

Lindfield Apartments

Acoustic report for Section 75w

ANKA c/- Crone Partners

05/12/2012

Revision No.2

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Revision

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Contents

1.	INTRODUCTION	2
2.	PROJECT DESCRIPTION	3
2.1	SITE DESCRIPTION	3
2.2	EXISTING AMBIENT NOISE LEVELS	4
3.	ACOUSTIC CRITERIA.....	5
3.1	PROTECTION OF THE ENVIRONMENT OPERATIONS, NOISE CONTROL REGULATION (PEO) 2008	5
3.2	KU-RING-GAI CITY COUNCIL DCP 38	5
3.3	NSW INDUSTRIAL NOISE POLICY (INP 2000)	6
4.	ACOUSTIC ASSESSMENT	9
4.1	NOISE EMISSION BY MECHANICAL SERVICES	9
5.	ACOUSTIC RECOMMENDATIONS	10
6.	CONCLUSIONS	11
7.	APPENDIX 1: GLOSSARY OF ACOUSTIC TERMS	12
8.	APPENDIX 2: MARK-UP OF PROPOSED BARRIER LOCATION	14

1. INTRODUCTION

As part of the modification to the Application for the proposed mixed use development at Lindfield Ave and Havilah Lane, Lindfield (MP08_0244), Wood & Grieve Engineers has been engaged by ANKA to provide an acoustic assessment for the Section 75 submission (S75w).

It is our understanding that the existing acoustic report conducted by Acoustic Logic covers most of the required information for planning purposes, however in the aforementioned report there is no mention to the mechanical plant noise impact.

For this reason, this assessment discusses only the potential noise impact of the proposed development on the nearest most-affected residential receivers considering the mechanical plant noise and provides the appropriate requirements in order to comply with Ku-Ring-Gai Council Development Control Plan and the NSW Office of Environment & Heritage (OE&H) Industrial Noise Policy (INP).

This report provides:

- A statement of compliance with the Ku-Ring-Gai Council DCP and NSW OEH's INP criteria for the proposed mixed-use 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 above conditions when compliance is not achieved.

This noise assessment is based on the noise data collected from a noise logger, placed on the existing premises by Acoustic Logic in the Project Application.

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. PROJECT DESCRIPTION

2.1 Site Description

The proposed development is located next to the Lindfield train station in a residential / commercial area 30m away from the North Shore railway line. The site is within the boundaries of the Ku-ring-Gai Council and it is bound by Lindfield Avenue to the west, Havilah Lane to the East and commercial receivers to the northern and southern boundaries.

The nearest potentially affected receivers have been identified as follows:

- Residential R1: Multi residential apartments at Havilah Lane.
- Residential R2: 51 Lindfield Ave.
- Commercial C1: 2 Kochia Lane
- Commercial C2: 39-47 Lindfield Ave
- Mixed use C/R: 1- 21 Lindfield Avenue
- Commercial C3: Lindfield Executive Centre.

Figure 1 provides details of the site area (in orange), and identifies the noise sensitive locations: residential in green (R1 and R2), commercial in blue (C1, C2 and C3) and mixed use (C/R) in red. Figure 2 provides details of the site location and its surroundings.

Figure 1: Aerial Photo of the Area Showing an Overview of the Site and its surroundings

Source: nearmap.com

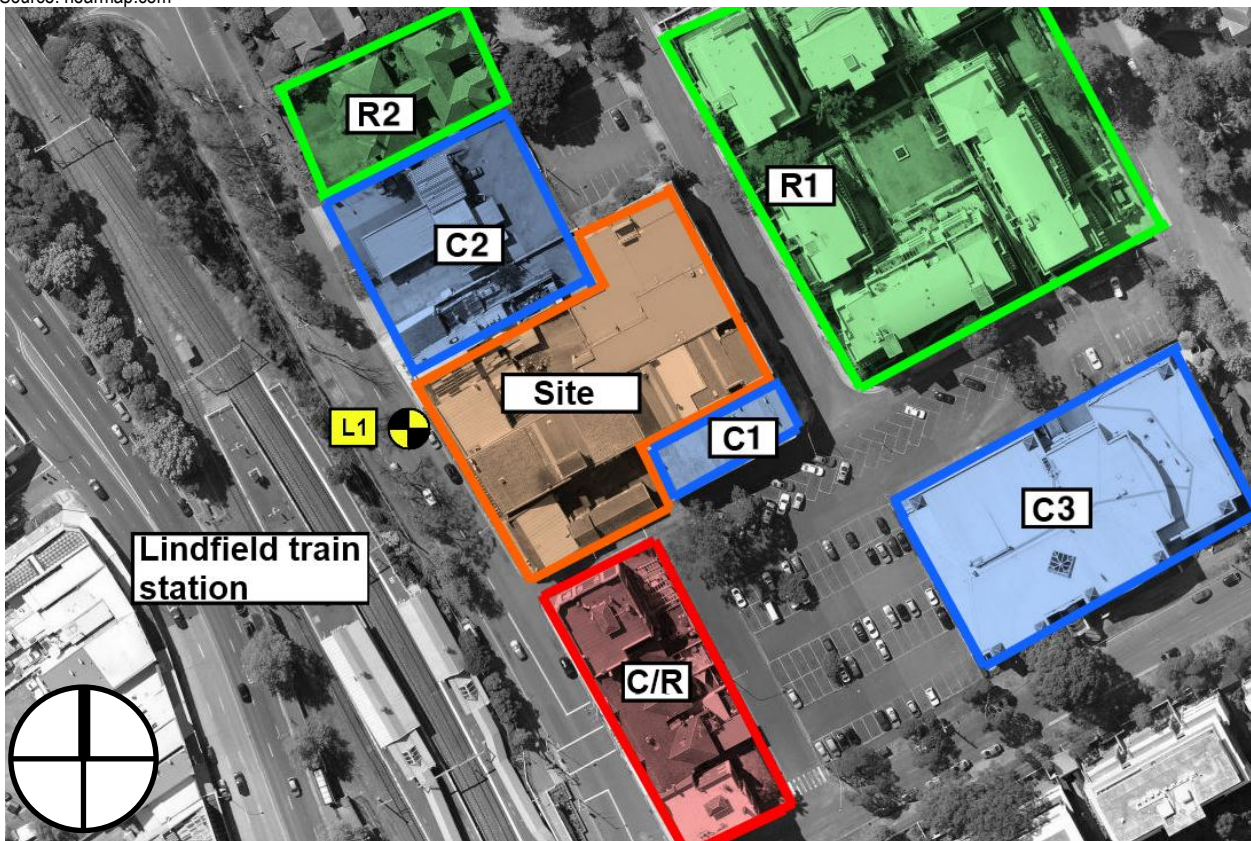
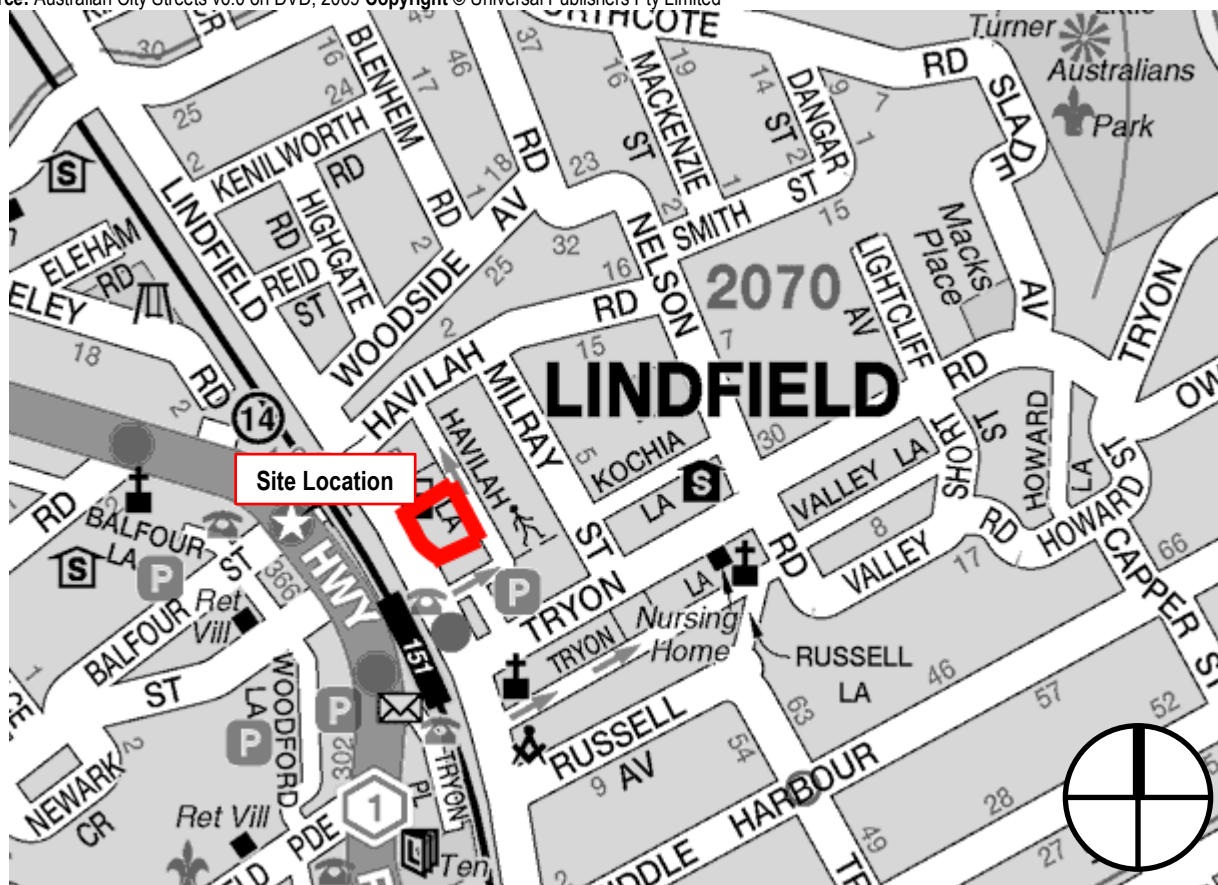


Figure 2: Site location and surrounding areas

Source: Australian City Streets v6.0 on DVD, 2009 Copyright © Universal Publishers Pty Limited



2.2 Existing Ambient Noise Levels

The local ambient noise level is dominated by traffic and railway noise and a general hum from proximity of commercial premises. The background noise level varies over the course of 24-hour period, typically low at night (from 2:00am to 7:00am) and fairly stable during the day.

The NSW OEH Industrial Noise Policy (INP) defines background and ambient noise for the daytime, evening and night time periods. The NSW OEHINP defines these 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.

Long term noise monitoring was undertaken during the day, evening and night during a 7-day period, during August 2010, to measure the background noise level of the area at one location L1 (see Figure 1).

The results from the noise logger have been used to establish the noise criteria at the boundary of the nearest premises so as to determine criteria for noise emission by the building services of the proposed development.

Table 1: Long-term Noise Survey Results – dB(A)

Values have been rounded to the nearest integer

Measurement Position (see Figure 1)	Average Noise Level L _{Aeq} - dB(A)			Rated Background Level RBL - dB(A)		
	Day (7.00am – 6.00pm)	Evening (6.00pm – 10.00pm)	Night (10.00pm – 7.00am)	Day (7.00am – 6.00pm)	Evening (6.00pm – 10.00pm)	Night (10.00pm – 7.00am)
Monitoring Location L1	59	57	52	44	42	39

3. ACOUSTIC CRITERIA

Noise from mechanical plant associated with the mixed use development has the potential to adversely impact the nearest residential receivers surrounding the site. Due to the mixed nature of the development there are several criteria that apply to each part of the development plant described in the following sections.

3.1 Protection of the Environment Operations, Noise Control Regulation (PEO) 2008

To create a level of consistency in the monitoring of noise, a set of laws have been developed within the *Protection of the Environment Operations (Noise Control) Regulation 2008* and a summary of different versions of the EPA have been used to compile the following noise criteria. These laws take into account the quantitative volume of noise, time, place and the frequency of the noise. The EPA specifies a number of noise sources that local government are responsible for administering, including:

52 Air conditioners and heat pump water heaters

(1) A person must not cause or permit an air conditioner or heat pump water heater to be used on residential premises in such a manner that it emits noise that can be heard within a habitable room in any other residential premises (regardless of whether any door or window to that room is open):

- (a) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or
- (b) before 7 am or after 10 pm on any other day.

Maximum penalty: 100 penalty units in the case of a corporation, 50 penalty units in the case of an individual.

(2) A person is not guilty of an offence under subclause (1) in relation to a heat pump water heater if the conduct alleged to give rise to the offence occurs within 6 months after the commencement of this Regulation.

(3) A person is not guilty of an offence under subclause (1) unless:

- (a) the person has, within 7 days after causing or permitting an air conditioner or heat pump water heater to be used in such a manner, been warned by an authorised officer or enforcement officer not to cause or permit the air conditioner or heat pump water heater to be used in that manner, and
- (b) the person causes or permits an air conditioner or heat pump water heater to be used in that manner within 28 days after the warning has been given.

(4) In this clause:

heat pump water heater means a device that heats water using the energy generated from the compression of a gas.

Given this criteria is effectively referring to inaudibility there is no need to assess the offensive noise as the amelioration measures will be put in place to ensure that the noise from the condenser units from the residential development achieve inaudibility.

3.2 Ku-Ring-Gai City Council DCP 38

DCP 38 from Ku-Ring-Gai Council makes the following reference to noise in the residential design manual:

Assessment Criteria

4.6.3 Out-buildings

Out-buildings (such as studios, hobby rooms, storage structures, cubby houses or cabanas) should be located on the site having regard to the relationship with existing development onsite and on adjoining properties.

Outbuildings (including garages) should be designed so as not to exceed a single storey. All outbuildings will be included in both floor space ratio calculations and built upon area calculations.

Pool motor enclosures and filters, pumps and the like should be soundproofed to ensure there is no noise reading exceeding 5dba above background noise level when measured at the nearest residential property boundary. Air conditioning enclosures are also required to ensure that noise levels do not exceed 5dBA above the background noise level when measured at the nearest residential property boundary. Any fan forced air from these units should not be directed on to plants so as to cause them stress.

Design Requirements

Consideration must be given to the position of windows associated with habitable rooms and the potential impact of noise, fumes, loss of light, and ventilation.

A minimum setback of 2 metres from boundaries is to apply for any building with a wall height exceeding 2 metres relative to the ground level at the boundary.

3.3 NSW Industrial Noise Policy (INP 2000)

3.3.1 Amenity

The NSW DECCW 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 the table in the policy which are relevant to the project are reproduced below:

Table 2: Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area (as defined in EPA INP 2. 2.1.6.)	Time of Day	Recommended L_{Aeq} Noise Level, dB(A)	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial	All	When in use	65	70

*Urban area as defined in EPA INP 2. 2.1.6.

By applying Table 2.2 of the NSW DECCW INP for modification to the acceptable noise level to account for existing levels of industrial noise, the amenity criteria are as shown in Table 3:

Table 3: EPA INP Amenity Criteria

Period		Amenity Criteria for Residential Locations	Commercial
Daytime 7am – 6pm	$L_{Aeq, Day}$	54	65
Evening 6pm – 10pm	$L_{Aeq, Evening}$	47	65
Night 10pm – 7am	$L_{Aeq, Night}$	42	n/a ¹

3.3.2 ‘Modifying Factor’ Adjustments

The NSW DECCW INP also states:

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

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

Table 4.1 of Chapter 4 of the NSW DECCW INP (see Table 4 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

¹ It is assumed the commercial premises will not be operative during night time periods.

Table 4: Table 4.1 NSW DECCW INP – Modifying Factor Corrections

Factor	Assessment / Measurement	When to Apply	Correction ²	Comments
Tonal Noise ³	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: - 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz - 8 dB or more if the centre frequency band containing the tone is 160 to 400 Hz inclusive - 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz	5 dB	Narrow-band frequency analysis may be required to precisely detect occurrence.
Low Frequency Noise ²	Measurement of C-weighted and A-weighted level	Measure / assesses C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more	5 dB	C-weighting is designed to be more responsive to low-frequency noise, especially at higher overall levels
Impulsive Noise ⁴	A-weighted fast response and impulsive response	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction, up to a maximum of 5 dB.	Characterised by a short rise time of 35 milliseconds (ms) and decay time of 1.5 s.
Intermittent Noise	Subjectively assessed	Level varies by more than 5 dB	5 dB	Adjustment to be applied for night-time only .
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	On event in any 24-hour period	0 to – 20 dB(A)	The acceptable noise level may be increased by an adjustment depending on duration of noise.
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A) ⁱⁱ (excluding duration correction)	

From our preliminary review of the current noise data, it is expected no modifying factors will be required.

3.3.3 Intrusiveness

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 L_{Aeq} 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 follows:

$$L_{Aeq, 15 \text{ minute}} \leq \text{RBL background noise level plus } 5 \text{ dB(A)}$$

² Corrections to be added to the measured or predicted levels.

³ Where a source emits tonal and low-frequency noise a 5 dB correction should be applied if the tone is in the low-frequency range.

⁴ At this point of the process noise emissions from the mechanical plants operations have not been determined. Therefore there is no particular consideration given to potential tonal or impulsive character for the emitted noise. Therefore no penalty has been applied to the noise sources associated with the proposed development.

The intrusiveness criterion for the closest residential receivers is presented in Table 5 below. Note the intrusiveness criteria is only applicable to the residential receivers.

Table 5: EPA INP Intrusiveness Criteria

Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
Daytime 7am – 6pm	$L_{Aeq,15min} \leq L_{90,15min} + 5$	49
Evening 6pm – 10pm	$L_{Aeq,15min} \leq L_{90,15min} + 5$	47
Night 10pm – 7am	$L_{Aeq,15min} \leq L_{90,15min} + 5$	44

3.3.4 Project Specific Noise Level (PSNL)

Table 6 below displays the project-specific noise levels PSNL for the project, i.e. the noise criteria that has to be met in function of the type of receiver. In the case of the EPA INP intrusiveness and amenity criteria, the lowest of the two has to be chosen as the PSNL. Note this PSNL is applicable to all receivers within the development as well as the residential receivers that are not part of the site (e.g. R1, R2 from Figure 1). In addition we should also mention that the PEO 2008 has a specific criterion just for air-conditioning units applicable only at night that conflicts with the Ku-Ring-Gai DCP 38. In this regard, we can confirm that both criteria will be met if the amelioration measures in Section 5 are applied.

Table 6: Project Specific Noise Levels L_{Aeq} from Industrial Noise Sources

Period	Descriptor	PSNL dB(A)
Residential Areas (R1, R2) + Mixed use (C/R)		
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	49
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	47
Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	42
Commercial Areas (C1,C2, C3)		
Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	65
Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	65
Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	n/a

The most stringent noise criterion to meet at the boundary of the nearest residential residence is the night time criterion of 42 dB(A). Given the commercial areas have a significant higher noise criteria, it is assumed that the noise criteria, if met at residential receivers will be also met at the commercial receivers.

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. Proposed plant associated with the residential site includes an outdoor air conditioning unit. Relating to noise emission from the air conditioning unit, the following in-principal recommendations are provided:

- Implementation of noise control for mechanical services equipment may need to be undertaken ensure that they shall not emit noise levels which exceed the noise limits presented in Table 7. As noise control can affect the performance of the mechanical services system, it is recommended that consultation with a mechanical services consultant be made during the initial stage of the design in order to reduce the need for plant re-selection;
- Mechanical plant noise emission can be managed by appropriate noise control system design and implementation of common engineering methods that may include any of the following:
 - Procurement of 'quiet' plant,
 - Strategic positioning of plant away from sensitive neighboring premises, maximizing the intervening shielding between the plant and sensitive neighboring premises,
 - Commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
 - Acoustically lined and lagged ductwork;
 - Acoustic screens and barriers between plant and sensitive neighboring premises; and/or
 - Partially-enclosed or fully-enclosed acoustic enclosures over plant.
- Mechanical plant shall have their noise specifications and their proposed locations checked prior to their installation on site; and
- Fans shall be mounted on vibration isolators and balances in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery – Mechanical Vibration".

4. ACOUSTIC ASSESSMENT

4.1 Noise Emission by Mechanical Services

The noise sources associated with the mixed use development, including the expected noise levels are given below in the ensuing sub-sections. There are two main types of noise sources:

1. Air-conditioning equipment (outdoor equipment) servicing the apartments, and
2. Plant associated with the retail areas including exhaust fans, condenser units, supply fans etc.

All these noise sources have been used to predict the worst case scenario noise impact of the proposed air conditioner installation to nearby residential properties.

4.1.1 Noise Sources

The typical noise data (Sound Power Levels) of the proposed units is presented in Table 7

Table 7: Sound Power Levels of Mechanical Plant (dB re 1pW)

Item Code	Manufacturer (Model No)	Octave Band Centre Frequency (Hz)								Overall dB(A)
		63	125	250	500	1000	2000	4000	8000	
Condenser Unit for Residential	3 x REYQ14PY1	73	71	70	66	64	61	52	51	70
	3 x REYQ16PY1	74	71	71	67	66	61	53	51	71
Residential A/C units	144 x AOT045L	67	65	63	66	60	53	51	45	66
Supermarket Package unit	1 x Airchange	58	68	71	80	77	78	79	69	85
Kitchen Exhaust	7 x Fantech CHD716	92	93	88	78	76	74	72	72	84
Car-park Exhaust	1 x Fantech AP1406DP9/23	97	100	95	97	94	93	89	80	100
Car-park Supply	1 x Fantech AP1004CA9/23	97	94	94	93	91	90	86	82	97

4.1.2 Predicted Noise Levels

The noise associated with the mechanical plant, which is to be installed on the roof and lower ground levels was assessed. A noise desktop analysis was conducted taking into consideration the geometric divergence, the plant and building screening effect, the atmospheric conditions, the air attenuation, etc. The results of the analysis are summarised below in Table 8 for the nearest affected residences as shown in Figure 1.

Table 8: Predicted Noise Levels and Associated Criteria

Noise Sensitive Locations	Period	Criteria (dBA)	Predicted Noise Levels – dB(A)
Residential 1	Day	49	38
	Evening	47	38
	Night	42	38
Residential 2	Day	49	37
	Evening	47	37
	Night	42	37
Commercial / Residential (C/R)	Day	49	40
	Evening	47	40
	Night	42	40
Commercial C1	When in use	65	44
Commercial C2	When in use	65	41
Commercial C3	When in use	65	35

To achieve predicted noise levels as shown in Table 8, it is recommended that acoustic barriers be implemented around the mechanical plant on the roof of Building B.

5. ACOUSTIC RECOMMENDATIONS

It is required to install two acoustic barriers in the roof of Building B in order to achieve compliance with the relevant criteria as per Figure 3. The barrier containing the retail condenser units requires a minimum height of 2 metres; this is to ensure that the direct line of sight from the units to the apartments in Building A is eliminated. Due to the low height of the exhaust fans the other acoustic barrier could have a minimum height of 1.2m.

Both barriers should possess a minimum surface density of 16kg/m^2 and transmission loss values as described in Table 9. The presented values are characteristic of the barriers listed below nevertheless any other product with comparable or better performance could be used.

The acoustic barriers should be continuous and solid over the length and height specified. Any holes and gaps would compromise the barriers performance therefore should be avoided. If for aesthetic reasons alternative barrier material finishes are chosen, these should be installed on the outside of the acoustic barrier.

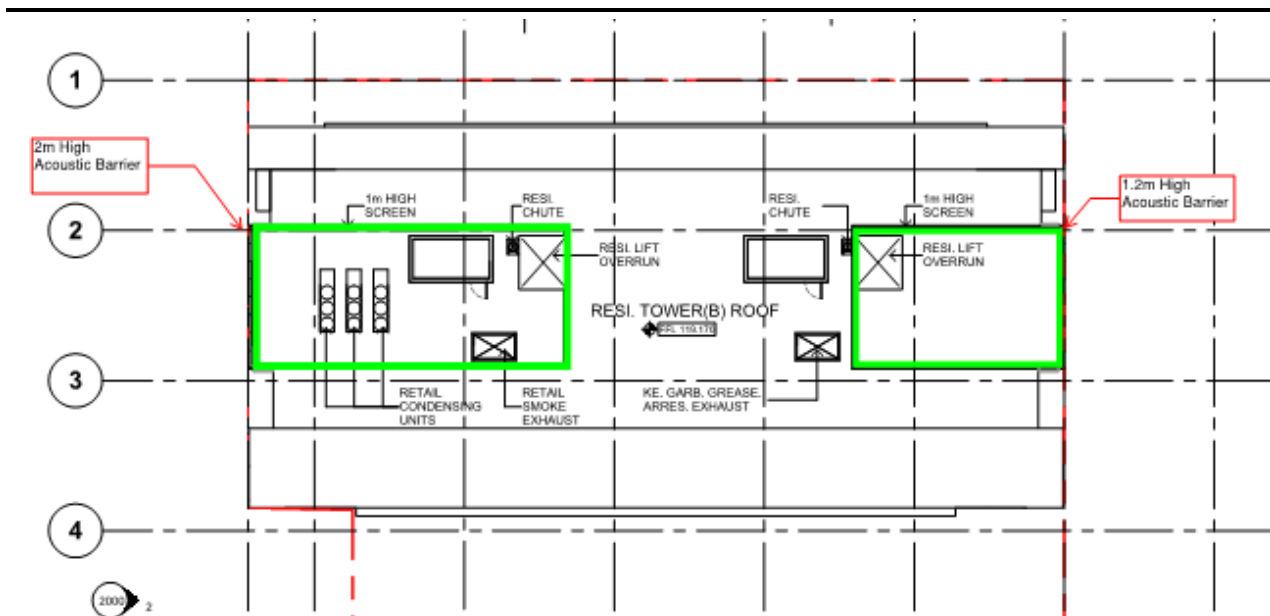
It is recommended that the structural engineer provides additional input on the feasibility of the proposed acoustic solutions.

Table 9: Barrier Construction and Associated Transmission Loss (dB)

Barrier Type	Octave band centred frequencies							
	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz
9mm thick Compressed fiber cement	17	21	26	31	35	36	34	35
Wallmark Evo Panel (Polystyrene + CFC) (75mm thickness; 16kg/m^2 surface density)	18	22	23	27	18	45	52	41

Figure 3 shows the proposed locations of the acoustic barriers for Building B. For a more detailed view, refer to Appendix 2.

Figure 3: Roof Level Acoustic Barrier Locations



6. CONCLUSIONS

As part of the modification to the Application for the proposed mixed use development at Lindfield Ave and Havilah Lane, Lindfield (MP08_0244), Wood & Grieve Engineers has been engaged by ANKA to provide an acoustic assessment for the Section 75 submission (S75w).

An assessment of noise emanating from mechanical plant for the proposed development has been conducted. This report has provides criteria, in-principle treatment and design requirements which aim to achieve the desired criteria based on the INP and Ku-Ring-Gai DCP.

The predicted noise levels presented in this report show that the day, evening and night criteria would be met with the implementation of the proposed mitigation measures for external mechanical plant as detailed in Section 5.

Even though no assessment can be considered as being thorough enough to preclude all potential environmental impacts, having given regard to the above listed conclusions, it is the finding of this assessment that the noise generated by the proposed air-conditioning unit meets the development application conditions.

The information presented in this report shall be reviewed if any modifications to the features of the development 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.

7. Appendix 1: Glossary of Acoustic Terms

Noise

Acceptable Noise Level:	The acceptable L_{Aeq} 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 L_{90} noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
L_{Amax}	The maximum A-weighted sound pressure level measured over a period.
L_{Amin}	The minimum A-weighted sound pressure level measured over a period.
L_{A1}	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.

L_{A10}	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
L_{A90}	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L ₉₀ noise level expressed in units of dB(A).
L_{Aeq}	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
L_{AeqT}	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 L _{eq} 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.

