cars on the internal road, and the underground carpark will include vehicles starting, car doors and boots closing, people talking and cars travelling through the carpark. Most noise from modern cars is from road-tyre contact noise, with very little exhaust or engine noise. The road-tyre contact noise increases with increasing vehicle speed. Generally speaking, the low vehicle speeds, expected to be less than 30 km/hr, will result in very low car travel noise levels, as long as some important factors are taken into account. ACOR recommends the following be considered to minimise noise from vehicle travel:

1. Do not use a smooth surface that results in tyre squeal. Use a brushed or textured surface that does not result in tyre squeal.
2. Avoid sharp transitions in angle. Instead, use smooth transitions between flat surfaces and ramps.
3. Do not use loud speed humps, such as metal speed humps. If concrete or rubber speed humps are necessary, use a smooth transition on either side to minimise vehicle clunking etc.
4. Minimise vehicle speed through the internal road by using appropriate traffic calming devices.
5. The use of acoustically absorptive materials on concrete soffits can help to reduce noise from the carpark, and this is recommended. Where thermal insulation is required, insulation with acoustically absorptive properties to absorb some of the sound generated within the carparks should be used.
6. Any carpark ventilation, including jet fans, will require appropriate acoustic attenuators to minimise noise emissions to neighbouring residences.

4.4 Noise from Patrons

The management will be responsible for any offensive noise created by patrons. This includes noise from patrons as they enter and leave the premises, regardless of the usage. Noise from patrons congregating outdoors can be a potential area of complaint and care should be taken to minimise noise emissions from the site due to the use of any outdoor areas.

If the premises is to be a licensed premises, the liquor Act (2010) states that "*Noise from licensed premises and permitted premises must not be excessive*". (Section 9, Division 1.2, paragraph 10(g). This includes all noise from the premises, including noise from music and noise from patrons. If the noise is considered to form a part of anti-social behavior, this constitutes an incident that will need to be recorded in the incident register.

These tenancies will be designed to attenuate low frequency noise from music. Therefore, noise from speech will not present a significant issue when patrons are inside the venue. When outside the venue, there is the possibility of disturbance to nearby receivers when patrons enter the street or the courtyard. Given the location of this site with respect to busy roads and carparks and other commercial developments, disturbance to nearby receivers outside this development is unlikely.

4.5 Other Noise Emissions from the Site

As stated above, for any noise sources in this development, the Zone Noise Standards set the noise limits of L_{10} 40 dBA night-time and L_{10} 50 dBA daytime at North (PRZ1), South and East lease boundaries, and L_{10} 45 dBA night-time and L_{10} 55 dBA daytime at North (CZ1) and West lease boundaries.

Any noise generating equipment such as air conditioning equipment or the like must be chosen for quiet operation and must be in a location that provides acoustic shielding to nearby sensitive receivers.

The equipment selection is yet to be made. The mechanical system should be assessed by a suitable qualified acoustic consultant who is a member of the Australian Acoustical Society with experience in the assessment of environmental noise once the mechanical design has progressed and equipment noise levels are known.

4.5.1 Mechanical Equipment

Specific equipment selections are not available at this stage and a full assessment of plant and equipment noise levels must be undertaken by a suitably qualified acoustic consultant who is a member of the Australian Acoustical Society with experience in the assessment of environmental noise at detailed design stage to ensure compliance with environmental noise requirements.

Any noise generating equipment such as air conditioning equipment, cold room/freezer room plant, carpark plant or the like must be chosen for quiet operation and must be in a location that provides acoustic shielding to the nearby residences.

The transfer of noise from plant and equipment to the building structure should be minimised. To this end, all reciprocating plant and equipment should be provided with suitable vibration isolation mounts that provide at least 95% vibration isolation. In addition, the following should be observed:

- Large equipment such as chillers should only be mounted on concrete slabs and should be provided with concrete plinths at least 100 mm high. Mounts should consist of a spring mount and an isolation pad. Typical static deflections of 25-50 mm will be required, depending upon the equipment. The equipment manufacturers should be consulted as to suitable mounting options.
- Pumps should be provided with a spring mounted concrete inertia base.
- All connections of pipework ductwork and the like to any reciprocating equipment must be of the resilient type to prevent any bridging of the vibration isolation.

Allowance should be made for attenuators to loud fans and the like, especially where short duct runs are expected. As an indication, 1.5 metres is typically sufficient space for attenuation.

An understanding of the implications of the ACT EPA requirements is important in considering how the building be managed. The law is the ACT EPR2005, which sets the environmental noise limits based upon the appropriate noise zones. This noise limit is applicable at the lease boundary in all cases, whether this be inside or outside, on residential balconies for example.

The producer of the noise must meet the Zone Noise Standards at the compliance points.

4.6 Noise Intrusion from External Sites

Road traffic noise is expected to be the dominant noise source at this location. Any adjoining sites need to meet the same Zone Noise Standards as this development. Therefore, there are no additional requirements to address noise ingress from neighbouring premises.

4.7 Noise from Garbage Collection

There is a general exemption from noise limits for garbage collection as long as the requirements of the 1998 *ACT Commercial Waste Industry Code of Practice* are met. For this area, that means garbage collection can occur from 6 am to 10 pm. Due to the location of the Waste Removal Area, limiting garbage collection to between 8am and 10pm is, however, considered by ACOR to be a suitable time frame for garbage collection as it will not result in sleep disturbance to nearby noise sensitive receivers during the night-time hours.

ACOR would also recommend using waste bins with nylon rollers, in order to reduce the noise involved with rolling the bins across the floor.

5 Recommendations

5.1 Residential Tenancies – Façade Design

1. All residential glazing is to be minimum 6.38 mm thick laminated glass with a minimum acoustic rating of Rw 33, or Viridian DGU with minimum 6 mm thick float glass and 6.38 mm thick laminated glass with a 12 mm spacer between with a minimum acoustic rating of Rw 33, or acoustic equivalent.
2. If an alternate glazing is proposed, the proposed double-glazing solution must be checked by a suitably qualified acoustic consultant to ensure it meets the minimum acoustic requirements for this location.
3. All solid facades to have an acoustic rating not less than Rw 50.
4. All doors with exposure to Clarrie Hermes Drive, Horse Park Drive, the carpark to the north-west or the Commercial Short Term Stay Park/Waste Removal Area to be fitted with acoustic seals to achieve an acoustic rating not less than Rw 30.
5. The framing system must not degrade the performance of the glazing by more than 2dB. Any framing system must achieve a positive acoustic seal when closed. Any leaks, gaps, cracks or weep holes can significantly degrade the performance of the glazing.

5.2 Commercial Tenancies - Construction

Any restaurant usage to be limited to a floor with no tenancies below only.

ACOR recommends the following minimum construction:

1. The commercial tenancies that contain a restaurant should be restricted to tenancies not sharing a separating wall with any residences.
2. The commercial tenancies that contain a restaurant should be separated by a minimum Rw+Ctr 50 wall of discontinuous construction.
3. Other ground floor tenancies should be separated by full height, slab to slab walls achieving a minimum Rw 45 construction.
4. The commercial tenancies adjacent to the Commercial Short Term Stay Park/Waste Removal Area should be separated from this area by a minimum Rw+Ctr 50 wall. Any doors should not compromise the acoustic performance of the wall, which may require air locks.
5. The concrete floor slab between a restaurant and another tenancy must be a minimum of 200 mm thick (see below for fit-out ceiling recommendations).
6. All waste pipes passing through the floors between tenancies must be lagged with acoustic pipe wrap. The pipe wrap is to have a mass not less than 4.5 kg/m^2 and must contain a foam decoupling layer of at least 12 mm thickness. Suitable products include Pyrotec 4525C and Thermotec Nu-Wrap 5.
7. All floor slab penetrations between tenancies must be acoustically sealed using an appropriate flexible sealant.
8. Doors must be provided with acoustic seals and the layout must be designed so that acoustically sealed air locks can be provided by the tenant as part of the fitout if as part of their normal operation they will play music on the premises.
9. All restaurant glazing must be minimum 10.38mm laminated glazing or acoustically equivalent, if operating only during daytime hours, and at least 3m from the nearest residential unit; if operating at night-time, all restaurant glazing must be minimum 10/12/6.38 double glazing or acoustically equivalent, and at least 10m from any residential unit.

10. Doors must be provided with acoustic seals. Sound locks are required for restaurants as recommended above.
11. Vibration within the building must be limited to meet the requirements of *NSW Environmental Noise Management – Assessing Vibration: a technical guide (February, 2006)*. This includes all vibration associated with mechanical plant and equipment as well as any vibration associated with uses that create vibration, like laundromats or the like.

5.3 Commercial Tenancies – Fit out and Operation

The following is a list of treatment measures to be implemented to minimise noise emissions from the premises based upon nominal A weighted and C weighted noise levels. These should be considered to be the minimum treatment options and it may be appropriate to increase the treatment applied depending upon the type and level of music played. The frequency content of the noise will determine what ultimately will be appropriate. In all cases, regardless of the following recommendations, the noise requirements provided in the ACT EPR (2005) must be achieved.

ACOR recommends the following:

1. Any noise emanating from the premises shall comply with ACT Zone Noise Standards, which will be assessed according to the ACT Noise Measurement Manual, as detailed in Section 2.2 of this report. It is important to note that it is highly likely that there will be a 5 dB to 10 dB adjustment to account for the annoyance characteristics of music (being impulsive and also probably low frequency, depending upon the situation). This adjustment is added to the measured noise level, which is essentially the same as having a compliance limit that is 5 dBA to 10 dBA lower than the Zone Noise Standard. This must be taken into account.
2. Assumptions used for the noise assessment in this report are to be adhered to.
3. Speakers are to be mounted in such a way as to limit structural transfer of noise to other premises within the building. An acoustically resilient mounting to a wall, or floor standing speakers on rubber mounts are likely to be the best options. Speakers that play music should not be mounted in any ground floor ceilings.
4. It is recommended that consideration be given to speakers that are highly directional in nature so that sound can be concentrated where required. This will improve attenuation to areas not requiring high music noise levels and will concentrate the highest noise levels away from the facades of the establishments. This will also help to address work health and safety requirements relating to employees. This will also rely on the reverberance of the space being controlled to give the best benefit. Some general principles include facing speakers inward toward the centre of the tenancy and maximising the distance of the speakers from any facade or wall.
5. There are to be no outdoor speakers provided to any of the commercial tenancies.
6. Music is only to be played within restaurants when façade, windows and doors are closed.
7. Any additional plant and/or equipment provided for the restaurant, such as air conditioning units, cool room condenser unit, kitchen exhaust or the like must be assessed by a suitably qualified acoustic consultant that is a member of the Australian Acoustical Society to ensure it complies with Zone Noise Standards and Building Code of Australia requirements.
8. A ceiling is to be provided to the restaurant tenancies that minimises noise transfer through the 200mm concrete floor slab. The minimum construction of the ceiling is to be as follows:
    a. Minimum 100 mm cavity to a 13 mm thick set plasterboard ceiling suspended using acoustic isolation hangers from the soffit, with heavy acoustic insulation in the cavity.
    b. Fully acoustically sealed ceiling.

9. Acoustic absorption is to be incorporated into the design of the fitout so that reverberation times are minimised. As an indication, reverberation times should not exceed 1 second in the octave band frequency range between 125Hz to 4000Hz, and 1.5 seconds at 63Hz.
10. The façade is to be upgraded to significantly increase low frequency performance. This must include the following:
    a. Fully sealable sound lock entries to all restaurants.
    b. The façade must be upgraded according to the recommendations in Section 4.1.

5.3.1 Management Procedures and Considerations

To minimise the impact of noise on surrounding noise sensitive receivers, the following is to be implemented:

1. A procedure for after-hours cleaning and the like should be considered. This should include:
    a. Music is to be turned down as soon as patrons leave. Music may be played at a low level inside the building (say 65 dBA) when staff are cleaning-up.
    b. For bottle and glass collection and disposal, store such rubbish inside the premises until the daytime hours, where they can be transferred from inside to the garbage collection area outside.
    c. Any loud cleaning activities should consider the neighbours and noisy cleaning activities should only occur during the daytime hours.
2. A complaints handling procedure should be set-up by management. The procedure should include the following minimum information, or information as required by Law:
    a. Time, day and date of complaint being received and relevant information about the reason for the complaint, including the time, day and date the complainant was disturbed by noise from the premises.
    b. Contact details for the complainant, including full name and contact details.
    c. Details of when and how the complaint was addressed, including any operational, procedural or engineering measures introduced to reduce noise emissions.
    d. Details of follow-up with the complainant, including date, day and time of any meetings, phone calls, etc. A record of the complainant's response to the follow up should be kept.
    e. All complaint records should be kept indefinitely by the management, for the entire time the establishment operates, or as required by Law.

5.4 Commercial Short Term Stay Park/Waste Removal Area

The commercial tenancies adjacent to the Commercial Short Term Stay Park/Waste Removal Area should be separated from this area by a minimum Rw+Ctr 50 wall. Any doors should not compromise the acoustic performance of the wall, which may require air locks.

The following could also be considered for the improved amenity of the residents:

1. Screening the residential apartments/adaptive commercial apartments to the eastern end of the service road from the service road by enclosing it to the east.
2. Deliveries to commercial tenancies only being made during the daytime.
3. Internally treating the underside of the soffit of the covered area with acoustic absorption to the ceiling and walls that has a noise reduction coefficient (NRC) not less than 0.95.
4. Isolating Waste Removal area floors, columns and walls from the ground or from the main structural foundations using an elastomeric base isolation system, such that there is no rigid connection between

the floor surfaces and the structural floor, walls and columns – details to be determined by a vibration expert during the design stage.

6 Conclusion

ACOR has prepared a revised Noise Management Plan (NMP) for the proposed mixed-use development at Block 9 Section 132 Casey, ACT. This assessment has been undertaken with reference to the following standards and codes:

- The ACT Territory Plan.
- The ACT Commercial Zones Development Code.
- The Casey Precinct Map and Code.
- The ACT Environment Protection Regulation (2005), Part 3 Noise.
- The ACT *Commercial Waste Industry Code of Practice* (CWIC).
- The Roads ACT Noise Management Guidelines (NMG).
- AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors.

Based upon ACOR preliminary assessment of the proposed design, with the recommendations proposed in this report implemented, the acoustic requirements of these planning documents can be achieved.

ACOR trusts this information meets your current requirements. If you have any questions, I can be contacted on 02 6240 2900.

Yours faithfully,
ACOR Consultants ACT Pty Ltd

Helen Tuttle
Senior Acoustic Consultant

Appendix A Glossary of Acoustic Terminology

dB	Decibel. This is the unit measurement of sound.
dBA	A weighted decibel is the most commonly used descriptor. The A weighting is an adjustment to the raw sound level to approximate what the average human ear can hear, which is less sensitive at very low and very high frequencies.
Lw or SWL	Sound power level. This is the total radiated sound energy.
Lp or SPL	Sound pressure level. This is the measurable sound level at a given distance from an item.
L_{max}	The RMS maximum noise level of a measurement
L_{10}	90th percentile sound level of a measurement. Often called the average maximum noise level
L_{eq}	The energy average noise level of a measurement.
L_{90}	10th percentile sound level of a measurement. Often called the average background noise level
L_{min}	The minimum noise level of a measurement
$L_{eq(T)}$	The time (T) equivalent energy noise level. The time interval is often in blocks of 10 or 15 minutes for short term measurements, or hours for long-term measurements. Common increments for long term measurements are 1 hour, day, night, 18 hours and 24 hours.
$L_{eq(8h)}$	The 8 hour equivalent energy noise level. Primarily used for occupational noise assessments
LC_{peak}	The C weighted peak noise level. Primarily used for occupational noise assessments
Dw	The Weighted Level Difference as defined in AS/NZS ISO 717.1:2004. This is the single number rating describing the ability of a partition to reduce noise as measured in the field with no standardisation or normalisation.
Rw	The Weighted Sound Reduction Index. This is the single number rating describing the ability of a building element to reduce noise as measured in a laboratory. Assessed in accordance with AS/NZS ISO 717.1:2004.
NRC	Noise Reduction Coefficient. The NRC defines how much sound is absorbed by a surface. An NRC of 0 means it absorbs no sound while an NRC of 1 means it will absorb most sound.