Beverly Hills Town Centre, 407 – 507 King Georges Road, Beverly Hills

Master Planning Acoustic Assessment

Beverly Hills Owners Association Incorporated

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1 INTRODUCTION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by Beverly Hills Owners Association Incorporated Pty Ltd to undertake an acoustic assessment of the potential noise and vibration impacts associated with the proposed redevelopment of 407-507 King Georges Road, Beverly Hills NSW.

It is understood the site forms part of the larger proposed 11.5 ha redevelopment of Beverly Hills Town Centre and that this development is currently in the master planning stage.

This report will outline the considerations and recommendations based on the relevant standards and guidelines that should be incorporated into the design of the subject site.

A list of acoustic terminology used in this report is included in Appendix A of this report.

1.1 Relevant Guidelines

The acoustic criteria that has been utilised for this assessment includes the requirements from the following guidelines or legislative documents.

- Georges River Council Local Environmental Plan (GRLEP) 2021.
- Georges River Council Development Control Plan 2021.
- NSW EPA Noise Policy for Industry (NPI) 2017.
- NSW EPA Road Noise Policy (RNP) 2011.
- NSW State Environmental Planning Policy (Transport and Infrastructure) 2021.
- Australian & New Zealand Standard AS/NZS 2106:2016 Acoustics-Recommended design sound levels and reverberation times for building interiors.
- NSW Government "Development near rail corridors and busy roads – Interim Guideline (DNRC & BR – IG).
- NSW EPA (formerly, Department of Environment and Climate Change) Assessing Vibration: A technical guideline 2006 (AV-TG).
- German DIN 4150: Part 3 – 1999 "Effects of Vibration on Structure" (DIN 1999).
- British Standard BS 6472-2008 – Evaluation of Human Exposure Vibration in Buildings (1Hz to 80Hz).

1.2 Proposed Development

With accordance to the conceptual designs as outlined in the Olsson and Associates Architects Pty Ltd Urban design study, it is understood that the proposed redevelopment of the urban boulevard will likely comprise of the demolition of existing buildings and associated infrastructure, to make way for the redevelopment of 12 blocks of mixed use residential and commercial buildings with retail tenancies on ground level with inner landscapes and greenery. Concept design compositions and a site plan can be identified in Figure 1 and Figure 2 below.

Figure 1 – Subject Site Concept Design - Sourced Olsson Urban Design Study

Figure 2 - Site Map v- Map sourced SixMaps

2 SURROUNDING RECEIVERS

The nearest sensitive noise receivers are identified below.

Receiver 1: Single and two-story commercial dwellings located to the east of the subject site on the eastern side of King Georges Road, stretching from 141 Morgan Street to 158 King Georges Road. These receivers will be known as the King Georges Road Commercial Eastern Receivers in this report and have been highlighted in Figure 2 above.

Receiver 1 (Alternative/Future) – Future receivers to the east of the site which is situated on the eastern side of King Georges Road. According to the Georges River Council Masterplan exhibited in July 2020 will include future commercial and residential receivers.

Receiver 2: Located to the south of the project site along the southern portion of Stoney Creek Road is single and two-story commercial receivers. These receivers will be known as the Stoney Creek Road Commercial Southern Receivers in this report and have been highlighted in Figure 2 above.

Receiver 3: Existing multi story residential apartment buildings situated to the southwest of the site, along the western side of Dumbleton Lane. These Receivers will be known as the Dumbleton Lane Western Receivers in this report and have been highlighted in Figure 2 above.

Receiver 4: Existing single storey dwellings and multi-story residential apartments building located to the north west of the site, situated along the northern portion of the Edgbaston Road. These receivers will be known as the Edgbaston Northern Receivers in this report and have been highlighted in Figure 2 above.

3 NOISE AND VIBRATION CRITERIA

All relevant noise and vibration criteria for the proposed subject site is presented below. Criterion have been separated into four main components: Building Envelope Criteria (Façade), External Noise Emission Criteria and Building Vibration Criteria.

3.1 Noise Intrusion Criteria

3.1.1 Georges River Council Local Environmental Plan (GRLEP) 2021

Acoustic requirements relevant to noise intruding into the future buildings are not provided in the Georges River GRLEP 2021 document. Therefore, the criteria outlined below will be used.

3.1.2 Georges River Council Development Control Plan (DCP) 2021

Acoustic requirements relevant to noise intruding the future buildings are not provided in the Georges River DCP 2021 document. Therefore, requirements from the below legislations and standards will be adopted.

3.1.3 NSW Government State Environmental Planning Policy (Transport and Infrastructure) 2021

Section - 2.100 Impact of rail noise or vibration on non-rail development states the following:

2.100 Impact of road noise or vibration on non-road development

1) This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration—

- Residential accommodation,
- A place of public worship,
- A hospital,
- An educational establishment or centre-based childcare facility.

2) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Secretary for the purposes of this clause and published in the Gazette.

3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded—

- In any bedroom in the residential accommodation—35 dB(A) at any time between 10.00 pm and 7.00 am,
- Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

Section 2.120 Impact of rail noise or vibration on non-rail development states the following:

2.120 Impact of road noise or vibration on non-road development

1) This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of RMS) and that the consent authority considers is likely to be adversely affected by road noise or vibration—

- Residential accommodation,
- A place of public worship,
- A hospital,
- An educational establishment or centre-based childcare facility.

2) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Secretary for the purposes of this clause and published in the Gazette.

3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded—

- In any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,
- Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

4) In this clause, freeway, tollway and transitway have the same meanings as they have in the Roads Act 1993.

3.1.4 NSW Department of Planning and Environments Development Near Rail Corridors and Busy Roads – Interim Guideline 2008

NSW Department of Planning's document DNRCBR adopts the same internal noise criteria outlined in the SEPP infrastructure (previous 2008, now updated 2021) see below. However, table 3.1 from the policy states:

Figure 3 Extract – DRCBR – Table 3.1

Table 3.1: Noise criteria

Residential Buildings		
Type of occupancy	Noise Level dBA	Applicable time period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time
Non–Residential Buildings		
Type of occupancy		Recommended Max Level dBA
Educational Institutions including child care centres		40
Places of Worship		40
Hospitals	- Wards	35
	- Other noise sensitive areas	45

3.1.5 Australian/New Zealand Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors - (AS/NZS 2107:2016)

Recommended ambient noise levels and reverberation times for internal spaces are given in a number of publications including Table 1 of Australian / New Zealand Standard 2107:2016 "Acoustics - Recommended design sound levels and reverberation times for building interiors". Unlike the previous version of this Standard, this latest edition recommends a range with lower and upper levels (rather than "satisfactory" and "maximum" internal noise levels) for building interiors based on room designation and location of the development relative to external noise sources. This change has occurred due to the fact that sound levels below 'satisfactory' could be interpreted as desirable, but the opposite may in fact be the case. Levels below those which were listed as 'satisfactory' can lead to inadequate acoustic masking resulting in loss of acoustic isolation and speech privacy.

Internal noise levels due to the combined contributions of external noise intrusion and mechanical ventilation plant should not exceed the maximum levels recommended in this Standard. The levels for areas relevant to this development are given in Table 1 below. The mid to maximum points of the internal noise level ranges are generally adopted as the internal design noise criteria for the combined effect of mechanical services and external noise intrusion. In this report we will confine our recommendations to dBA levels, however, where the background noise appears to be unbalanced, AS/NZS 2107:2016 provides direction in terms of suitable diagnostic tools that can be used to assess the spectrum distribution of the background noise.

Table 1 Recommended Design Sound Levels

Type of Occupancy/Activity	Design sound level range dBA ($L_{Aeq,t}$)	Project Design Noise Level[1] dBA ($L_{Aeq,t}$)
Residential Buildings—		
Houses and apartments in suburban areas or near minor roads —		
Sleeping areas (night-time)	30 to 35	35
Living areas (anytime)	30 to 40	40
Washrooms and toilets (anytime)	45 to 55	50
Commercial Buildings -		
Shop Buildings - Department Stores		
Main Floor	<55	<55
Upper Floor	<50	<50
Enclosed Carparks	<65	<65
Small Retail Stores (general)	<50	<50
Shopping Malls	<55	<55
Show Rooms	<50	<50
Speciality Shops (Where detailed discussion is necessary in transactions)	<45	<45
Supermarkets	<55	<55
Note 1 Overall recommended level for mechanical services noise and intrusive noise, combined.		

Section 6.18 of AS/NZ 2107:2016 notes that the presence of discrete frequencies or narrow band signals may cause the sound level to vary spatially within a particular area and be a source of distraction for occupants. Where this occurs, the sound level shall be determined as the highest level measured in the occupied location(s).

If tonal components are significant characteristics of the sound within a measurement time interval, an adjustment shall be applied for that time interval to the measured A-weighted sound pressure level to allow for the additional annoyance. If the background sounds include spectral imbalance, then the RC (Mark II) levels indicated in the Standard should be referenced (see also Appendix D of AS/NZ 2107:2016 for additional guidance).

Generally, where the final noise levels are within +/- 2 dB of the specified level given above, the design criteria will be considered met. Both the upper and lower limits will need to be satisfied especially where privacy is important or where noise intrusion is to be avoided.

3.2 External Noise Emission Criteria

3.2.1 Georges River Council Local Environmental Plan (GRLEP) 2021

Acoustic requirements relevant to noise emitted from the building are not provided in the Georges River GRLEP 2021 document. Therefore, the criteria outlined below will be used.

3.2.2 Georges River Council Development Control Plan (DCP) 2021

Acoustic requirements relevant to noise emitted from the building are not provided in the Georges River DCP 2021 document. Therefore, the criteria outlined below will be used.

3.2.3 NSW EPA Noise Policy for Industry (NPI) 2017

In NSW, the control of noise emissions is the responsibility of Local governments and the NSW Environment Protections Authority (NSW EPA).

The assessment of noise emissions from the operation of the building services and loading dock areas are required to be assessed in accordance with the requirements of the NSW EPA Noise Policy for Industry, which is detailed in this section of the report.

The NSW EPA has recently released a document titled Noise Policy for Industry (NSW NPI) which provides a framework and process for determining external noise criteria for the assessment of noise emission from industrial developments. The NSW NPI criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

3.2.3.1 Intrusive Noise Impacts (Residential Receivers)

The NSW NPI states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noises are generally considered acceptable if the equivalent continuous (energy average) A-weighted level of noise from the source (LAeq), measured in the absence of the source by more than 5dB(A). This if often termed the Intrusiveness Criterion.

The 'Rating Background Level' (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in the NSW NPI. Using the rating background noise level approach results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

3.2.3.2 Protecting Noise Amenity (All Receivers)

To limit continuing increase 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 2.2 of the NSW NPI. That is, the ambient L_{Aeq} noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the 'Background Creep' or Amenity Criterion.

The amenity assessment is based on noise criteria specified for a particular land use and corresponding sensitivity to noise. The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. These criteria relate only to other continuous industrial-type noise and do not include road, rail or community noise. If the existing (measured) industrial-type noise level approaches the criterion value, then the NSW NPI sets maximum noise emission levels from new sources with the objective of ensuring that the cumulative levels do not significantly exceed the criterion.

Project amenity noise level for industrial developments is specified as the recommended amenity noise level (Table 2.2 of the NPI) minus 5 dB(A). To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the LAeq,15min will be taken to be equal to the LAeq, period + 3 decibels (dB). Where the resultant project amenity noise level is 10dB or lower than the existing traffic noise level, the project amenity noise levels can be set at 15dB below existing traffic noise levels (i.e. LAeq, period(traffic) minus 15 dBA)

3.2.3.3 Residential Receivers - Area Classification

The NSW NPI characteristics the "Urban Residential" noise environment as an area that has the following characteristics:

- ***Urban*** *– an area with an acoustical environment that:*
    - *Is dominated by 'urban hum' or industrial source noise, where urban him means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources*
    - *Has through-traffic with characteristically heavy and continuous traffic flow during peak periods*
    - *Is near commercial districts or industrial districts*
    - *Has any combination of the above.*

Figure 4 was obtained using the NSW ePlanning Spatial Viewer and shows the land zoning map of the proposed site and the nearest sensitive receivers.

Figure 4 - NSW ePlanning Spatial Viewer

As shown in Figure 4 above the site and its surrounding receivers are within an area made up of R4 (high density residential) and B2 (local centre) classifications. Based on classification of B2 and R4, using table 2.3 of the NPI (see below), the amenity category would an urban receiver.

Figure 5 - NPfI Extract - Table 2.3 Determining which category applies

Table 2.3: Determining which of the residential receiver categories applies.

Receiver category	Typical planning zoning – standard instrument*	Typical existing background noise levels	Description
Rural residential	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime RBL <40 dB(A) Evening RBL <35 dB(A) Night RBL <30 dB(A)	**Rural** – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented in column 3 due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5 – village RU6 – transition R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Daytime RBL<45 dB(A) Evening RBL<40 dB(A) Night RBL <35dB(A)	**Suburban** – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime RBL> 45 dB(A) Evening RBL> 40 dB(A) Night RBL >35 dB(A)	**Urban** – an area with an acoustical environment that: • is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • has through-traffic with characteristically heavy and continuous traffic flows during peak periods • is near commercial districts or industrial districts • has any combination of the above.

Notes: *As cited in Standard Instrument – Principal Local Environmental Plan, New South Wales Government, Version 15 August 2014. RBL = rating background noise level.

Table 2 NSW NPI – Recommended L_{Aeq} Noise Source from Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level ($L_{Aeq, period}$)[2] (dBA)
Residence	Urban	Day	60
		Evening	50
		Night	45
Commercial		When in Use	65

Note 2 For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am

Note 3 The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound

3.2.4 Maximum Noise Level Event (Sleeping Disturbance)

Section 2.5 of the NPI states the following:

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater, a detailed maximum noise level event assessment should be undertaken.

3.2.5 NSW EPA (Formerly DECCW) NSW Road Noise Policy (RNP) 2011

This section of the report details the relevant noise assessment of noise resulting from additional traffic volumes on surrounding roadways.

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

3.3 Building Vibration Criteria

Future internal vibration levels and structure borne noise levels from train pass-bys in the nearby rail corridor would need to comply with the requirements listed below.

3.3.1 NSW Government "Development Near Rail Corridors and Busy Roads – Interim Guideline" (DNRC & BR - IG)

Regarding ground borne noise, the document titled "Development Near Rail Corridors and Busy Roads – Interim Guideline" (DNRC & BR – IG), recommends that residential developments should be designed so that the 95th percentile of train pass-bys complies with the following maximum allowable noise levels based on a "slow" time response:

- Day time (7:00 am – 10:00 pm): 40 dB L_{ASmax}

- Night-time (10:00 pm – 7:00 am): 35 dB L_{ASmax}

In relation to acceptable vibration levels for human comfort, the DNRC & BR – IG recommends that the intermittent vibration emitted by trains should comply with the criteria in the document titled "Assessing Vibration: A Technical Guideline" (AV-TG). These vibration criteria are discussed in Section 3.2.4.

Furthermore, for the assessment of vibration damage to structures, the DNRC & BR – IG references the following standards:

- German Standard DIN 4150 Part 3:1999
- British Standard BS 7385 Part 2: 1993

3.3.2 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled" Assessing Vibration – A Technical Guideline" (AV-TG). This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous Vibration – from uninterrupted sources (refer to tables Table 3 and Table 4)
- Impulsive Vibration – up to three instances of sudden impact e.g., dropping heavy items, per monitoring period (refer to Table 5 and Table 7)
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously Table 7

Table 3 Continuous vibration acceleration criteria (m/s2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010

Table 4 Impulsive vibration acceleration criteria (m/s2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Table 5 Continuous vibration velocity criteria (mm/s and dB re 10-9 m/s) 1 Hz-80 Hz, Z axis

Location	Assessment period	Z axis	
		Preferred Values	Maximum Values
Residences	Daytime	0.2 mm/s 106 dB	0.4 mm/s 112 dB
	Night-time	0.14 mm/s 103 dB	0.28 mm/s 109 dB

Table 6 Impulsive vibration velocity criteria (mm/s and dB re 10-9 m/s) 1 Hz-80 Hz, Z axis

Location	Assessment period	Z axis	
		Preferred Values	Maximum Values
Residences	Daytime	6 mm/s 136 dB	12 mm/s 142 dB
	Night-time	2 mm/s 126 dB	4 mm/s 132 dB

Table 7 Intermittent vibration impacts criteria (m/s1.75) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26

3.3.3 Vibration Criteria – Building Damage

It is expected that the human comfort criteria discussed in 3.3.2, will be stringent that that corresponding to building damage.

Therefore, it is our opinion that a vibration assessment for building damage is not relevant to our assessment since compliance with human comfort criteria will also achieve compliance with building damage criteria.

Table 8 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz1	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their 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

Note 1 For frequencies above 100Hz, at least the values specified in this column shall be applied.

4 NOISE INTRUSION ASSESSMENT

4.1 Building Envelope

External noise intrusion into the future buildings will generally be via the building envelope (i.e. external wall, glazing or external roof). The design of the building envelope should be such that the requirements listed in section 3 are achieved.

4.1.1 Assessment of Building Envelope

Preliminary observations of the surrounding acoustic environment from the land-based transportation systems surrounding the site indicate that the external noise levels which will likely impact the future façades will be likely attenuated with high performing acoustic façade systems (i.e. Typical Single Glazed, IGU systems or DGU systems). Specifically, we note

- For developments located along the northern section of the town centre (adjacent to the rail corridor) will require façade systems to attenuate noise from rail movements and traffic movements along the King George Road.
- Future eastern façades along King Georges Road will also require façade attenuation systems to ensure internal noise levels meet requirements listed in section 3.1. This is to be determined during future design phases.
- For developments along the southern section of the town centre (adjacent to Stoney Creek Road) will require future façade systems to ensure internal noise levels meet requirements listed in section 3.1. This is to be determined during future design phases.
- Anticipated noise levels on the western side of the proposed development are to be minimal in comparison to that of the northern, eastern and southern facades. As such, the façade will require a lower acoustic performance.
- Whilst further development and collaboration with other design team members is required, some spaces may require acoustically treated ventilation plenums to ensure both mechanical and acoustic requirements are met.
- Notwithstanding above, all environmental noise sources will be reviewed in detailed during the future design phases.

4.1.2 Alternative Ventilation Requirements

The internal design sound levels detailed above are achieved with the external building openings closed to the façade elements facing King Georges Road for traffic noise and northern façade closed due to rail noise from the T8 Airport and Southern Line.

Based on the requirements of the Department of Planning Development Near Rail Corridor and Busy Roads – Interim Guideline (road traffic noise) the trigger for the requirement of an alternative outside air source on this project, is mostly likely required for all residential façade elements of the project based on internal noise levels with the windows open.

The method of providing an alternative method of outside air ventilation is required to be provided in accordance with relevant regulations including the Building Code of Australia and AS1668.

Subject to further detailed review once building envelopes are determined.

5 NOISE EMISSION ASSESSMENT

5.1 Assessment of Operational Noise

Assessment of the potential noise emissions from the master plan redevelopment is outlined below.

5.1.1 Noise from Engineering Systems

At this stage of the project, the details of the future engineering services in each building are not known. As such, a detailed acoustic review cannot be undertaken at this stage. However, to ensure that any future external plant can comply with the noise emission criteria as detailed above the following considerations should be made during the future planning/design phases:

- Location of external plant relative to future/existing surrounding sensitive properties should be considered. Plant that will be operating during the evening and night periods (whilst likely to limited).
- Incorporation of high performing acoustic treatments to ensure compliance with the noise emission requirements detailed above, including adequate spatial allowances.

Where possible, incorporate timing controls to ensure plant is switched off during periods when spaces are not used.

5.1.2 Additional Traffic on NSW Roads

The NSW RNP recommends that a minor increase of 2dB due to additional public vehicles would result in a minor impact on surrounding receivers. The additional increase along King Georges Road is likely to be within the 2dBA tolerance from the policy due to an existing AADT flow exceeding 60,000. However, for surrounding roads which carry a lower volume of traffic a further detailed assessment should be undertaken during further planning phases to ensure the impact of additional traffic on the surrounding road network is below the 2dBA. Should an exceedance above 2dBA be determined, mitigation strategies as outlined in the policy should be considered.

5.1.3 Operational Noise Levels

Precinct Operational Noise Future precinct operational noise should take into the account the following:

- Any future commercial use (entertainment, dining, etc) must comply with the requirements outlined in this report
- Detailed acoustic assessments for each of the proposed commercial uses would be required. Typically provided as part of the individual building/tenancy DA.
- Based on the site location and existing/future acoustic environment the operation of these areas will likely result in compliance with all relevant NSW EPA noise legislation.
- In cases of tenancies which include the serving of alcohol all relevant NSW Liquor and Gaming requirements should be considered and complied with.

5.1.4 Onsite Vehicle Movements

All future parking areas for each development will be below ground in a basement type arrangement and will likely result in compliance.

6 BUILDING VIBRATION CRITERIA

To the north of the proposed precinct lies the T8-Airport & South Line (see Figure 2 above), the train line is currently operational and lies at its closest point approximately 15m from the northern façade of 407 King Georges Road.

As the site is still in its conceptual phase, vibration measurement testing is not required to be undertaken at this stage, however, to ensure future vibration and structure borne noise levels within any future residential spaces to the northern portion of the proposed site are compliant, a detailed vibration assessment should be undertaken at a later stage to determine the need for vibration isolation design.

7 CONCLUSION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by Beverly Hills Owners Association Inc Pty Ltd to undertake an acoustic assessment of the proposed master plan redevelopment of 407 – 507 King Georges Road, Beverly Hills as part of the Beverley Hills Town Centre

Relevant project acoustic criteria have been developed for the further design of the development of the project. Acoustic criteria have been established for the building envelope, operational noise emissions and rail vibration impacts.

Onsite noise and vibration surveys should be undertaken during the future planning phases to ensure all relevant components of the proposed development are designed to meet the nominated objectives.

For any additional information please do not hesitate to contact the person below.

Kind Regards,

George Kinezos
Acoustic Engineer
PULSE WHITE NOISE ACOUSTICS PTY LTD

APPENDIX A. APPENDIX TERMINOLOGY

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing 30dB(A) A quiet country park 40dB(A) Whisper in a library 50dB(A) Open office space 70dB(A) Inside a car on a freeway 80dB(A) Outboard motor 90dB(A) Heavy truck pass-by 100dB(A) Jackhammer/Subway train 110 dB(A) Rock Concert 115dB(A) Limit of sound permitted in industry 120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Ambient sound	The all-encompassing sound at a point composed of sound from all sources near and far.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
Reverberation	The persistence of sound in a space after the source of that sound has been stopped (the reverberation time is the time taken for a reverberant sound field to decrease by 60 dB)
Air-borne sound	The sound emitted directly from a source into the surrounding air, such as speech, television or music
Impact sound	The sound emitted from force of one object hitting another such as footfalls and slamming cupboards.
Air-borne sound isolation	The reduction of airborne sound between two rooms.
Sound Reduction Index [R] *(Sound Transmission Loss)*	The ratio the sound incident on a partition to the sound transmitted by the partition.
Weighted sound reduction index [R_w]	A single figure representation of the air-borne sound insulation of a partition based upon the R values for each frequency measured in a laboratory environment.
Level difference [D]	The difference in sound pressure level between two rooms.
Normalised level difference [D_n]	The difference in sound pressure level between two rooms normalised for the absorption area of the receiving room.
Standardised level difference [D_{nT}]	The difference in sound pressure level between two rooms normalised for the reverberation time of the receiving room.
Weighted standardised level difference [$D_{nT,w}$]	A single figure representation of the air-borne sound insulation of a partition based upon the level difference. Generally used to present the performance of a partition when measured in situ on site.
C_{tr}	A value added to an R_w or $D_{nT,w}$ value to account for variations in the spectrum.

Impact sound isolation	The resistance of a floor or wall to transmit impact sound.
Impact sound pressure level [L_i]	The sound pressure level in the receiving room produced by impacts subjected to the adjacent floor or wall by a tapping machine.
Normalised impact sound pressure level [L_n]	The impact sound pressure level normalised for the absorption area of the receiving room.
Weighted normalised impact sound pressure level [$L_{n,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in a laboratory.
Weighted standardised impact sound pressure level [$L'_{nT,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in situ on site.
C_I	A value added to an L_{nW} or $L'_{nT,w}$ value to account for variations in the spectrum.
Energy Equivalent Sound Pressure Level [$L_{A,eq,T}$]	'A' weighted, energy averaged sound pressure level over the measurement period T.
Percentile Sound Pressure Level [$L_{Ax,T}$]	'A' weighted, sound pressure that is exceeded for percentile x of the measurement period T.
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Sound Pressure Level, LP dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, Lw dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 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 picoWatt
Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the LA90 value
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
LMax	The maximum sound pressure level measured over a given period.
LMin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The 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).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.