WOOD & GRIEVE ENGINEERS

Manly Civic Club

Acoustic Report
Development Application

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Revision

REVISION	DATE	COMMENT	APPROVED BY
3	27/02/2017	Added Glazing for club noise	**ORFG**
2	22/02/2017	Updated plans	**ORFG**
1	22/12/2016	For comments	**ORFG**

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Contents

1. Introduction

As part of the DA documentation process, Wood & Grieve Engineers have been engaged by Eastview to provide an acoustic assessment for the proposed 6 storey mixed-use residential redevelopment of the Manly Civic Club located at 2 West Promenade, Manly.

The proposed development will consist of:

- 2 underground levels of car parking
- Ground floor sports and gaming lounge, bar and bistro
- 2 outdoor terrace areas opening out from the ground floor licenced premises
- 5 levels of residential apartments
- Rooftop plant

This assessment discusses the likely noise impact from the proposed development on the potentially nearest most-affected receivers of the development as well as the operational noise associated with the licenced premises.

This assessment has been prepared considering the following documentation:

- Manly Development Control Plan 2013 Amendment 8 24th September 2016
- AS/NZS 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors"
- NSW OEH Industrial Noise Policy (INP)
- NSW OEH Road Noise Policy 2011
- NSW OEH Assessing Vibration: A technical guideline 2006
- NSW Liquor Administration Board (LAB) Liquor Act 1982
- NSW EPA Noise Guide For Local Government
- British Standard BS5228: Part 1:1997 "Noise and Vibration Control on Construction and Open Sites."
- British Standard BS7358:1993 "Evaluation and Measurement for Vibration in Buildings" – Part 2: "Guide to Damage Levels from Groundborne Vibration"
- German Standard DIN4150-Part 3 "Structural vibration in buildings – Effects on structures"

This report provides:

- A statement of compliance with the Northern Beaches Council requirements for the proposed residential 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 and attended noise measurements at representative locations on the development site over 9 days during November 2016.

This report is based on our understanding of the proposed project, application of the relevant state guidelines and professional experience within the acoustic field. Therefore this report shall not be relied upon as providing any warranties or guarantees.

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.
- Architectural drawings provided by Mijollo International titled “1548 PRELIM RESUBMISSION” dated 20Feb17
- Noise data collected on site through the use of noise loggers and a hand held spectrum analyser.
- Traffic Impact Assessment report provided by Traffix, dated June 2016

3. Acoustic Issues

The acoustic issues relating to the development have been identified as follows:

- Noise intrusion from vehicle movements on Eustace Street, Gilbert Street, West Promenade and Belgrave Street
- Noise emissions from mechanical plant within the proposed development to the surrounding receivers
- Traffic generation noise for residents on Eustace Street from increased number of vehicles entering and exiting proposed carpark
- Noise emissions from proposed licensed premises onto nearby receivers
- Noise emissions from proposed licensed premises onto residential spaces directly above within the same proposed development

4. Project Overview

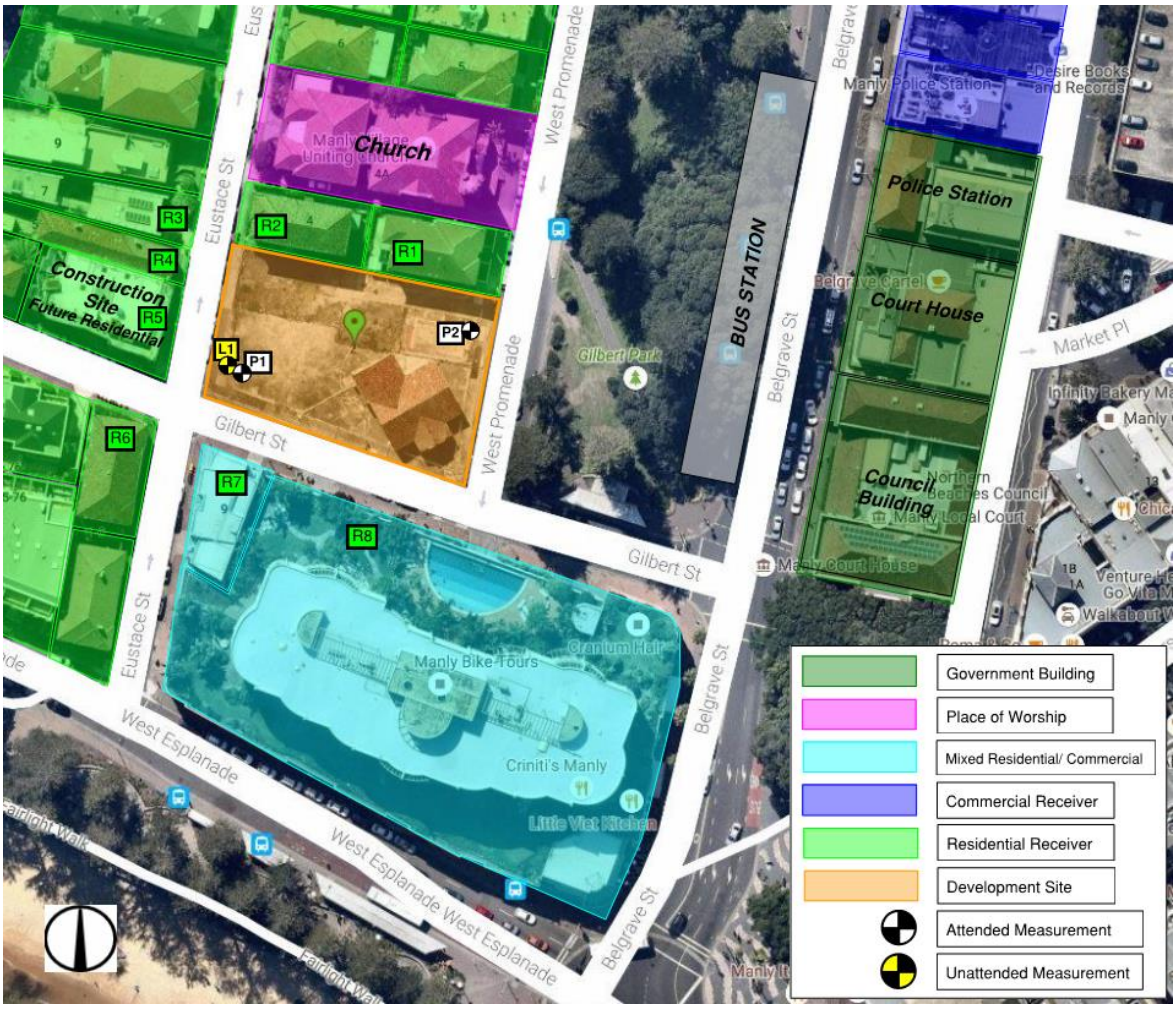
4.1 Site description

The site is located at a junction of 3 streets; West Promenade, Gilbert Street and Eustace Street, in Manly NSW. The site is indicated in Figure 1 along with the neighboring noise sensitive receivers and potential causes of noise intrusion. During the time of DA assessment, the building labeled R5 in Figure 1 was under construction and introduced intermittent noise from power tools.

The site address is at 2 West Promenade, and along this street, faces a quiet park. The other side of the park is a busy transit area with a well serviced bus station, local government and court buildings as well as a police station. During site inspection police sirens were heard leaving the precinct. Given the busy Manly area and proximity to police station, this is likely to be a semi regular occurrence. Other notable noise sources included the breaking of busses whose routes travel along Eustace Street and turn right onto Gilbert Street, at the junction of the site. Other traffic along Gilbert Road was generated from the entry and exit of vehicles to the carpark at 7 – 9 Gilbert Street, a large, multi-purpose complex indicated as R8 in Figure 1.

The site is predominately surrounded by quiet residential buildings, and is nearby a church, introducing periodic times of increased vehicle and foot traffic for services of worship.

Figure 1: Aerial Photo of the Area Showing an Overview of the Site, Measurement Locations and Nearby Receivers



4.2 Sensitive receivers

Residential receivers R1 – R8 are considered most sensitive to the noise generated from the development, in particular, the noise emission from the licensed premises on the ground floor of the proposed development. As there are no other licenced premises in the immediate vicinity, it is likely the introduction of any amplified music and noise generated by patrons leaving the premises late at night will contribute to an increase in the existing background noise levels.

Construction noise should also be considered as an intrusion onto neighbouring residences as well as the nearby church along West Promenade. In particular, R1 and R2 are closest to the site and will be considered the worst case scenario for residential noise intrusion. Appropriate noise mitigation measures should be undertaken to ensure the noise generated from construction and operation of the development does not disturb the nearby sensitive receivers.

5. Noise Survey

Continuous noise monitoring was undertaken between the 29th of November and the 7th of December 2016 on site at the logger location marked L1 in Figure 1 on the corner of Gilbert and Eustace Streets. Attended Noise measurements were also undertaken on the 7th of November 2016 at locations P1 and P2 at 15mins each.

5.1 Instrumentation

The following instrumentation has been used to conduct the noise surveys shown in the subsequent sections:

- ARL NGARA noise Logger S/N 8780F3
- Hand-held sound spectrum analyzer B&K 2250, S/N 2709742
- Sound Calibrator B&K Type 43231, 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.

5.2 Unattended Noise Survey Results

The NSW OEH Industrial Noise Policy (INP) defines background 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.

The Liquor Administration Board (LAB) criteria are broken into 2 time periods. The assessment time periods can be described as the following:

Before Midnight 7am – 12am
After Midnight 12am – 7am

Both the NSW INP and LAB assessment periods should be considered for the proposed development.

A noise logger was placed at location L1 as shown in Figure 1 to measure the ambient and background noise that is representative of the site and surrounding residential receivers. The noise logger collected octave band sound data so as to assess the background noise levels between 31.5 Hz and 8 kHz (inclusive) as per the LAB requirement. The noise logger was installed from the 29th November to the 7th December 2016. The results of the unattended noise surveys are shown in Table 1 and Table 2 below.

Table 1: Unattended Background Noise Measurements at L1

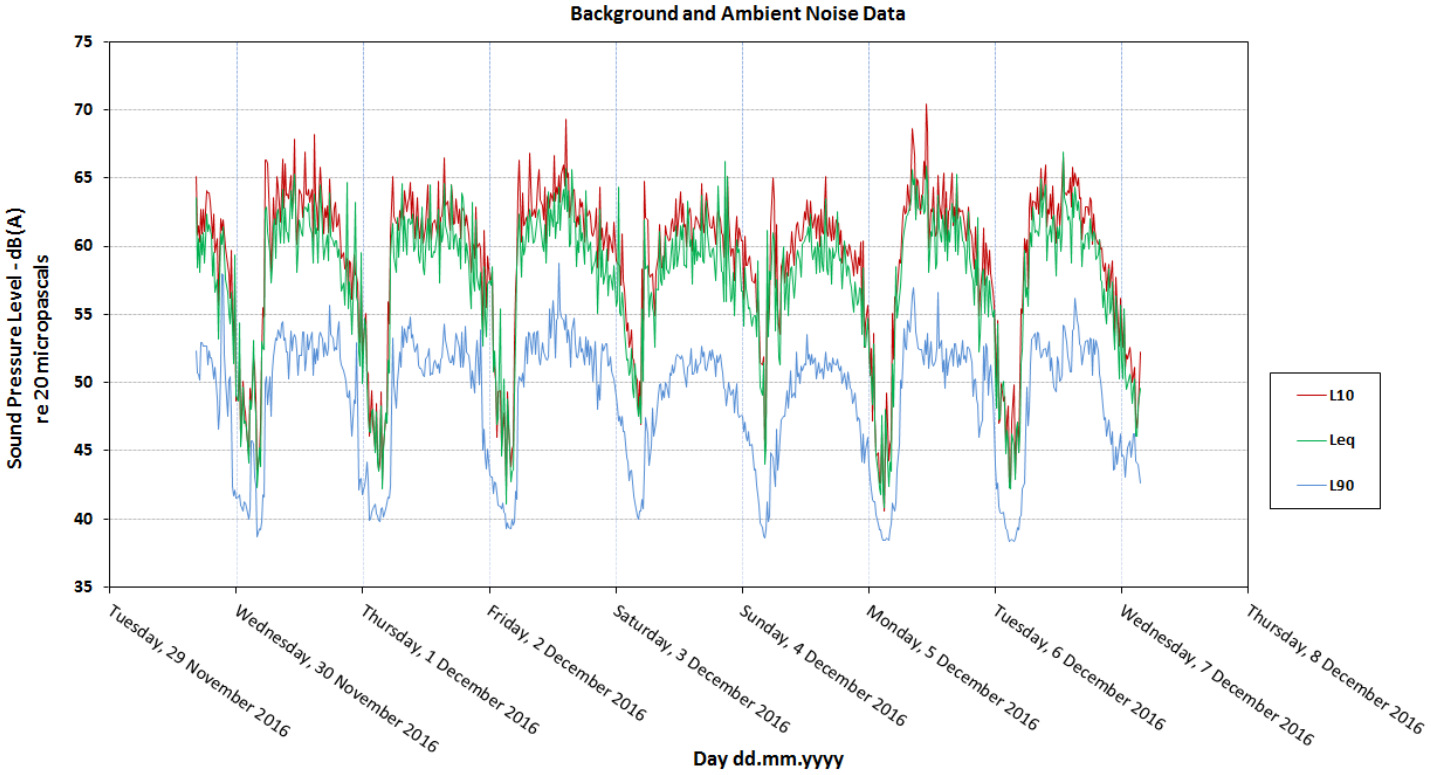
Location	Equivalent Continuous Noise Level $L_{Aeq,15\ minutes}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	61	60	56	51	49	40

Table 2: Logged Octave Band Noise Measurements at L1 (Z weighted)

Octave Band Centre Frequency (Hz)	31.5	63	125	250	500	1k	2k	4k	8k
Before Midnight	65.38	61.26	56.73	52.21	49.33	48.28	45.89	41.26	32.83
After Midnight	59.94	55.06	49.46	45.33	43.25	42.58	41.01	39.54	30.48

The local ambient noise environment along the surround streets of the development site consists primarily of noise from intermittent traffic movements including busses and trucks for most periods of the day. Other suburban noise sources such as pedestrians, lawn mowers, and small power tools were also observed. Refer to Figure 2 for the noise data over the logging period. Any rain affected data has been excluded from the calculations.

Figure 2: Unattended Background Noise Monitoring Data



5.3 Attended Noise Survey Results

Attended traffic noise measurements of 15-minute duration were conducted on the corner of Gilbert and Eustace Streets (P1) and along West Promenade (P2) to characterise the traffic noise intrusion into the proposed development. The measurement was conducted between 11:40 am and 12:05 pm on Monday the 7th November 2016. A summary of the attended noise measurements is shown in Table **3** below.

Table 3: Attended Noise Measurements

Measurement Location (Refer to Figure 1)	Measurement Time	$L_{Aeq, 15mins}$ dB(A)	L_{A90} dB(A)	L_{A10} dB(A)	Comments
P1	11:43am	62.9	51.5	64.9	Intermittent bus, truck, car traffic, <30second angle grinder, leaf blower in distance
P2	11:49pm	57.1	51.3	58.9	Police Siren, continuous traffic along busy parallel road (Belgrave Street)

6. Noise Criteria

6.1 Internal Noise Levels

This section details the criteria used to define the internal noise targets for spaces within the proposed development. It should be noted that the Manly Development Control Plan 2013 does not specify a maximum internal noise level within spaces of a development. As a consequence, the maximum internal noise levels for the proposed development will be established in accordance to *AS/NZS 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors"*.

6.1.1 AS/NZS 2107:2000

The proposed development is located parallel to a major road (Belgrave Street) and the recommended internal noise levels are provided in Table 4. Both the ground floor licensed premises and the residential development have been considered for internal noise levels.

Table 4: Summary of Recommended Internal Noise Levels using AS/NZS 2107:2000

Type of Occupancy	Recommended Sound Levels - L_{Aeq}, dB(A)	
	Satisfactory	Maximum
Houses and apartments near major roads		
Living Areas	35	45
Sleeping Areas	30	40
Work Areas	35	45
Apartment common areas (e.g. foyer, lift lobby)	45	55
Hotels and Motels		
Bars and Lounges	45	50
Dining Rooms	40	45
Enclosed Carparks	55	65
Foyers and Recreational Areas	45	50
Kitchen, Laundry and Maintenance Areas	45	55

6.2 External Noise Emission

The following section presents the criteria applicable for noise emissions from the proposed residential development.

6.2.1 Manly Development Control Plan 2013 (Amendment 8 – last amended 24 September 2016)

Residential Development

The Manly Development Control Plan 2013 states the following in regards to the control of noise emissions from electrical, mechanical or hydraulic plant within the proposed development:

> *"Proposed development and activities likely to generate noise including certain outdoor living areas like communal areas in Boarding Houses, outdoor open space, driveways, plant equipment including pool pumps and the like should be located in a manner which considers the acoustical privacy of neighbours including neighbouring bedrooms and living areas."*

In addition, the Manly DCP also references the NSW EPA Noise Guide For Local Government, which also makes reference to the NSW INP for criteria noise levels.

Licenced Premises

The Manly CDP supports the noise criteria set out by the Office of Liquor Gaming and Racing. As part of the Development Application, noise control reports are to be submitted outlining the management of patron noise as well as other offensive noise such as amplified music and associated plant noise. The Manly DCP criteria is the same as that set out by the Liquor Administration Board (LAB), and is summarized below:

> *"The LA10 noise level emitted from the licensed premises must not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8 kHz inclusive) by more than 5 dB between 7am and 12 midnight at the boundary of any affected residence."*
>
> *"The LA10 noise level emitted from the licensed premises must not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8 kHz inclusive) between 12 midnight and 7am at the boundary of any affected residence.*
>
> *"The noise level from the licensed premises must not be audible within any habitable room in any residential premises between the hours of 12 midnight and 7am or as otherwise required under conditions of development consent."*

In addition to the LAB noise conditions, Manly DCP also states:

> *"Balconies, verandahs, any roof top areas and any external access thereto must be closed to patrons between the hours of 10pm to 8am daily to minimize noise nuisance."*

For the purposes of condition, the LA10 can be taken as the average maximum deflection of noise emission form licensed premises. Using the octave band noise data collected, the project specific criteria for the licensed premises is summarized in Table **5**. These values have been adopted as criteria for the noise emissions of the licensed premises.

Table 5: LA10 Octave Band Noise Criteria in accordance with the Liquor Administration Board (LAB) - A weighted

Octave Band Centre Frequency (Hz)	31.5	63	125	250	500	1k	2k	4k	8k	Overall DB (A)
LA10: 7am – Midnight (Background + 5 dB)	30.8	40.0	45.5	48.5	51.1	53.3	52.1	47.2	36.7	53
LA10: Midnight – 7am (≤Background noise)	19.4	28.8	33.3	36.7	40.0	42.6	42.2	40.5	29.3	45

6.2.2 NSW OEH Industrial Noise Policy

The NSW Office of Environment and Heritage (OEH) Industrial Noise Policy has been deemed the most suitable criteria for the residential development given the size of the proposed development and its proximity to sensitive noise receivers. The INP sets out noise criteria to control the noise emission from industrial noise sources. The external noise due to mechanical services from developments is also addressed following the guideline in the NSW OEH's INP.

The INP 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).

The operational criteria for the licenced premises was set out in Table **5** as it is deemed most suitable for the land use.

Intrusiveness Criteria

The NSW OEH INP states the following:

> *"The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the LAeq descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A)."*

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

Table 6: OEH INP Intrusiveness Criteria

Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
Daytime 7am – 6pm	$L_{Aeq,15min} \leq$ RBL + 5	56
Evening 6pm – 10pm	$L_{Aeq,15min} \leq$ RBL + 5	54
Night 10pm – 7am	$L_{Aeq,15min} \leq$ RBL + 5	45

Amenity Criteria

The NSW INP states the following:

> *"To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the INP. Meeting the acceptable noise levels in Table 2.1 will protect against noise impacts such as speech interference, community annoyance and to some extent sleep disturbance. These levels represent best practice for assessing industrial noise sources, based on research and a review of assessment practices used overseas and within Australia."*

The applicable parts of Table 2.1: Recommended L_{Aeq} Noise Levels from Industrial Noise Sources - dB(A) which are relevant to the project are reproduced below:

Noise Criteria

Table 7: Amenity Criteria for External Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB(A)	
			Acceptable	Recommended Maximum
Residential	Suburban	Day	55	60
	Suburban	Evening	45	50
	Suburban	Night	40	45
Commercial Premises	All	When in use	65	70
Place of worship – internal	All	When in use	40	45
Area specifically reserved for passive recreation (eg. National Park)	All	When in use	50	55

Note: *Suburban interface area as defined in EPA INP 2. 2.1.6.

6.2.3 Project Specific Noise Levels

The project specific noise criteria have been established using the most stringent values of the Intrusiveness and Amenity criteria (as shown previously).

Table 8 below displays the project-specific noise levels (PSNL) for the proposed mixed-use development. Any mechanical noise emissions from the development must comply with the PSNL provided at the surrounding receivers. These levels are in accordance with the NSW INP.

Table 8: Project specific noise levels

Receiver	Period	Descriptor	PSNL dB(A)
Residential	Day (7:00am to 6:00pm)	$L_{Aeq,\ period}$	55
	Evening (6:00pm to 10:00pm)	$L_{Aeq,period}$	45
	Night (10:00pm to 7:00am)	$L_{Aeq,period}$	40
Commercial premises	When in use	$L_{Aeq,when\ in\ use}$	56
Place of worship – internal	All	$L_{Aeq,when\ in\ use}$	40
Area specifically reserved for passive recreation (eg. National Park)	All	$L_{Aeq,when\ in\ use}$	50

Where necessary, noise mitigation measures will be incorporated in the design to ensure that noise levels comply with the recommended noise emission criteria noted above.

It should be noted that for noise levels specifically associated with the licensed premises onto neighbouring residential receivers, the octave band noise levels outlined in Table **5** should be adhered to when more stringent than the INP PSNL.

6.3 Traffic Noise 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 NSW Road Noise Policy (RNP, Office of Environment and Heritage 2011). 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 in Table 9.

Table 9: 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	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55	$L_{Aeq, (15\ hour)}$ 50
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/subarterial roads	$L_{Aeq, (15\ hour)}$ 60	$L_{Aeq, (15\ hour)}$ 55
	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local Roads	4. Existing residences affected by noise from new local road corridors	$L_{Aeq, (1\ hour)}$ 55	$L_{Aeq, (1\ hour)}$ 50
	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		

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'.

Also, the inherent quality of noise from vehicles on public roads arriving to and departing from the site would be indistinguishable from other traffic noise on public roads.

7. Construction Noise and Vibration Criteria

7.1 Construction Noise Criteria

Noise criteria for construction sites are established in accordance with the NSW ICNG. 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, the assessment procedures and criteria in Chapter 4 of the NSW ICNG have been considered.

Consequently, the noise management levels (NMLs) for the construction and demolition activities are presented in Table 10 below.

Table 10: NSW ICNG 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 50 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted 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: 1. 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) 2. 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 Evening – 47 dB Night time – 41 dB	• 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 1.5 m above ground level. If the property boundary is more than 30m away 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*.

7.2 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.

7.2.1 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 11. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Table 11: 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 12: 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

7.2.2 Structural Damage – Vibration Criteria

Ground vibration criteria are defined in terms of levels of vibration emission from infrastructures or from the construction activities which will avoid the risk of damaging surrounding buildings or structures.
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 13 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn't occur.

Table 13: 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 14 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 14: 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

7.2.3 Vibration Objectives

Table 15 indicates the construction vibration criteria for the nearest residential properties to the proposed development.

Table 15: Construction vibration criteria summary

Location	Period	Human Comfort Vibration Objectives			Building damage Objectives – Velocity (mm/s)
		Continuous mm/s² (RMS)		Intermittent m/s$^{1.75}$ (VDV)	
		z-axis	x- and y-axis		
Residential	Daytime	10-20	7-14	0.24-0.4	5
	Night time	7-14	5-10	0.13-0.26	5

8. Noise Impact Assessment

8.1 External Glazing

8.1.1 Design for Existing Traffic Noise

The general limiting factor of the performance of a building façade in terms of noise attenuation is the glazing system. In this particular case of the proposed development, the traffic noise on Gilbert Street and Eustace Street provides the largest acoustic demand on the facades of the development facing the roads.

In order to achieve the internal noise levels recommended in AS 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors", the minimum recommended glazing selection for the facades of the proposed development is presented in Table 16 below. The data presented in this table is based on external noise levels obtained from the conducted measurements. The glazing thicknesses presented below should be considered as the minimum thicknesses to achieve the required internal noise levels. Greater glazing thicknesses may be required for structural loading, wind loading, thermal requirements, etc.

Table 16: Recommended Acoustic Performance of Glazing System for traffic noise

Building	Façade	Level	Occupancy	Proposed glass system	Required acoustic rating of proposed glazing assembly, Rw	Open windows for ventilation
All	All	All	Living	6mm float	31	Yes, All
			Bedroom	4mm float*	29	

Note: * The proposed glass is the minimum thickness satisfying the acoustic requirements, nevertheless 6mm float glass is the minimum glass thickness being used for typical residential development.

8.1.2 Design for Predicted Club Noise

Based on a calculation for patron noise of the licensed premises, a worst case scenario was modeled estimating approximately 1m^2 per patron in the outdoor gaming terrace (80 patrons). The same noise levels were used for the club entry, as patrons coming and going could gather outside these areas and could potentially be boisterous late at night. The Western façade was also considered to be noise sensitive, particularly in the sleeping areas due to the carpark entry with the potential so have car leaving late at night, outside of the normal weekly predicted residential vehicle movements.

A model based on typical measured club patron noise was constructed to predict the sound pressure at 5m from the club, the approximate location of the first level apartments' glazed façade. The Rw requirements are shown in Table 17 for the predicted worst case scenario noise at each level of the building. Appendix 1 shows a glazing markup of Rw requirements for each façade in relation to the estimated predicted noise levels based on club activity and distance from ground level.

These glazing performances are provided as a guideline for costing purposes only, and do not include predictions for amplified or live music. Noise control from the club should be addressed by the tenant to ensure noise emissions meet the criteria set out in Section 7.1. Evidence that these criteria can be met should be provided prior to operation of the premises.

Table 17: Recommended Acoustic Performance of Glazing System for club noise (East, South and Western facade)

Distance from Club	Façade	Level	Occupancy	Example of recommended Rw performance glazing	Recommended acoustic rating of glazing assembly, Rw	Open windows for ventilation
5m	Glazed	1	Living	8.38mm laminate	34	No
			Bedroom	6.38mm laminate 12mm air gap 6mm glass	38	
8m	Glazed	2	Living	6mm float glass	31	No
			Bedroom	8.38mm laminate	34	
11m	Glazed	3	Living	4mm float glass*	29	No
			Bedroom	6mm float glass	31	
14m	Glazed	4	Living	4mm float glass*	29	No
			Bedroom	6mm float glass	31	
17m	Glazed	5	Living	4mm float glass*	29	No
			Bedroom	6mm float glass	31	

Note: * The proposed glass is the minimum thickness satisfying the acoustic requirements, nevertheless 6mm float glass is the minimum glass thickness being used for typical residential development.

8.2 Predicted Club Noise Impact and Restrictions

Noise emission from the club must not exceed background noise plus 5dB (A) between the hours of 7am and 12am midnight. The proposed hours of operations are shown in Table 18, all of which fall within this time period criteria. It should be noted if the club was to remain open beyond 12am midnight, the criteria becomes background noise plus 0 dB, ie there should be no additional noise from the club at the boundary of the nearest residential receiver.

Table 18 Proposed Hours of Club Operation

	Club Operational Hours	Outdoor Eating Area Hours
Monday – Wednesday	1030 – 2300	1030 – 2200
Thursday - Saturday	1030 – 2400	1030 – 2230
Sunday	1030 – 2200	1030 – 2100

As established in section 6.2.1, the LAB criteria at the nearest residential receiver during operational times is an overall of 53 dB (A) and 45 dB (A) after midnight closing. The maximum allowable noise (LA10) must not exceed 5 dB (A) in any octave band between 31.5 Hz and 8 kHz. The tables below demonstrate a predicted sound power level of 90 dB (A) for 80 patrons with raised voices in the outdoor gaming area. This number was considered a worst case scenario maximum, allowing approximately 1m^2 per patron in the outdoor area. Table 19 shows the spectrum compliance for a predicted 80 patrons at the Level 1 residential receiver. Table 20 shows a maximum of 7 patrons in the outdoor gaming area after midnight in order to meet compliance at the nearest residential receiver in all octave bands.

Table 19 Maxium predicted noise levels of club patrons at nearest residential receiver during operation

Octave Band Centre Frequency (Hz)	31.5	63	125	250	500	1k	2k	4k	8k	Overall dB (A)
Predicted RBL 7am – 12am 80 patrons raised voice @ nearest residential receiver	16	16	26	46	50	47	41	34	27	51
Criteria = LA10: 7am – Midnight (Background + 5 dB)	31	40	46	49	51	53	52	47	37	53

Table 20 Maxium predicted noise levels outdoor club patrons at nearest residential receiver

Octave Band Centre Frequency (Hz)	31.5	63	125	250	500	1k	2k	4k	8k	Overall dB (A)
Predicted RBL 12am – 7am 7 patrons raised voice @ nearest residential receiver	16	16	16	36	40	37	31	23	17	41
Criteria = LA10: 12am – 7am (<Background noise)	19	29	33	37	40	43	42	41	29	45

All acoustic modelling assumes a worst case scenario of 80 patrons in the outdoor area, and a 477 patrons indoors. It is assumed when the outdoor areas are not in use, the doors will remain closed. The acoustic modelling does not account for any low frequency spectrum attributed from amplified music etc. Monitoring of noise levels should be considered when introducing additional noise sources to the club. By taking into consideration these figures and predictions, the club should maintain a sound power level (SWL) within the outdoor gaming terrace, as well as any other noise emissions to maximum of 90 dB (A) SWL in order to meet background plus 5 dB at the nearest residential receiver.

8.3 Mechanical Services Noise Emissions

The following noise sources are associated with the site operation, and details about expected noise levels from these sources are given in the ensuing sub-sections. Noise sources from general operations at the site typically include mechanical services noise from air-conditioning equipment and exhaust and supply fans servicing the carpark. These noise sources have been used to predict the worst case scenario noise impact of the proposed use of the site to nearby residential and commercial receivers.

The main mechanical sources associated with the development will include:

- Roof-top plant items (hot water plant, condenser units)
- Mechanical risers throughout the building

In order to assess the worst case scenario, it was assumed that the mechanical units servicing each space are running at any time throughout a 24hr period. With all, night time is the most stringent period for the noise generated by the operation of the mechanical plant where as for the commercial receivers the hours of operation are the most stringent.

8.3.1 Proposed Noise Levels

For the purpose of the calculation, we have assumed that all the mechanical equipment is operational on a 24 hour basis as a worst case scenario. Therefore, acoustic recommendations are provided in order to achieve resultant noise levels at the nearest most-affected sensitive residential receivers that comply with the night time criterion, which is the most stringent, as listed in Section 6.2.3.
The proposed maximum sound power levels of the condenser units located on the roof are provided in the table below.

Table 21 presents the proposed maximum sound power level in order to achieve the criteria outlined in Table 8 at the boundary of the nearest receivers for the rooftop plant.

Table 21: Proposed maximum acoustic power at rooftop plant

Item	SWL re 1pW								
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	Overall dB(A)
Rooftop Condensers	79	85	79	71	70	68	66	61	77

8.4 Traffic Noise Assessment

For the road traffic noise assessment, combined traffic count data for the afternoon peak hour (5:00pm – 6:00pm) are presented in Table 22. This data was based on a traffic survey conducted on what was considered a typical day on the 7th of December 2016. The predicted increased traffic information was provided in the Traffix Traffic Impact Assessment. The data has been used to calculate the existing noise level on the corner of Gilbert and Eustace Streets and the expected increase due to the proposed development associated traffic. The existing and predicted traffic flows are outlined in Table 22.

Table 22: Existing and Predicted Traffic Flows

Time	Residential	
	Existing	Existing + Increased
PM Peak	300	353

Based on the existing and proposed traffic volume data, the following predicted increases in road traffic noise levels have been determined for the worst case scenario during the peak afternoon hour.

A computer model was used to predict the traffic noise increase arising from the proposed development. The software algorithm is based on the "Calculation of Road Traffic Noise (CoRTN) model" of the UK Department of Transport. This model describes noise emitted by a constant traffic flow. The model uses standard curves to approximate vehicle noise levels. It also assumes the traffic can be broken down into two broad categories; cars and heavy vehicles. The source sound levels used in this project to model traffic noise levels are contained within the calculation algorithms of the noise model. Furthermore, the model was verified and calibrated using the short-term noise monitoring results obtained for this project. The values presented in Table 23 below compare the existing noise levels estimated by the model with the estimated noise levels expected from an increase in vehicle movements associated with the proposed development.

Table 23: Predicted Increase in Traffic Noise Levels

Route to/from Site	Existing Noise Levels Day $L_{10(1hr)}$	Predicted Noise Levels Day $L_{10(1hr)}$	Predicted Increase in Traffic Noise, dB(A)
Corner Eustace and Gilbert Streets	62	63	1

As shown in Table 23, the predicted increase in traffic noise due to the development is 1 dB(A). For this reason, we understand that the traffic generated by the proposed development will not have an adverse impact on the existing residents as the increase in traffic noise is expected to be imperceptible over the total assessment period.

9. Conclusion

An acoustic assessment for the proposed residential development at 2 West Promenade, Manly 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 6. With regards to noise criteria, we have provided the following:

- Satisfactory and maximum internal noise levels in accordance with AS/NZS 2107:2000.
- Noise criteria for emissions from the proposed development to sensitive receivers provided in Section 6 in accordance with the Manly Development Control Plan 2013 and the NSW Industrial Noise Policy
- Traffic noise criteria provided in Section 8.4 in accordance with the NSW Road Noise Policy
- Construction noise and vibration criteria provided in Sections 7.1 & 7.2 respectively

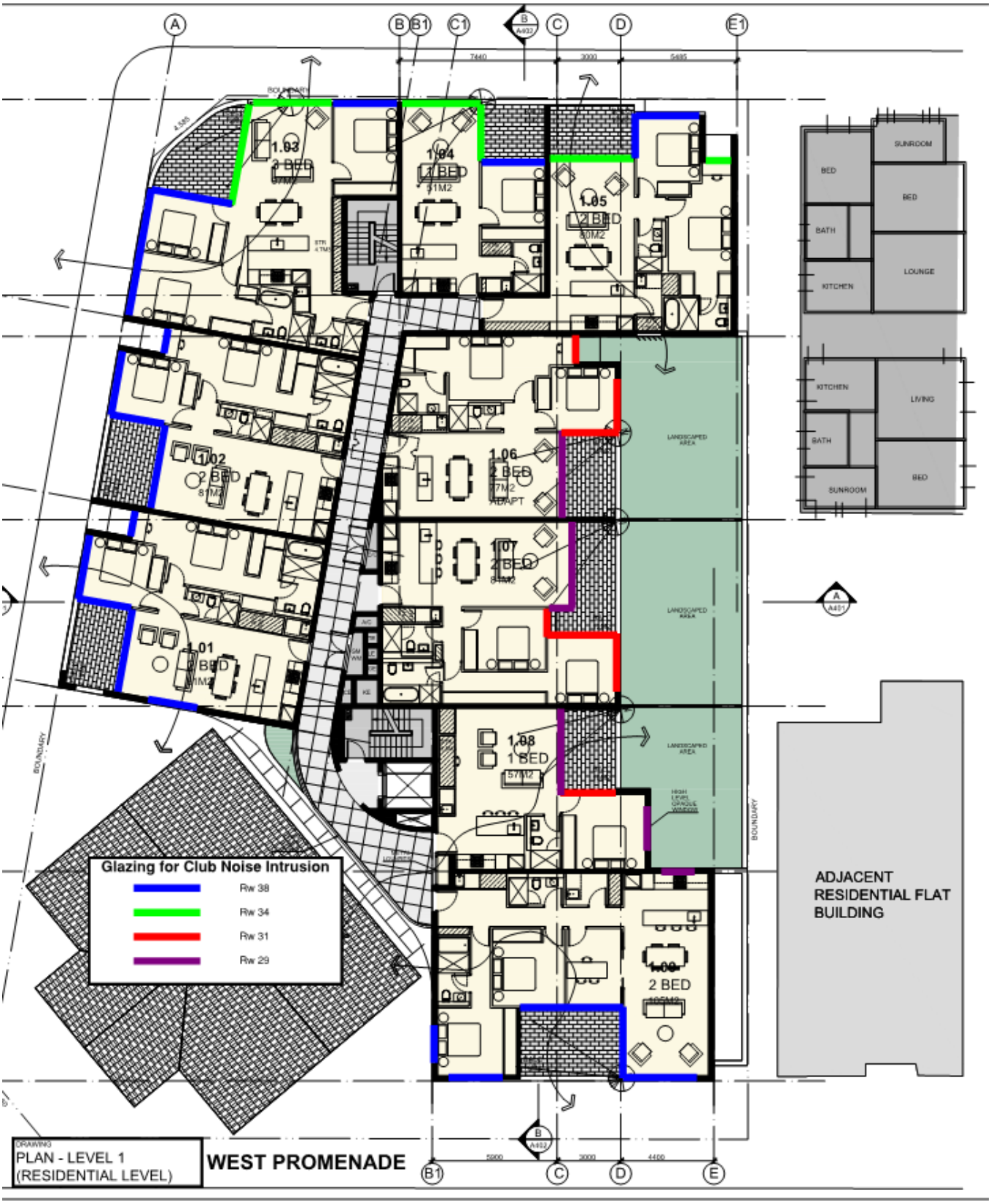
Glazing for the building has been designed to achieve internal noise levels in accordance with the recommendations outlined in AS/NZS 2107:2000.

The day, evening and night time criteria for external noise emissions are expected to be met at the surrounding sensitive receivers (shown in Figure 1) following the implementation of the proposed noise mitigation measures.

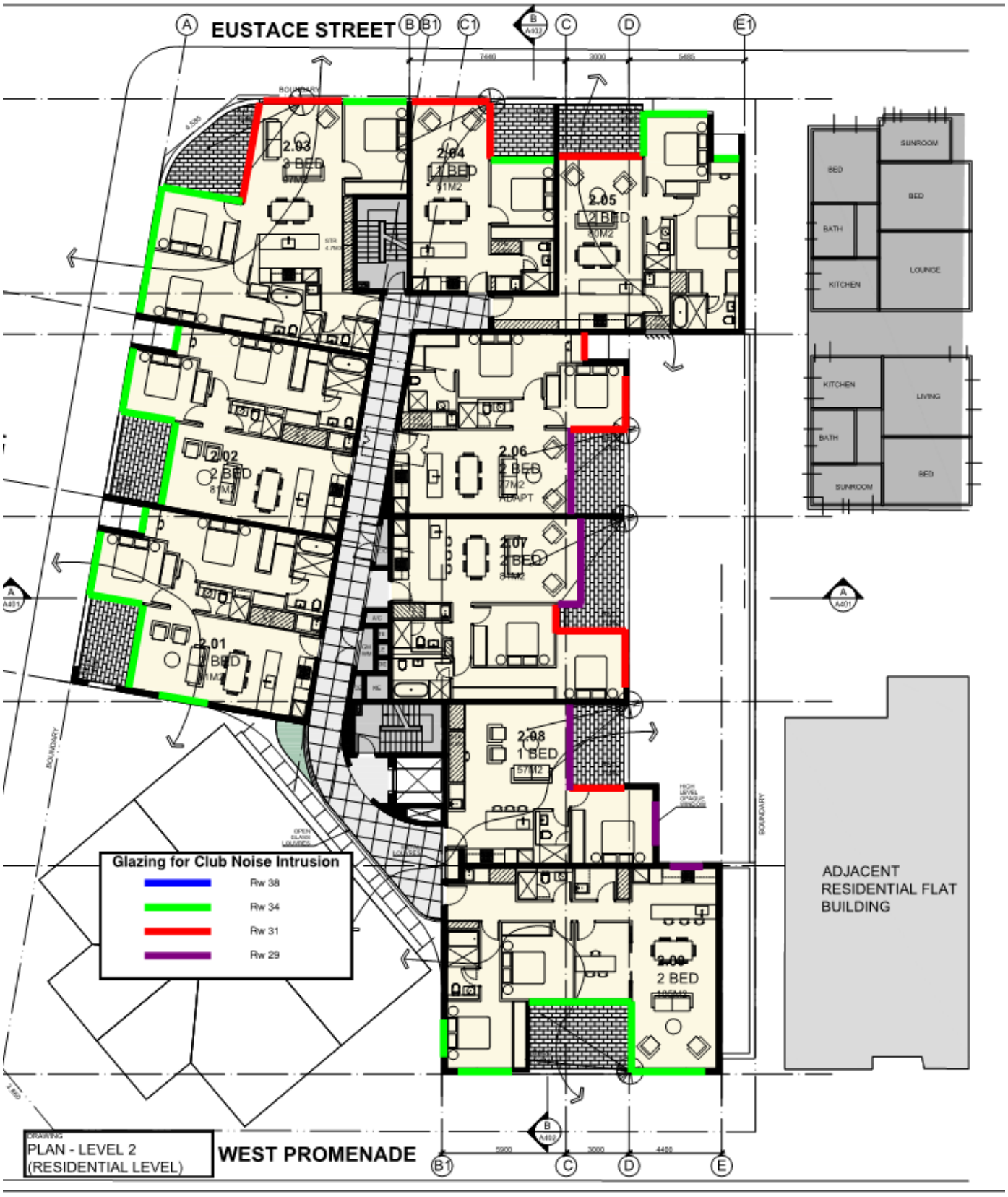
Though no assessment can be considered to have been assiduously undertaken to preclude all potential environmental impacts, having given regard to the above listed conclusions, it is the finding of this assessment that the development application should not be refused on the grounds of excessive noise generation.

The information presented in this report shall be reviewed if any modifications to the features specified in this report occur, including and not restricted to selection of air-conditioning units, layout of equipment, modifications to the building and introduction of any additional noise sources.

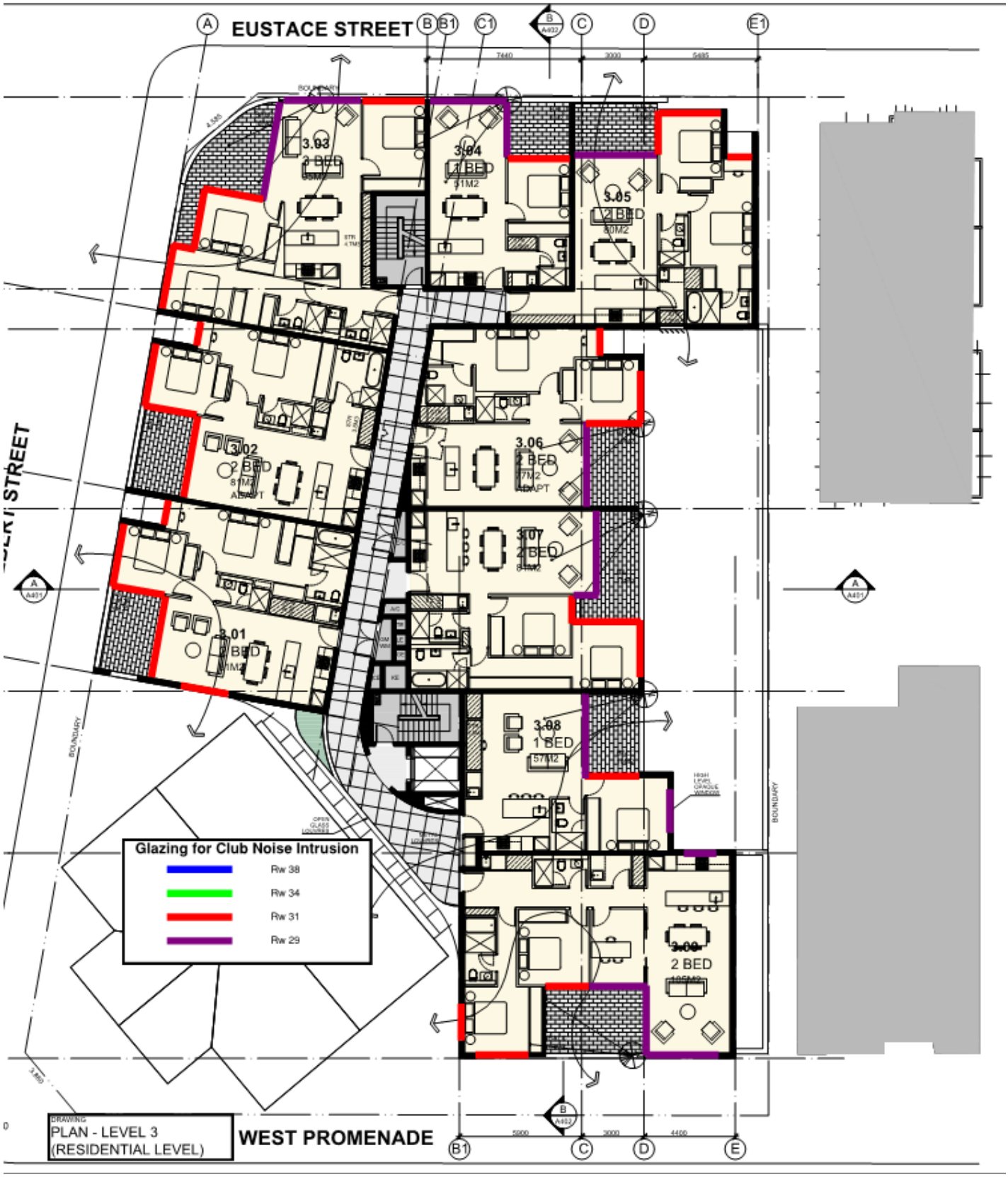
Appendix 1 – Glazing Mark-Up



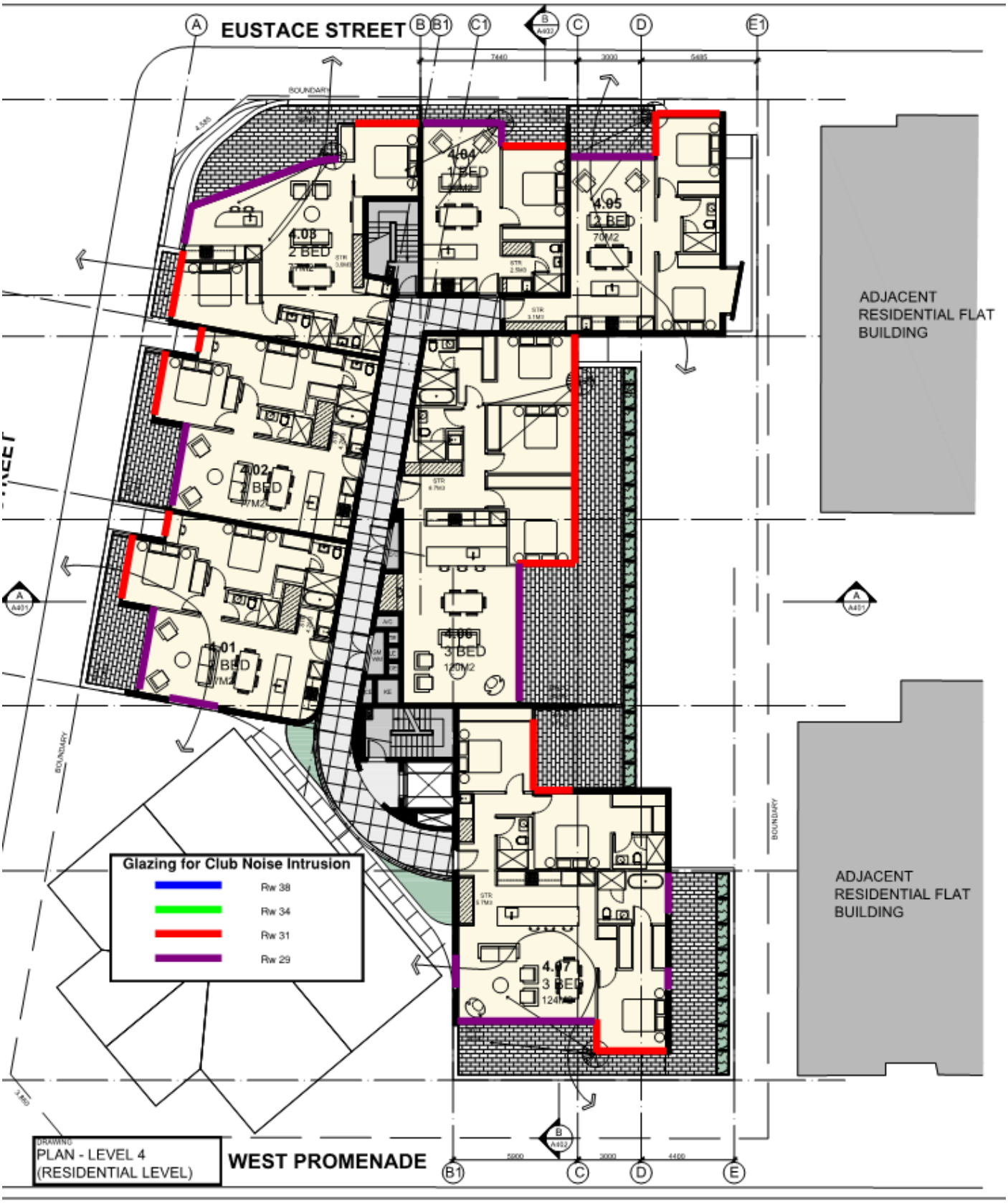
Appendix 1 Glazing Mark-Up



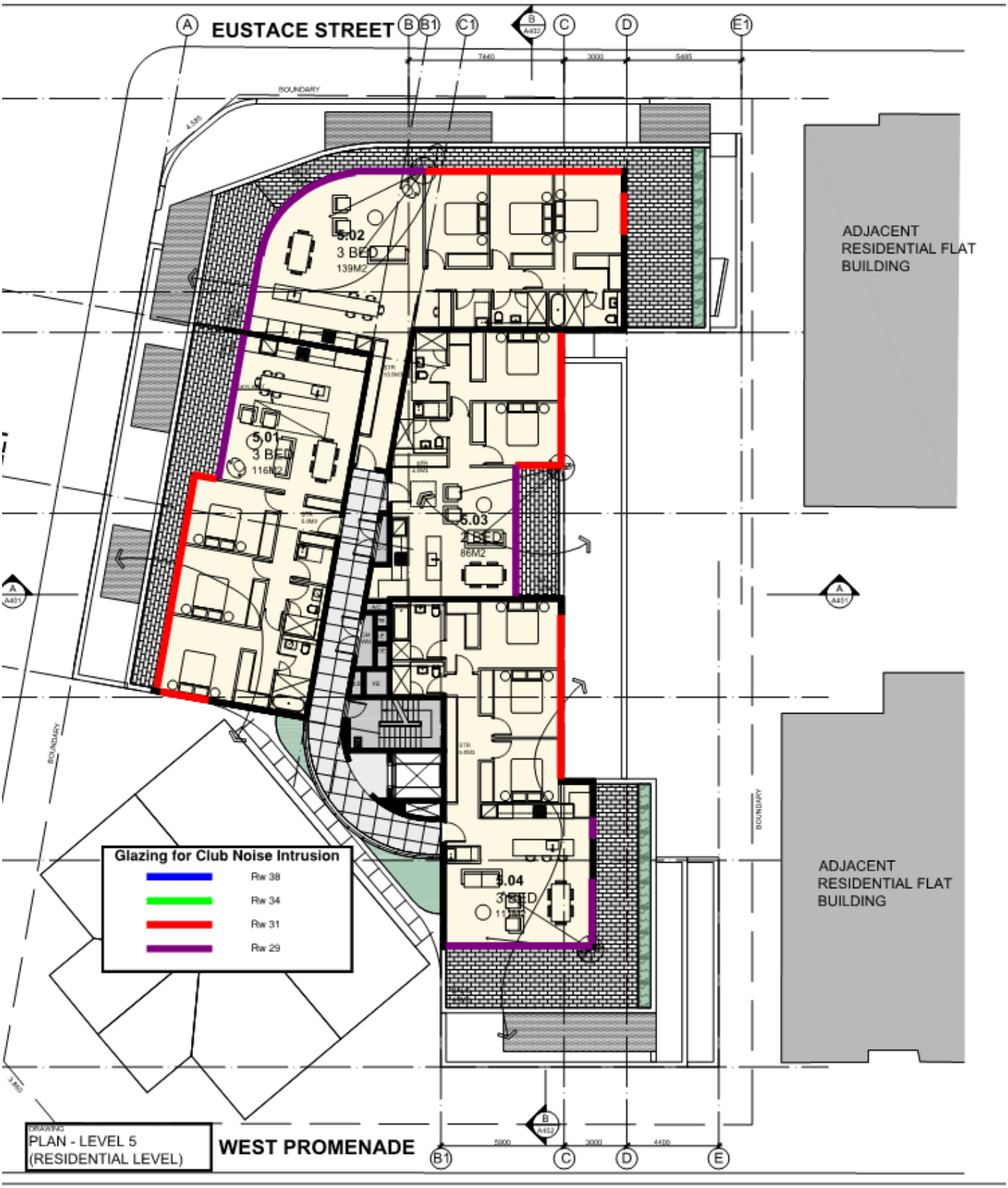
Appendix 1 Glazing Mark-Up



Appendix 1 Glazing Mark-Up



Appendix 1 Glazing Mark-Up



Appendix 1 Glazing Mark-Up

Appendix 2 - 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.

Appendix 1 Glazing Mark-Up

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.