Crown Prosha Joint Venture

Eastlakes Shopping Centre Redevelopment

Acoustic Impact Assessment for Part 3A Project Application

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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd. (VIPAC) has been commissioned by Crown Prosha Joint Venture to assess the acoustic interaction of the proposed mixed use development at Gardeners Road, Eastlakes with the surrounding environment. The development will consist of a shopping centre and residential apartments.

An acoustic assessment of the proposed development has been carried out in accordance with the relevant noise policies and Australian Standards as detailed in Section 5.

The assessment is summarised as follows.

- Noise levels of aircraft at the proposed site have been assessed using the predicted levels based on AS 2021: 2000.
- The ingress of aircraft and traffic noise through the various building elements, glass windows, roof/ceiling and external wall is to be controlled using the specifications detailed in Section 5.3.1 of this report.
- Based on monitoring results and the use of NSW Industrial noise policy the noise limits for the control of plant noise has been assessed. Mechanical plant noise should be limited by the set noise limits. (see Section 4.3 and Table 8).
- Limits of construction noise have been provided based on NSW OEH Interim Construction Noise Guidelines (see Section 3.4.4)
- Noise impact from the generated traffic has been assessed and was found to comply with OEH Road Noise Policy criterion. (See Section 5.2.4)

In conclusion, the proposed mixed use development should meet all the relevant criteria specified in this report provided that the given recommendations are implemented.

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1 INTRODUCTION

Vipac Engineers & Scientists Ltd. (VIPAC) has been commissioned by Crown Prosha Joint Venture to assess the acoustic interaction of the proposed mixed use development at Gardeners Road, Eastlakes with the surrounding environment.

2 SITE & DEVELOPMENT DETAILS

The site is currently occupied by the Eastlakes shopping centre. The site is bound by Gardeners Road to the north, Barber Avenue to the east and south, Eastlakes reserve to the west. Part of the east and west boundaries at the north end adjoin residential properties. Evans Avenue runs through the site in an east-west direction. The site location is detailed in Figure 1 below.

Figure 1: Site Location and Noise Monitoring Positions

The proposed development will comprise of:

- A shopping mall consisting of commercial spaces and amenities on ground level.
- 443 residential units and serviced apartments above the retail/commercial level.
- Two levels of basement parking.
- Two swimming pools located within the internal residential common areas.

The nature of the development and existing site surroundings have been considered to determine the acoustic issues and likely sources of noise that may impact the development and also site generated noise that has potential to impact on existing noise sensitive receivers. These are summarised below:

- Demolition, construction noise & vibration impacts
- Aircraft noise intrusion
- Traffic noise intrusion into residential living areas
- Noise from mechanical services
- Noise from site generated traffic
- Noise transfer from commercial to residential areas
- Noise from use of swimming pool
- Noise from delivery trucks
- Structural noise & vibration transfer from the loading docks activities (inc compactors, trolley movements, pallet and stock handling) to the apartments above

Each item has been considered in the assessment.

3 NOISE CRITERIA

The following standards and guidelines are applicable to this project:

- NSW Department of Planning Director General Requirements.
- Botany Bay Council DCP.
- NSW Department of Planning (DoP) Development Near Rail Corridors and Busy Roads– Interim Guideline.
- Australian standard AS/NZS 2021-2000: Acoustics – Aircraft noise intrusion – Building siting and construction.
- Australian standard AS/NZS 2107-2000: Acoustics – Recommended design sound levels and reverberation times for building interiors.
- NSW OEH Industrial Noise Policy.

- Australian standard AS 1055.1-1997: Acoustics - Description and measurement of environmental noise - General procedures.

The above criteria and policies seek to either protect the amenity of existing noise sensitive receivers, requirements of each are summarised as follows:

3.1 ACOUSTIC AMENITY CRITERIA

Recommended design sound level for the internal spaces is contained in several policies including the local council DCP. They are summarised as follows:

3.1.1 NSW Department of Planning Director General Requirements

The Director General requires that due to the close proximity of the proposal to Gardeners Road, aircraft noise and the interface between retail/residential, future residential amenity will be a key issue in the assessment of the application. As such the environmental assessment is required to address the issues of acoustic privacy and construction impacts.

An acoustic assessment is also required due to the proximity to Sydney Airport to ensure suitable residential amenity.

3.1.2 Botany Bay Council

Botany Bay Council DCP 35 has been referred to for the purpose of considering the acoustic privacy of the residential apartments though it does not apply to the subject site. Part 3.3.10 of Botany Bay Council DCP 35 on multi unit housing and residential flat buildings, acoustic privacy states the following:

- Developments which are located adjacent to a main road should provide compliance with Australian standards AS3671 and AS 2107.

- Areas affected by aircraft noise shall take into consideration the guidelines provided in the Australian Standard AS 2021-2000: Acoustics – Aircraft noise intrusion – Building siting and construction.

The document also provides the following advisory notes on acoustic privacy. The buildings shall be designed and constructed taking into account the requirement for effective sound insulation against external road traffic noise in accordance with the following design criteria:

- The $L_{Aeq,1hr}$ noise level in sleeping and living areas shall be less than 40 dBA with the doors and windows closed.

- The $L_{Aeq,1hr}$ noise level in sleeping and living areas shall be less than 50 dBA with the doors and windows normally open.

- The above requirement may be equally satisfied by the alternative provision of either a mechanical or natural ventilation system of a special acoustic design solution to be approved by the council.

3.1.3 AS/NZS 2107–2000

AS/NZS 2107–2000 outlines the acceptable internal noise levels such that a satisfactory acoustic environment within occupied spaces in new and existing buildings can be achieved. Typically, the recommended internal noise level L_{Aeq} for fully furnished spaces should meet the criteria presented below.

Table 1: AS/NZS 2107:2000 - Recommended Design Sound Levels for building interiors

Type of occupancy/activity	Recommended design sound level L_{eq} dB(A)	
	Satisfactory	Maximum
Houses and apartments near major road		
Living areas	35	45
Sleeping areas	30	40
Work areas	35	45
Apartment common areas	45	55
Commercial & shop buildings		
General office area	40	45
Small retail stores (general)	45	50
Public spaces (eg speciality shops)	40	45
Undercover carparks	55	65

3.1.4 NSW DoP Developments Near Rail Corridors and Busy Roads – Interim Guideline

The DoP Interim Guideline provides internal noise level criteria for residential buildings near rail corridors or busy roads, which are detailed in Table 2 below.

Table 2: DoP Development Near Rail Corridors and Busy Roads – Noise Criteria

Type of occupancy/activity	Noise Level	Applicable time Period
Residential Buildings		
Sleeping areas (bedroom)	35 dBA	10 pm – 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40 dBA	At any time

In addition to the table above, the DoP guideline states the following:

"If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also meet the ventilation requirements of the Building Code of Australia."

3.2 AS 2021 AIRCRAFT NOISE INTRUSION

For aircraft noise intrusion, the development will be required to comply with Australian Standard AS2021-2000 – Acoustics-Aircraft Noise Intrusion-Building Siting and Construction. The maximum internal noise levels (L_{Amax}) during aircraft fly-overs must meet the criteria presented in Table 3 below.

Table 3: Indoor Design Sound Levels for Determination of Aircraft Noise Reduction (Based on Table 3.3 of AS2021-2000)

Building type and activity	Indoor Design Sound Level dB(A)
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable areas	55
Bathrooms, toilets, laundries	60
Commercial building, office and shops	
Private offices, conference rooms	55
Shops, supermarkets, showrooms	75

3.3 SOUND INSULATION PROVISIONS BETWEEN PREMISES

NCC (formerly BCA) deemed to satisfy sound insulation requirements for intertenancy wall of Volume 1 for Class 2 building are summarised in the following Table 4. A waste pipe or other penetration that is embedded in or passes through a floor, serves or passes through more than one apartment must be separated from the rooms of any sole-occupancy unit by construction of a partition with the R_{w+} Ctr ratings is also specified in Table 4.

Table 4: Part F5 of NCC Acoustic Requirements

SEPARATING PARTITIONS	Minimum NCC Requirement
WALLS AND FLOORS	
Walls between sole occupancy	Rw + Ctr 50
Walls between apartments and stairway, public corridors, public lobby or the like	Rw 50
Walls between wet areas (bathrooms, sanitary compartment, laundry or kitchen) and a habitable room (other than kitchen) in adjoining apartments	Rw + Ctr 50 & of discontinuous construction
Walls between a plant room or lift shaft and a sole occupancy unit	Rw 50 & of discontinuous construction
Doors assemblies located in a wall between an apartment and a stairway, public corridor, public lobby or the like	Rw 30
Floors between sole occupancy units or between a sole occupancy unit and plant room, lift shaft, stairway, public corridor, public lobby or the like.	Rw + Ctr 50 & Ln,w + Cl < 62

SEPARATING PARTITIONS	Minimum NCC Requirement
DOORS	
Door assemblies located in a wall between an apartment and a stairway, public corridor, public lobby or the like.	Rw 30
SERVICES	
(a) a duct, soil, waste or water supply pipe including a duct or pipe that is located in a wall or floor cavity serves or passes through more than one sole occupancy unit	
(i) if the adjacent room is a habitable room (other than a kitchen); or	Rw + Ctr 40
(ii) if the room is a non-habitable room	Rw + Ctr 25
(b) a storm water pipe passes through a sole occupancy unit	
(i) if the adjacent room is a habitable room (other than a kitchen); or	Rw + Ctr 40
(ii) if the room is a non-habitable room	Rw + Ctr 25

Note, according to the NCC requirements:

1. For the purpose of complying with the NCC 2011 sound insulation requirements, the R_w + C_{tr} must be determined in accordance with AS/NZS 1276.1 or ISO 717.1, using results from laboratory measurements.

2. Discontinuous construction means a wall system having a minimum 20mm cavity between two separate leaves with:

- for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and
- for other than masonry, there is no mechanical linkage between leaves except at the periphery.
- A staggered stud wall, which has a common top and bottom plate, is not considered to be discontinuous.

3. A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating pump or other pump.

Refer to glossary of acoustic terminology in Appendix B for definitions of the sound insulation ratings.

3.4 SITE NOISE EMISSION CRITERIA

3.4.1 NSW Department of Planning Director General Requirements

The Director General requires that due to the interface between retail/residential units, future residential amenity will be a key issue in the assessment of the application. As such

the environmental assessment is required to address the issues of acoustic privacy and construction noise impacts.

3.4.2 NSW OEH Industrial Noise Policy

Site generated noise such as mechanical plant and other building services will be assessed against the requirements of the NSW Industrial Noise Policy. The procedures detailed in the INP have been considered to determine the limit of allowable noise emissions. The assessment procedure has two requirements that must be met, namely:

- that the noise source not be 'intrusive'; and also
- that the 'amenity' of the nearby land be preserved.

This policy sets out two separate noise criteria designed to ensure developments meet environmental noise objectives. The first criterion accounts for intrusive noise and the second criterion applies to protection of amenity of particular land uses. Applying both the amenity and intrusiveness criteria to the situation and adopting the more stringent of the two is used to assess the new development. This becomes the project specific noise levels. Applying the most stringent requirement as the project specific noise levels ensures that both intrusive noise is limited and the amenity is protected.

3.4.3 NSW OEH Road Noise Policy

Noise from traffic movements to and from the site including truck and car movements will be assessed using the NSW OEH Road Noise Policy (RNP). There are three car park entry points. Entry 01 is the principle entry point and is located at the junction of Evans Avenue and Racecourse Place. Car Park 02 is accessed from Barber Avenue. There is a separate loading dock entry and exit located along Barber Avenue, east of the roundabout intersecting with St Helena Parade. Both Barber Avenue and Evans Avenue are classified as local roads.

Table 5 presents the OEH's road traffic noise assessment criteria for land use developments with potential to create additional traffic on existing roads. The external criteria are assessed at 1 metre from the affected residential building façades and at a height of 1.5 metres from the floor.

Table 5: Road Traffic Noise Assessment Criteria for Residential Land Use.

Road category	Type of project/land use	Assessment criteria, dBA	
		Day :7am to 10 pm	Night :10 pm to 7 am
Local Roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{eq\ (1\ hr)}$ 55 (External)	$L_{eq\ (1\ hr)}$ 50 (External)

Note: In cases where noise exceeds the above criteria:

1. The OEH recommends that "where feasible, existing noise levels should be mitigated to meet the noise criteria. In this regard the RNP states that for existing roads there is limited potential for noise control as the development is not linked to road improvements. It does however advise that applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments."
2. For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

In addition to above assessment criteria, the RNP requires any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development to be considered. The relative increase criteria outlined in the RNP is presented in Table 6.

Table 6: Relative Increase Criteria for Residential Land Use.

Road Category	Type of project / land use	Total traffic noise level increase, dB(A)	
		Day (7am - 10pm)	Night (10pm-7am)
Freeway/ arterial/ sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{Aeq, (15\ hour)}$ + 12dB (external)	Existing traffic $L_{Aeq, (9\ hour)}$ + 12dB (external)

3.4.4 NSW Guidelines for Construction Noise

Construction noise will need to be controlled in accordance with the Interim Construction Noise Guideline developed by the NSW OEH.

The Guideline presents two ways of assessing construction noise impacts – the quantitative method, which is generally suited to longer-term construction, and the qualitative method, which is generally suited to short-term works such as infrastructure maintenance. Using a quantitative as described in the guideline the noise criteria as presented in Table 7 would be adopted.

Table 7: Noise at Residences Using Quantitative Assessment

Time of day	Management level, LAeq(15min)	How to apply
Recommended standard hours Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays and Public Holidays	Noise affected RBL+10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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 hours	Noise affected RBL+10dB	• 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. of guideline.

3.4.1 Botany Council Standard Noise Criteria 2001

Botany Bay Council Noise Criteria has been referred to for the purpose of reviewing site noise emission goals.

The Botany Council Standard Criteria sets the minimum acoustical requirements that any proposed development or activity must achieve as a minimum to ensure that a suitable acoustical amenity is provided.

(a) The operation of all plant and equipment shall not give rise to an equivalent continuous (L_{Aeq}) sound pressure level at any point on any residential property greater than 5 dB(A) above the existing background LA90 level (in the absence of the noise under consideration).

(b) The operation of all plant equipment when assessed on any residential property shall not give rise to a sound pressure level that exceeds L_{Aeq} 50 dB(A) day time and L_{Aeq} 40 dB(A) night time.

(c) The operation of all plant and equipment when assessed on any neighbouring commercial/industrial premises shall not give rise to a sound pressure level that exceeds L_{Aeq} 65 dB(A) day time/night time.

For assessment purposes, the above L_{Aeq} sound levels shall be assessed over a period of 10 – 15 minutes and adjusted in accordance with EPA guidelines for tonality, frequency weighting, impulsive characteristics, fluctuations and temporal content where necessary.

The above requirements are similar in nature to the requirements of the Industrial Noise Policy. Therefore to avoid duplication the Industrial Noise Policy will be the primary policy that determines noise emission goals for plant and equipment.

4 SITE ENVIRONMENTAL NOISE CLIMATE

4.1 METHODOLOGY

Noise monitoring was conducted at the proposed development site between the 21st and 27th February 2012. Measurement positions are shown in Figure 1.

At measurement positions 1 and 2 an unattended noise logger was left on site for approximately a 6 day period. Measurement Position 1 was selected to obtain ambient and background noise data representative of sensitive receivers located to the north-west, north and north east of the site. Measurement Position 2 was selected to obtain the same information for sensitive receivers located to the south west, south and south east.

A monitor was also placed on Gardeners Road boundary (Position 3) for a period of 24 hours to measure traffic noise. Road traffic measurements results and data from the traffic consultant's report have been used to prepare a road traffic noise model for the site.

Attended noise measurements were also taken for aircraft noise at the site.

The noise loggers internal software calculated and stored the L_n percentile noise levels for each 15 minute sampling period. Measurements were made of L_{Amin}, L_{Amax}, L_{A90}, L_{A10}, and L_{Aeq}, the results were stored in an internal memory and were later retrieved for detailed analysis.

All measurements conducted were in general accordance with the Australian standard AS1055.

4.2 INSTRUMENTATION

Measurements were conducted using the following equipment:

- Larson Davis Integrating Sound Level Analyser Model LD812, Serial Number 0385.
- Larson Davis Integrating Sound Level Analyser Model LD812, Serial Number 0381.
- Bruel & Kjaer Sound Level Meter Model 2250, Serial Number 2590541.
- Larson Davis Sound Level Calibrator Model CA250, Serial Number 0665.

The instruments were checked for calibration immediately before and after the measurements and there was no adverse deviation between the two. The instruments carry traceable calibration certificates.

The sound analysers are Type 1 and comply with the Australian standard AS1259.2: 1990.

4.3 AMBIENT NOISE LEVELS AND NOISE GOALS

Table 8 presents a summary of ambient noise measurements at the site and associated noise goals which have been determined using the procedures in the OEH Industrial Noise Policy. Values have been rounded to the nearest dB.

Table 8: Measurement Results and Noise Goals

All Values in dBA

Location/Type	Period	Existing Noise levels dBA		ANL[1]	Operational noise goals (dBA)		
		LAeq	RBL		Amenity $L_{Aeq(period)}$	Intrusiveness $L_{Aeq(15min)}$	INP Project Specific Level
North, East and Western Boundary / Residential	Day	60	49	60	60	54	54
	Evening	59	49	50	50	54	50
	Night	51	39	45	45	44	44
South West, South boundary/ Residential	Day	63	52	55	55	57	55
	Evening	61	52	45	45	57	45
	Night	54	47	40	40	52	40

Noise from mechanical plant and equipment associated with the proposed development should not exceed the operational noise criteria specified above.

4.4 ROAD TRAFFIC NOISE

Unattended noise monitoring was conducted on site between the 21st and 22nd February 2012 to measure the traffic noise. The noise monitor was placed within the existing site, at

[1] Recommended Acceptable Noise Level from table 2.1 in the OEH Industrial Noise Policy

the front boundary of Gardeners Road. Table 9 below presents a summary of the noise measurement levels. Values were rounded to the nearest 0.5 dB.

Table 9: Summary of Traffic Noise measurement Levels

All Values in dBA

Location	Day (0700-2200) Noisiest $L_{eq\ (1\ Hour)}$	Night (2200-0700) Noisiest $L_{eq\ (1\ Hour)}$
Gardeners Road boundary	68.0	65.5
Barber Avenue boundary	66.0	59.0

To further understand how future road traffic noise may interact with the development a noise model was developed using SoundPLAN 7.0. Data from the traffic consultant's report and site noise measurement results were used in order to predict road traffic noise levels around the site. The predicted road traffic noise levels around the development are presented in Fig 2.

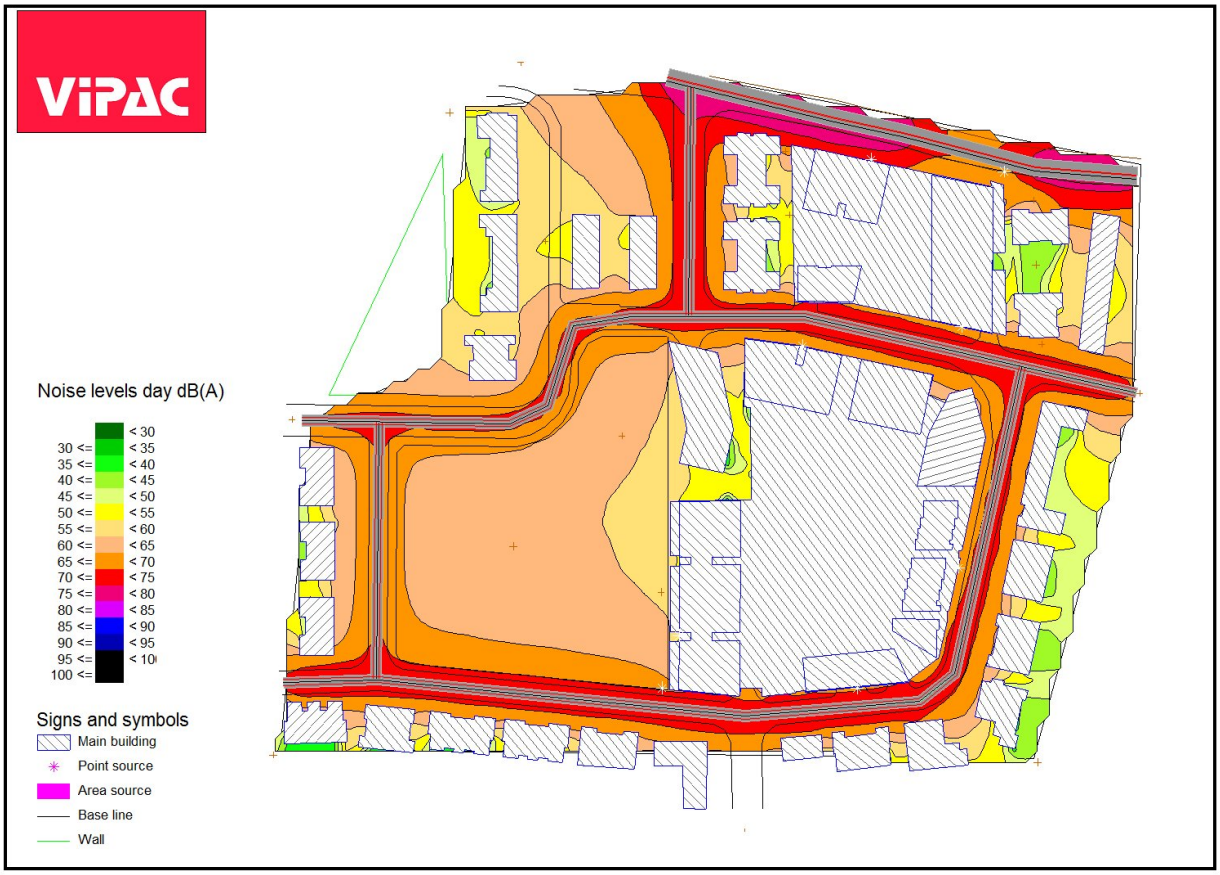

Figure 2: Road Traffic Noise Model Results

The majority of the new residential areas facing the road along the north, east and south facades will be exposed to traffic noise levels in the order of 65-70 dBA. Apartments facing west are expected to experience low road traffic noise with levels expected to be 50-55

dBA. Facades of those apartment facing in towards to communal and pool areas are expected to have traffic noise levels less than 50 dBA.

4.5 AIRCRAFT NOISE

4.5.1 AS 2021 aircraft noise values

The site is located within the Sydney airport ANEF noise contours 20-25. In accordance with acceptability criteria, Table 2.1 of AS 2021, the commercial units will be “acceptable” while the residential units will be “conditionally acceptable”.

The location of the site is such that the development will be affected by flights running on the east-west runway only.

The aircraft noise levels were obtained using the method presented in Australian Standard AS 2021: 2000. Distances between the runway and the site were determined in accordance with AS2021: 2000 and are shown in Table 10.

Table 10: Distance Coordinates for the site – East-west runway

Parameter	Distance in metres
DS – Distance from the runway centre-line to the site	800
DL – Distance along the runway centre-line to the building site, starting from the closer end of the runway	2420
DT – Distance along the runway centre-line to the building site, starting from the further end of the runway	4640

The corresponding average maximum aircraft noise levels are obtained from Table 3.4 to Table 3.16 of the standard and are presented in Table 11 below.

Table 11: Aircraft noise levels L_{max} dB(A) – East-west runway

Aircraft Type	Landing	Take-off (short range)	Take-off (Long range)
747-400 B	68	80	77
Boeing 737 & Airbus 320	62	72	-
Boeing 767	64	75	80

Review of the tabulated levels above indicates that the highest aircraft noise level at this site is the take-off of a Boeing 747 from the east-west runway and has a level of L_{max} 80 dB(A).

5 ACOUSTIC ASSESSMENT AND RECOMMENDATIONS

5.1 CONSTRUCTION NOISE AND VIBRATION

In order to manage the noise from the construction activities the following work practices and procedures are to be considered:

- Adherence to the NSW OEH recommended preferred hours for construction and deliveries;
- Turn off plant that is not being used;
- Avoid demolition of existing buildings using rock breaks, but rather demolishing structures with jaw crushers and saws;
- Consider using bored piling instead of impact piling to reduce noise;
- Where possible organise the site so that delivery trucks and haulage trucks only drive forward to avoid the use of reversing alarms;
- Truck drivers are to be informed of site access routes, acceptable delivery hours and minimising extended periods of engine idling;
- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers;
- When selecting equipment ensure where feasible and reasonable it has the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise;
- Locate noisy plant away from potentially noise-affected areas or behind barriers, such as sheds or walls;
- Construct purpose built barriers or screens where required;
- Table 12 is an excerpt from Appendix E 'Noise Sources, remedies and their effectiveness' Australian Standard 2436:2010, presenting possible noise reductions from various control mechanisms.

Table 12: Excerpt – Relative Effectiveness of Various Forms of Noise Control

Control by	Noise Reduction Possible in Practice, dB(A)
Distance	Approximately 6 for each doubling of distance
Screening	Normally 5 to 10, maximum 15
Enclosure	Normally 15 to 25, maximum 50
Silencing	Normally 5 to 10, maximum 20

Vibration may be generated as a result of construction work during the demolition, excavation and construction phases. Vibration is usually considered both in respect of potential damage of buildings and potential annoyance to the occupants. In many cases, it is the occupants/residents fear of building damage that enhances the potential annoyance.

The most common form of vibration measurement is the peak particle velocity (PPV) in mm/s. In respect of building damage, a vibration level limit and frequency is normally specified, however, in respect of potential annoyance to receivers, a combination of vibration level frequency and duration is more appropriate. This is normally termed as a dose value.

Before and after the construction activities, we recommend consideration is given to carrying out dilapidation reporting to a selection of existing residential and commercial receiver buildings, which are adjacent to the site.

5.2 OPERATIONAL NOISE ASSESSMENT

The following section details the operational noise assessment and considers noise generated by the site which has potential to impact on adjacent noise sensitive receivers.

5.2.1 Mechanical Plant

Mechanical noise emission from development should be controlled in accordance with the intrusiveness criteria and those of commercial units should be limited to Project Specific Noise Level criteria as shown in Table 8.

At this stage, the design and selection of the plant required to service the proposed development has not been finalised therefore the possible noise impact cannot be assessed. However, the mechanical services consultant should select plant so that the total mechanical services noise does not exceed the lowest project specific noise level at the common boundary of the receiver.

In general, based on previous experience with similar size developments, a number of amelioration measures can be implemented to control the noise emission.

Typical amelioration measures are outlined below (not necessarily limited to):

- Location of mechanical services equipment away from noise sensitive receivers.
- Achieving no direct 'line of sight' path between the nearest residence and all the major mechanical equipment or exhaust fans.
- Installation of low noise condenser units.
- Installation of barriers and acoustic enclosures where the above measures do not provide sufficient attenuation.
- Installation of all mechanical equipment on vibration isolators (pads) as recommended by the manufacturers.

5.2.2 Commercial Tenancies / Loading Dock Areas

The nature of the commercial centre and associated service areas (such as the loading dock) coupled with the location of the proposed residential units above means there is potential for transfer of noise and vibration via structural elements including columns, walls and separating floors. Acoustic issues include:

- Delivery and Collection Vehicles inside the loading dock
- Waste collection & refuse compactors
- Movement of stock trolleys, pallet jacks
- Use of Hydraulic Scissor lifts
- Handling and movement of Stock Pallets
- Manual handling of stock
- Use of floor cleaning / buffing machines
- Mechanical Services noise
- Background music played in stores

The airborne noise emissions from the docks could also cause a noise impact upon the nearby residences. The amount of noise impact depends on the noise level of equipment used in the loading dock, however such noise impacts can be minimised by providing acoustic absorption linings to the bay and the entrance and by installation of doors to enclose the area.

It is recommended that during the detailed design and construction certification stages further assessments are completed to evaluate the noise and vibration transfer into the residential apartments and ensure that where required suitable treatment is built into the development to minimise such transfer.

It is likely that a combination of engineering controls and management controls would be required. Examples of engineering noise controls may include vibration isolated plant including mechanical services, refuse compactors, suitable vibration isolation for floors and other structural elements to minimise transfer of noise from stock cage movements and the like.

Examples of management practices include use of manual handling procedures to minimise incidents of poor stock handling practices as well as restricting the times of use for certain higher noise activities such as deliveries and use of compactors.

5.2.3 Swimming pools

The swimming pools are located within the common spaces on the lower floors and are exposed to residential apartment windows of the upper levels therefore has potential for noise impact. However, noise reduction from the pool is only feasible through management mitigation measures.

We recommend that swimming hours to be restricted to daylight hours and there should be signage to request swimmers to keep the noise level to a minimum.

5.2.4 Generated traffic noise impact

The noise levels of local roads due to new developments set by Road Noise Policy is given in Table 5. Noise measurements on Barber Avenue on the south & east of the development

indicate that these levels are already exceeded at the site. Strategies for controlling road traffic noise are limited as the development does not result in road improvements. Access roads are generally located in favourable positions similar to the existing centre and as such there will be minimal change to the operational nature of the development. There is no opportunity to install noise barriers neither will the use of quiet vehicles be practical as the majority of traffic is generated by existing vehicles and customers where the choice of vehicle is beyond the control of the centre. There is scope to manage noise from delivery and collection vehicles by imposing time restrictions and prevent for example activities occurring outside 07:00 and 22:00 hours.

The noise generated by additional road traffic resulting from the development has been quantified to consider the relative noise increase. Data provided in Traffic Report (By Colston Budd Hunt & Kafes Pty Ltd, dated April 2012) was utilised. Calculations have been performed to obtain the noise increase from the generated traffic during the morning and afternoon peaks. A summary of calculations is shown in the following Table 13.

Table 13: Summary of calculations- generated traffic noise impact

Road	Existing Volume (vph)		Generated Volume (vph)		Noise increase dBA		Allowable noise Level increase dBA	Complies (Yes/No)
	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak		
Gardeners Road (east of Racecourse Pl)	3500	3490	3560	3570	0.07	0.09	12	Yes
Gardeners Road (west of Racecourse Pl)	3025	3055	3055	3075	0.04	0.03		Yes
Racecourse Pl	815	745	905	840	0.45	0.52		Yes
Evans Ave (east of Barber Ave)	280	220	285	220	0.07	0		Yes
Evans Ave (west of Barber Ave)	545	385	600	500	0.41	1.1		Yes
Barber Ave (south of Evans Ave)	325	225	340	275	0.2	0.8		Yes
Barber Ave (east of St Helena Pde)	325	245	350	285	0.3	0.6		Yes

The noise level increase from additional road traffic generated by the development at Gardeners Road is within the allowable 12 dBA and at the surrounding local roads within the allowable 2 dBA increase, therefore complies with the Road Noise Policy.

5.3 OCCUPANT ACOUSTIC AMENITY

5.3.1 Acoustic Separation of Residential Areas

The walls and floors separating sole occupancy units should be designed to achieve the acoustic performance requirements of the NCC. This requires further assessment during detailed design / construction certificate stages to ensure appropriate separating elements are documented.

5.3.2 External road traffic / aircraft noise intrusion

The outer envelope of the building will need to be designed to reduce noise impacts on occupants and to achieve the following internal noise goals:

- Living rooms = 40 dBA
- Bedrooms = 35 dBA

Traffic noise places greater demand on the acoustic performance of the building envelope at Gardeners Road façade whilst aircraft noise places greater demand at all other locations.

Traffic noise (measured and predicted using the acoustic model) has been used in the assessment. Calculations were performed to assess the noise through the outer walls, roof/ceiling, and the glazed areas. It was assumed that all bedrooms and living rooms were carpeted.

The architects have confirmed that the preferred construction for the outer walls of the buildings is 90 mm Hebel panels, cavity, studs and plasterboard panels. The roof will be constructed of 200 mm concrete slabs, cavity, insulation and plasterboard ceiling panels.

The acoustic performances of these structures have been determined and were used in the calculations. The proposed roof and walls are expected to have sufficient acoustic performance as long as they comprise the following:

- All top floor bedrooms to have a suspended ceiling comprising of 1x13 mm plasterboard mounted on 200 mm cavity with 75 mm insulation.
- All wall linings to have 1x13 mm plasterboard plus insulation as a minimum.

Table 14 below presents the minimum glazing requirements for this development. This configuration will provide acoustic performance to achieve the recommended internal sound level as specified in Sections 3.1.3 and 3.2.

Table 14: Glazing schedule- Minimum requirements

Level	Unit	Space	Recommended glazing		
			Glazing type	Rw glass	Rw glass+frame
Ground	Commercials	-	6.38 laminated	32	29
All	All residential units of building 1 facing Gardeners Rd	Beds	10.38 lam/100/10.38 lam	47	44
		Living	10.38 lam/100/6.38 lam	47	44
All (except top floors)	All residential	Beds (with large windows/doors)	10.38 lam	35	32
		Bed (with small windows)	6.38 lam	33	30
		Living	10.38 lam	35	32
		Toilet, bathroom	6.38 lam	33	30
Top floor	All residential	Bed (with large windows/doors)	10.38 lam	35	32
		Bed (with small windows)	10.38 lam	35	32
		Living	10.38 lam	35	32
		Toilet, bathroom	6.38 lam	33	30

The above glazing thicknesses are the minimum required for acoustic performance. Glazing thicknesses can be increased for the reasons of fire, safety, etc.

5.3.3 General Remarks

Glazing is generally the weakest component of any building façade where it would serve as a major noise transmission path, especially in cases where it has not been installed properly.

Sometimes different glass configurations have the same R_w ratings but they have different Sound Transmission Loss characteristics at each frequency band. Our glazing recommendations have been based on the glass performance across the octave band frequency spectrum.

All Windows/doors should be well sealed (air tight) when closed with good seals such as **Q-LON®** acoustic seals (or equivalent) around the top and bottom sliders. Special attention should be given to the balcony doors and the sliding doors to have good quality acoustic seals around them. Any air gap will significantly reduce the performance of the glazing in terms of the ability to attenuate noise. Mohair seals are not considered to be acoustic seals. All of the above assumed that the glass is properly sealed airtight.

5.3.4 Open window scenario

The NSW DoP Development Near Rail Corridors and Busy Roads – Interim Guideline recommends a maximum of 10 dBA above the internal noise level with the windows and doors open (for natural ventilation). In this case the recommended value window open noise criteria is L_{eq} 45 dBA for the bedrooms and 50 dBA for living areas.

Typically, an open window will provide 10 dBA noise reduction from outside to the inside. This implies that if the external noise level is more than 60 dBA for living rooms and 55 dBA for bedrooms, alternative means of ventilation are required so that the occupant can leave windows closed if they so desire, whilst also meeting the ventilation requirements of the Building Code of Australia."

With the exception of the west façade (adjacent to the Eastlakes reserve where the noise levels are 55-60 dBA) alternative means of ventilation will need to be provided for all bedrooms and living rooms with facades facing Gardeners Road, Evans Road and Barber Avenue. Alternative means of ventilation can be use of a passive attenuated wall vents with a pressure differential created by using bathroom exhaust sufficient to draw fresh air into the building.

6 RECOMMENED MEASURES

The mitigation measures recommended in this report can be separated as Recommendations and Management Plan items, summarised as follows:

6.1 RECOMMENDATIONS

- The mechanical services consultant should select plant so that the total mechanical services noise does not exceed the lowest project specific noise level (see Table 8)at the boundary of the receivers.
- For the loading docks, it is recommended that during detailed design and construction certification stages further assessments are completed to evaluate the noise and vibration transfer into the residential apartments and ensure that where required suitable treatment is built into the development to minimise such transfers.
- The walls and floors separating sole occupancy units should be designed to achieve the acoustic performance requirements of the NCC. This requires further assessment during detailed design / construction certificate stages to ensure appropriate separating elements are properly designed and documented.
- The minimum glazing required is presented in the glazing schedule Table 14. For prevention of noise intrusion, glazing should be installed according to the glazing schedule.

- With the exception of the west façade (adjacent to the Eastlakes reserve) alternative means of ventilation will need to be provided for all bedrooms and living rooms with facades facing Gardeners Road, Evans Road and Barber Avenue. Alternative means of ventilation can be use of a passive attenuated wall vents with a pressure differential created by using bathroom exhaust sufficient to draw fresh air into the building.

6.2 MANAGEMENT PLANS

- For the supermarket loading areas, examples of management practices include use of manual handling procedures to minimise incidents of poor stock handling practices as well as restricting the times of use for certain higher noise activities such as deliveries and use of compactors.
- For control of noise from the swimming pools management measures are required, examples being restriction of swimming to daylight hours and use of signage to request swimmers to keep the noise level to a minimum.

7 CONCLUSION

An acoustic assessment of the proposed development has been carried out in accordance with the relevant noise policies and Australian Standards as detailed in Section 5.

The assessment is summarised as follows.

- Noise levels of aircraft at the proposed site have been assessed using the predicted levels based on AS 2021: 2000.
- The ingress of aircraft and traffic noise through the various building elements, glass windows, roof/ceiling and external wall is to be controlled using the specifications detailed in Section 5.3.1 of this report.
- Based on monitoring results and the use of NSW Industrial noise policy the noise limits for the control of plant noise has been assessed. Mechanical plant noise should be limited by the above noise limits. (see Section 4.3 and Table 8).
- Limits of construction noise have been provided based on NSW OEH Interim Construction Noise Guidelines (see Section 3.4.4)
- Noise impact from the generated traffic has been assessed and was found to comply with OEH Road Noise Policy criterion. (See Section 5.2.4)

In conclusion, the proposed mixed use development should meet all the relevant criteria specified in this report provided the given recommendations are implemented.

APPENDIX A: ARCHITECTURAL DRAWINGS

The environmental assessment carried out in this report was based on the following architectural drawings provided by Rice Daubney Architects.

Drwg No.	Date/Issue	Description
DA02	D	Site plan
DA03	F	Basement level 2 plan
DA04	F	Basement level 1 plan
DA05	F	Ground floor plan
DA06	E	Level 1 plan
DA07	E	Level 2 plan
DA08	E	Level 3 plan
DA09	E	Level 4 plan
DA10	E	Level 5 plan
DA11	E	Level 6 plan
DA12	E	Level 7 plan
DA13	E	Level 8 plan
DA14	D	Roof plan
DA15	D	Building 1 & 1B layout
DA16	D	Building 1A layout
DA17	D	Building 2A & 3 layout
DA18	D	Building 4 & 4A layout
DA19	D	Building 5 layout
DA20	D	Building 6, 6A, 6B layout
DA21	D	Building 7 layout
DA22	D	Elevations sheet 1
DA23	D	Elevations sheet 2
DA24	D	Elevations sheet 3

DA25	D	Elevations sheet 4
DA26	D	Sections
DA27	D	Sections
DA28	D	Sections

APPENDIX B: GLOSSARY OF ACOUSTIC TERMS

Decibel, dB:
Unit of acoustic measurement. Measurements of power, pressure and intensity. Expressed in dB relative to standard reference levels.

dB(A):
Unit of acoustic measurement weighted to approximate the sensitivity of human hearing to sound frequency.Sound Pressure Level, Lp (dB), of a sound:

20 times the logarithm to the base 10 of the ratio of the r.m.s. sound pressure to the reference sound pressure of 20 micro Pascals. Sound pressure level is measured using a microphone and a sound level meter, and varies with distance from the source and the environment.

Sound Power Level, LW (dB), of a source:
10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 Pico Watt. Sound power level cannot be directly measured using a microphone. Sound power level does not change with distance. The sound power level of a machine may vary depending on the actual operating load.

Ambient Sound:
Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far.

Background noise:
The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed.

Percentile Level - L_{90}, L_{10}, etc:
A statistical measurement giving the sound pressure level which is exceeded for the given percentile of an observation period, e.g. L90 is the level which is exceeded for 90% of a measurement period. L_{90} is commonly referred to as the "background" sound level.

$L_{AEQ,T}$:
Equivalent continuous A-weighted sound pressure level. The value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.

Rating Background Level – RBL:

Method for determining the existing background noise level which involves calculating the tenth percentile from the LA90 measurements. This value gives the Assessment Background Noise Level (ABL). Rating Background Level is the median of the overall ABL.

R_w – Weighted Sound Reduction Index:

A new single number quantity for airborne sound insulation rating which replaces STC. STC has been traditionally used for the classification of partitions and to define acoustical requirements in the Building Code of Australia.

For majority of partitions, the value for R_w will be similar to the value for STC. Partitions with particularly poor performance at 100Hz may have lower values for R_w than for STC. Conversely, partitions with poor performance at 4kHz may have higher values for R_w than for STC.

C_{tr} – Adaptation factor:

C_{tr} is a spectrum adaptation factor which has been chosen in the NCC to take into account lower frequency level sounds. For an airborne sound insulation, the C_{tr} factor and the R_w of building element will need to be considered. C_{tr} is a negative number which means that $R_w + C_{tr}$ of a building element will be less than the R_w of the building element. For example a wall system may have an R_w of 55 but would have an $R_w + C_{tr}$ of 50 if the C_{tr} value was –5.