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Mod 9 Application Acoustic Impact Assessment

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EXECUTIVE SUMMARY

This report presents the assessment of acoustic impacts associated with the proposed Central Barangaroo development.

The proposed development consists of a mix of residential, commercial and community uses.

The Director General's Requirements (DGR's) for assessment include the following guidelines:

- NSW Industrial Noise Policy (OEH). The Industrial Noise Policy has been superseded by the Noise Policy for Industry (2017).
- Environmental Criteria for Road Traffic Noise (NSW EPA). This document has been superseded by the Road Noise Policy (2011).
- Environmental Noise Control Manual (OEH). The Environmental Noise Control Manual has been superseded by current policies and is no longer relied upon as per guidance provided in the EPA Noise Guide for Local Government. The noise guide references the Industrial Noise Policy (superseded), Road Noise Policy and Interim Construction Noise Guideline.
- Development Near Rail Corridors and Busy Roads – Interim Guideline 2008.

Noise impacts have been assessed based on the following guidelines, regulations and Australian Standards (where the DGRs mention a superseded guideline, the current equivalent guideline has been adopted):

- NSW Environment Protection Authority
    - Noise Policy for Industry (NPfI)
    - Road Noise Policy (RNP)
    - Interim Construction Noise Guideline (ICNG)
- NSW Independent Liquor and Gaming Authority ("ILGA")
- State Environmental Planning Policy (Infrastructure) 2007. ("Infrastructure SEPP")
- NSW Department of Planning and Environment "Apartment Design Guide" (2015) ("ADG")
- Development Near Rail Corridors and Busy Roads – Interim Guideline 2008. ("DNRCBR")

A summary of potential impacts and the findings of the assessment as summarised below.

Traffic Noise Intrusion

Traffic noise intrusion into the development (principally from Hickson Road and the Western Distributer) is capable of being mitigated by adopting appropriate façade constructions and providing alternative ventilation to habitable spaces using the criteria adopted in DNRCBR, Infrastructure SEPP and the ADG.

Operational and Traffic Noise Impacts on Nearby Properties

The following noise emission sources have been identified and addressed in the report:

- Retail food and beverage tenancies (which may have the ability to trade 24 hours per day/7 days per week)
- Mechanical plant and equipment
- Traffic noise generation on public roads

The preliminary assessment undertaken indicates the proposed development is capable of complying with noise emission criteria at all surrounding receivers providing appropriate mitigation and management measures are adopted.

A management plan should be developed in order to regulate development of food and beverage outlets, particularly in respect of external dining, given that they may trade 24 hours. The purpose of the management plan is to ensure a satisfactory balance between enabling community and entertainment uses against the provision of adequate acoustic amenity for existing and future receivers. It should consider the mitigating effect of any treatment provided to the façades of new dwellings within the subject development or to the food and beverage outlets, and recommend noise emission limits for each tenancy so that noise criteria are not exceeded.

Noise emissions from plant and equipment is capable of being fully mitigated through appropriate siting, selection and treatment. The cumulative noise level from site (including plant and activity-related noise) should not exceed criteria established using the EPA NPfI guideline and (where applicable) liquor licence conditions.

Traffic generation forecasts included with the Mod 9 assessment (Barangaroo Concept Plan (MP06_0612 MOD 9) Transport Management and Accessibility Plan – MOD 09 (Arup, Rev A 28/06/2021) predict, using worst case assumptions, an increase in vehicle movements compared to the MOD 8 assessment. This is partly due to an increased allowance for of bus movements on Hickson Road. The increase in vehicle movements is very minor and traffic noise generated would not be perceptively different to the Mod 8 predictions and assessment, which concluded that there would be no adverse traffic noise impacts.

Construction Noise and Vibration Emissions

The site is surrounded by existing residential, community and commercial uses, and is located above railway infrastructure (metro). As with all major development occurring near sensitive receivers, these receivers will be impacted by construction-related activities. Accordingly, construction noise and vibration emissions should be managed in accordance with the IGNG (generally), Transport for NSW, Sydney Metro – Technical Services – *Sydney Metro Underground Corridor Protection Technical Guidelines* (dated 16th October 2017, Reference: NWRLSRT-PBA-SRT-TU-REP-000008, Revision 1) and Transport for NSW, "Development Near Rail Tunnels" (2018).

Prior to the commencement of construction, a Construction Noise and Vibration Management Plan (in accordance with ICNG recommendations and the recommendations of this assessment) should be developed to manage potential impacts to surrounding receivers. Implementation of this plan will ensure that potential impacts are adequately mitigated.

Metro Noise and Vibration Impacts on the Subject Development

The proposed development would not need to incorporate additional railway vibration mitigation, as the "at track" treatment proposed to be installed by the Metro developers will likely fully mitigate ground borne vibration impacts for all expected uses within the subject development.

1 INTRODUCTION

Acoustic Logic Consultancy have been engaged by Infrastructure NSW to conduct an acoustic assessment of noise impacts associated with the proposed Central Barangaroo development. The proposal is for Modification 9 to the Central Barangaroo Concept Plan (referred to as Mod 9) and does not seek approval for buildings, which will be the subject of future applications.

This assessment has been commissioned to address aspects of noise impact associated with the proposed site including:

- Existing and future noise and vibration sources impacting the residential uses as part of the development including:
    - Traffic noise from Hickson Road and the Bradfield Highway / Western Distributer
    - Entertainment noise from retail uses as part of the development,
    - Entertainment noise from the public domain.
    - Underground Metro (Barangaroo Station)
- Traffic noise generation from additional vehicle movements on public roads
- Plant and equipment (in principle)
- Retail and commercial uses (in principle).
- Construction noise and vibration impacts.

Noise impacts have been assessed with consideration to the following guidelines, regulations and Australian Standards:

- NSW Environment Protection Authority
    - Noise Policy for Industry (NPfI)
    - Road Noise Policy (RNP)
    - Interim Construction Noise Guideline (ICNG)
- Independent Liquor and Gaming Authority NSW
- State Environmental Planning Policy (Infrastructure) 2007/ DNRCBR.
- Transport NSW guidelines in relation to protection or rail assets.

Noise levels have been predicted for the reference scheme at the receiver locations using SoundPlan™ modelling software implementing the ISO 9613-2:1996 *"Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation"* noise propagation standard.

Strategies for the mitigation of any impacts identified have been identified.

2 ACKNOWLEDGMENT OF COUNTRY

We would like to acknowledge the Gadigal people who are the Traditional Custodians of this land. We would also like to pay respect to the Elders both past and present of the Eora Nation and extend that respect to all Aboriginal people.

3 SITE PROPOSAL AND LOCATION

3.1 EXISTING USES AND ROAD NETWORK

The site is located within the Barangaroo precinct area. Barangaroo is made up of three (3) distinct precincts, known as Barangaroo South, Central Barangaroo and Barangaroo Reserve. This assessment addresses the Central Barangaroo precinct. The site is presently unoccupied and is being used as construction staging areas for the Barangaroo redevelopment area.

The surrounding road network consists of:

- Hickson Road running the length of the eastern boundary,
- Future internal roads connecting through to Hickson Road and Barangaroo South.
- Western Distributer to the East which carries high volumes of passenger, commercial and heavy vehicle traffic.

3.2 CENTRAL BARANGAROO PRECINCT PROPOSAL

To allow for development within the Central Barangaroo precinct and below Barangaroo Reserve, Modification 9 to the Barangaroo Concept Plan (MP06_0162 MOD 9) proposes:

1) An increase in total permissible GFA from 602,354 sqm to 708,041sqm, with the following within Central Barangaroo and Barangaroo Reserve:

   a) up to 116,189sqm of above ground GFA within Blocks 5, 6 and 7;

   b) up to 28,166sqm of below ground GFA within Blocks 5, 6 and 7;

   c) a minimum of 2,800sqm of Community uses GFA within Blocks 5, 6 and 7; and

   d) a minimum of 6,000sqm and up to 18,000sqm of Community uses GFA within the RE1 Zone of Barangaroo Reserve, to allow for future community / cultural facilities located in the Cutaway.

3) Modifications to Barangaroo's movement network to redirect and reduce the impact of vehicular traffic and significantly improve pedestrian movement, safety, and amenity, including the removal of vehicular traffic from Block 5 and 6 and the extension of Central Barangaroo's Harbour Park.

4) Modifications to the Central Barangaroo building envelope that allow for greater variation in building heights across Blocks 5, 6 and 7 to enable building form, massing and modulation that is responsive to context and adjusts the development boundary for Block 5.

5) Introduction of Design Guidelines for Central Barangaroo.

6) Consequential amendments to the State Significant Precincts SEPP.

7) Revisions to the Barangaroo Concept Plan Statement of Commitments.

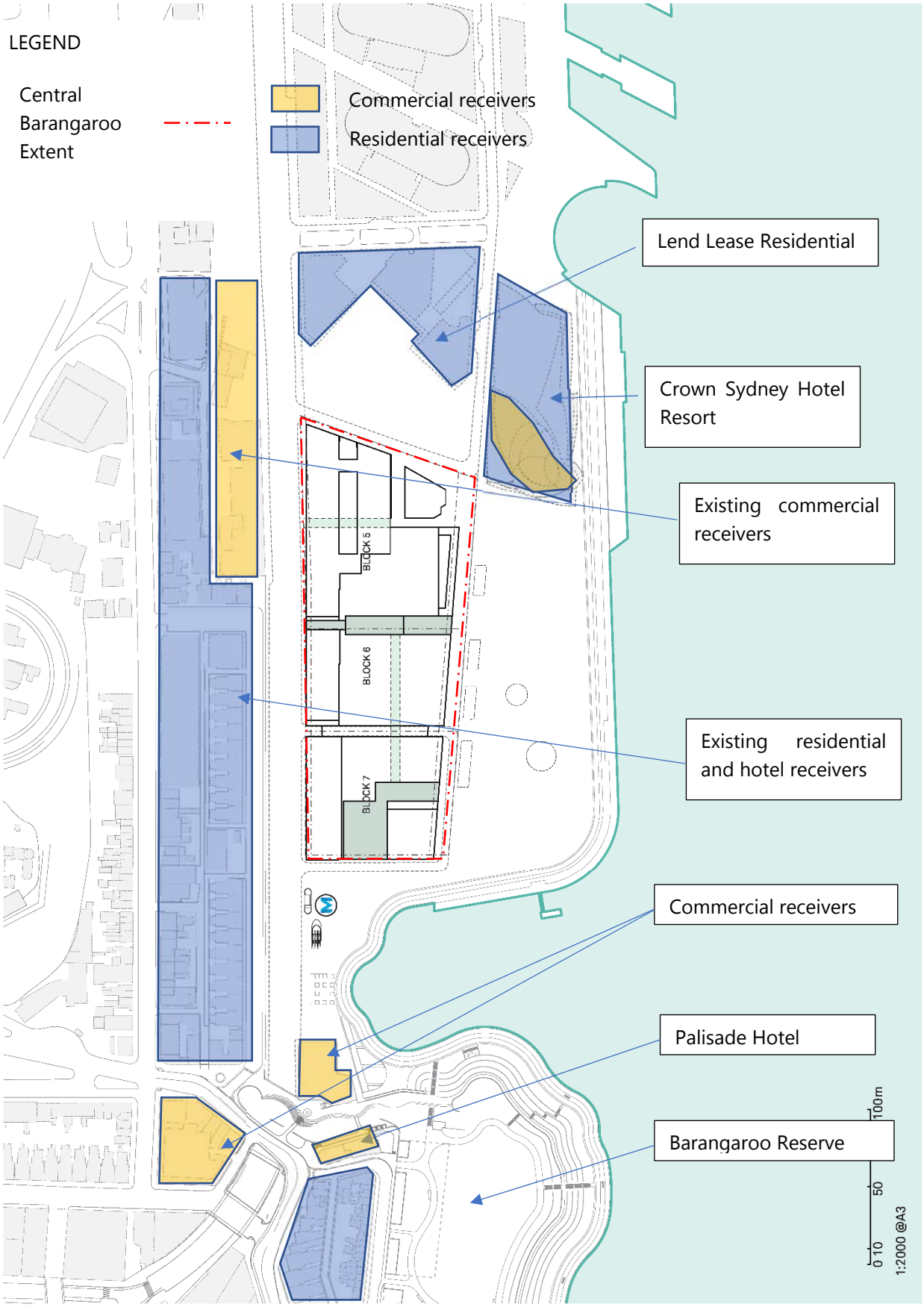

Figure 1: Site and Surrounds

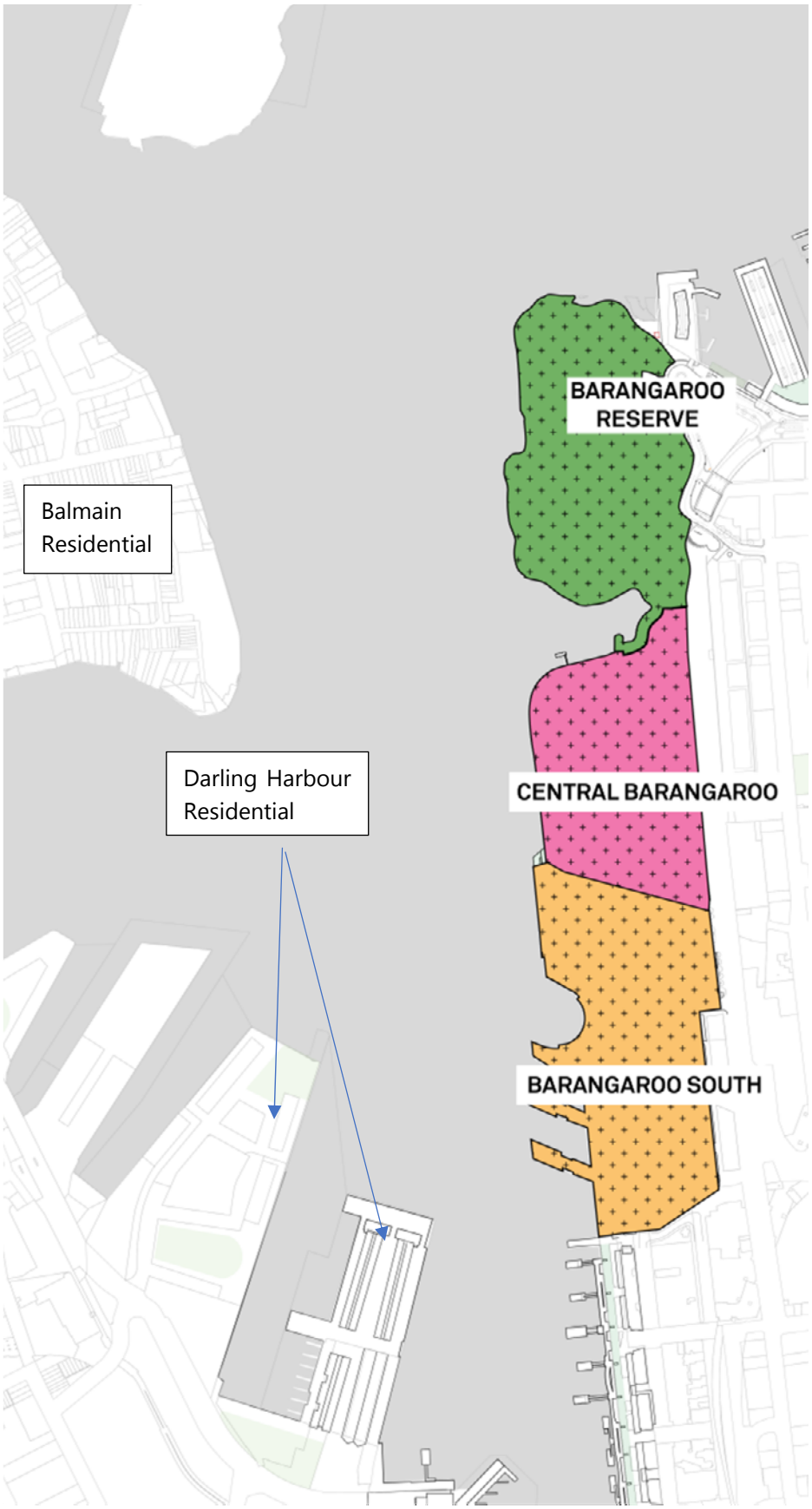

Figure 2: Site and Sensitive Receivers to West

3.3 EXISTING SENSITIVE RECEIVERS

The precinct is surrounded by the following uses:

- Public domain, and Barangaroo Reserve to the north, with a hotel and commercial and residential properties further to the north
- To the south-west, Crown Sydney Hotel Resort (including residential receivers)
- To the west Darling Harbour and Balmain
- To the south:
    - Hickson Park, passive recreational public domain.
    - Lendlease residential developments
    - Commercial towers beyond
- To the east:
    - Residential dwellings on Hickson Road and High Street
    - Commercial and hotel development along Hickson Road and Kent Street beyond
    - Residential dwellings and serviced apartments on Kent Street

4 EXISTING ACOUSTIC ENVIRONMENT

Noise monitoring has been previously conducted as part of the Barangaroo Concept Plan and subsequent modifications. These noise levels have been used as a basis for this assessment given that the significant construction activity occurring in the vicinity prevents the establishment of rating background noise levels from monitoring at this time.

4.1 ENVIRONMENTAL NOISE DESCRIPTORS

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis, and statistical and integrating techniques are applied to the data to determine noise descriptors.

In analysing environmental noise, three-principal measurement descriptor parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new

source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15 minute period. L_{eq} is important in the assessment of environmental noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

4.2 HISTORICAL NOISE MONITORING

Noise monitoring has been conducted in and around the Barangaroo area as part of the approved Concept Plan and subsequent modifications.

Noise levels have been adopted from the Wilkinson Murray report titled 'One Sydney Harbour Residential Building R4A – Construction and Operational Noise Report' dated 28 July 2016.

Background noise levels were established prior to significant works being undertaken as part of the Barangaroo Site and as such would not be impacted by construction noise which currently exists. Monitored noise levels are presented in the following table.

Detailed noise monitoring is recommended to be conducted as part of future development applications (after construction activities in the area have abated) to ensure emission assessment criteria are based on representative background noise levels.

The activation of the Barangaroo precinct is expected to increase background noise levels, commensurate with the general increase in activity produced by the establishment of entertainment and community uses.

Table 1 – Historical Noise Monitoring

Logging Site	Monitoring Location	Rating Background Noise Level, dB(A) L_{90}				Equivalent Continuous Sound Level dB(A) L_{eq}				Consultant
		Day	Evening	Night	Saturday	Day	Evening	Night	Saturday	
1	Level 4, The Bond 30-38 Hickson Road	53	53	49	51	62	61	57	60	Arup
2	Middle of Barangaroo South Site	52	50	45	50	56	54	50	56	Arup
3	Adjacent to Sussex Street and Shelley Street	60	59	49	57	67	66	62	66	Arup
4	Adjacent to King Street Wharf Boulevard	52	60	46	48	60	62	60	60	Arup
5	3 High Street, Millers Point	47	44	41	45	58	55	51	55	WM
6	18 Merriman Street, Millers Point	46	44	40	46	58	55	50	56	WM
7	25 Edward Street, Balmain East	49	45	40	46	67	51	47	56	WM
8	3 Darling Island Road, Darling Island	47	44	39	50	54	49	46	56	WM

5 AIRBORNE NOISE INTRUSION FROM EXISTING SOURCES

The impact of local environmental noise sources on the amenity of the occupants of the proposed development has been assessed.

5.1 RELEVANT STANDARDS AND GUIDELINES

The standards and guidelines referenced in this assessment are:

- State Environmental Planning Policy (Infrastructure) 2007 ("Infrastructure SEPP")
- Development Near Rail Corridors and Busy Roads - Interim Guideline (NSW Department of Planning, 2008) (DNRCBR)
- AS NZS 2107-2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- NSW Apartment Design Guide (ADG)

The ADG and the Infrastructure SEPP make reference to DNRCBR in respect of sites impacted by these noise sources. The requirements contained in these documents apply only to noise sensitive land uses such as residential uses, schools, hospitals and the like, not to commercial uses. In respect of residential uses within the subject development, the internal noise criteria nominated in these guidelines are generally more stringent than the Australian Standard AS NZS 2107-2016 Acoustics - Recommended design sound levels and reverberation times for building interiors. AS 2107 can be used as a guide for non-sensitive uses such as commercial office space, etc.

5.2 TRAFFIC NOISE CRITERIA

Traffic noise impacts on the residential component of the development have been addressed in accordance with the requirements of the State Environmental Planning Policy (Infrastructure) 2007/DNRCBR.

5.2.1 State Environment Planning Policy (Infrastructure) 2007

The SEPP (Infrastructure) details specific acoustic requirements for traffic noise intrusion into residential uses as part of a development. Clause 102 sets out the following criteria for internal noise levels from airborne traffic noise.

102 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:

(a) residential accommodation,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or centre-based child care 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 LAeq levels are not exceeded:

(a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,

(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

The SEPP (Infrastructure) 2007 is supported by the Department of Planning 'Development Near Rail Corridors and Busy Roads – Interim Guideline'. This document is the guideline issued by the Director General for the purpose of 102(2) of the SEPP (Infrastructure).

5.2.2 Development Near Rail Corridors and Busy Roads – Interim Guideline

Potential noise impacts on a residential development should be considered for busy roads which are defined under the interim guideline as:

- Roads specified in Clause 102 of the Infrastructure SEPP: a freeway, tollway or a transit way or any other road with an average annual traffic (AADT) volume of more than 40,000 vehicles (based on the traffic volume data provided on the website of the RTA).
- Any other road – with an average annual daily traffic (AADT) volume of more than 20,000 vehicles (based on the traffic volume data published on the website of the RTA).
- Any other road – with a high level of truck movements or bus traffic.

Noise intrusion is addressed in accordance with Table 3.1 of the guideline which is consistent with the Infrastructure SEPP requirements.

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

Note: airborne noise is calculated as L_{eq} (9h) (night) and L_{eq} (15h)(day). Groundborne noise is calculated as L_{max} (slow) for 95% of rail pass-by events.

If the internal noise level with windows open to 5% of the floor area exceeds the noise levels in Table 2 by more than 10 dB(A), the guideline recommends that these rooms be designed such that the windows can be closed and still meet the ventilation requirements of the Building Code of Australia ("BCA").

5.2.3 Summary of Traffic Noise Objectives

A summary of the required internal windows closed noise level criteria incorporating all relevant legislative requirements are detailed in the table below.

Table 2 - Project Traffic Noise Assessment Criteria

Space /Activity Type	Internal Use	Assessment Criteria *
Residential	Bedrooms	35 dB(A)$L_{eq(9hr)}$
	Other Habitable Rooms Living rooms	40 dB(A)$L_{eq(15hr)}$
Child Care Centres	Child Care Centre	40 dB(A)$L_{eq(15hr)}$

* Where noise levels exceed the tabled values by more than 10 dB(A) with ventilation openings to 5% of the floor area, provide a ventilation system that complies with BCA with windows closed.

5.3 TRAFFIC NOISE INTRUSION ASSESSMENT

Traffic noise impacts have been addressed in principle for noise from the following roadways:

- Western Distributer / Bradfield Highway
- Hickson Road

The proposal is not sufficiently developed to enable specific control measures to be recommended. The following assessment is provided as an in-principle proof of concept to show that compliance with the traffic noise criterion can be achieved.

5.3.1 Traffic Noise Modelling

The Western Distributer / Bradfield Highway has been assessed based on existing traffic volumes during peak free flowing periods.

Hickson Road will carry the majority of development volume, and traffic volumes on this road (and consequently noise levels) are expected to increase as a result.

Traffic volumes used in this assessment for Hickson Road have been adopted from the ARUP 'Transport Management and Accessibility Plan – Mod 9' report dated 28th June 2021.

Indicative noise modelling has been undertaken using the CoRTN module of the SoundPlan noise modelling software and adopting the worst case peak hour traffic movements. This will be used to predict the likely worst-case traffic noise level impacting the future facades of the Central Barangaroo development during peak hour. These noise levels will be marginally higher than the 15 hour noise level, and would likely be 5 dB(A) higher than the 9 hour (night) noise level.

The highest noise levels will occur on the eastern facades of the buildings along Hickson Road, being primarily due to traffic on that road, as well as the Western Distributor at higher building levels.

5.3.2 Discussion

The predicted worst case noise levels (i.e. facades fronting Hickson Road) are 66-67dB(A) $L_{eq\ 1\ hour}$. It is noted:

- The predicted traffic noise levels are relatively moderate.
- The corresponding night-time (9hr) noise level would be up to approximately 61-62 dB(A) at the most exposed facades. The sleeping room internal "windows closed" noise criterion of 35dB(A) $L_{eq(9hour)}$ could typically be satisfied by medium to heavyweight single glazing.
- The corresponding daytime (15hr) noise level would be up to approximately 65-66dB(A) at the most exposed facades. The "other than sleeping room" internal noise criterion of 40dB(A) $L_{eq(15\ hour)}$ could typically be satisfied by medium to heavyweight single glazing.

In summary, traffic noise intrusion into the residential component of the Central Barangaroo development could be mitigated with moderate acoustic treatment to the façade, and the provision of an alternative ventilation supply complying with the BCA to the most exposed facades (refer below).

Assessment of traffic noise intrusion into the commercial component of the development is not mandatory and, in any case, would typically be addressed as part of the specific design of each building to ensure suitable internal acoustic amenity reflective of the use.

5.3.3 Natural Ventilation

The Infrastructure SEPP contains provisions for internal noise levels under naturally ventilated conditions. With windows open, the allowable internal noise goal is permitted to be 10dB(A) higher than when the windows are closed (i.e. – allowable level becomes 50 dB(A) in living rooms, and 45 dB(A) in bedrooms at night).

With open windows, sufficient to satisfy the BCA (i.e. 5% of floor area), the external to internal noise reduction typically is 10dB(A). The external "ventilation criteria" thus becomes 60dB(A) $L_{eq(15\ hour)}$ for living areas and 55dB(A) $L_{eq(9\ hour)}$ for bedrooms. Where the external traffic noise level exceeds these values, alternative sources of ventilation may be required.

One method of complying with the "windows open " requirement is the use of wintergardens. These provide an additional noise buffer between the external façade and windows of habitable rooms facing onto the wintergardens.

Wintergardens having an acoustically absorptive ceiling and a reduced opening in the façade can reduce internal noise levels by 5 dB(A) or more. Consequently, the permissible façade noise level before an alternative ventilation system is needed can be increased to at least 65dB(A) $L_{eq(15\ hour)}$ for living areas and 60dB(A) $L_{eq(9\ hour)}$ for bedrooms. Consideration can be given to the provision of wintergardens on facades impacted by significant external noise sources such that sufficient acoustic amenity can be provided to occupants within the apartment without having to introduce additional mechanical ventilation.

5.4 WATERFRONT PUBLIC DOMAIN

Central Barangaroo incorporates a public domain area along the waterfront which may be utilised for entertainment and community activities, concerts, performances, and the like.

To our knowledge a specific assessment has not been prepared to assess activities in the waterfront area, or to address potential noise impacts to existing and future sensitive receivers within the Central Barangaroo and Barangaroo South areas.

The public domain will likely involve sporadic live performance events and community events throughout the calendar year. Noise from the public domain will be controlled in accordance with its own specific management plan. In any case, we would anticipate that the requirements of the City of Sydney Council 'Event Guidelines' dated February 2018 would be adopted for such a space. Condition 54 of the document nominates the following:

54. Noise from any amplified music or notification system used at the event must not exceed 65 $L_{Aeq\ 15\ minute}$ when measured [at the nearest affected receiver].

There are no specific requirements relating to the operation of events in the waterfront public domain and the potential to impact surrounding residential receivers. In respect of residential receivers, assuming these events will be relatively infrequent and time limited to between 7am and 10pm, the adoption of a noise level criterion 5 dB(A) higher than the 40 dB(A) $L_{eq\ (15hour)}$ traffic noise criterion would be reasonable. The most impacted facades would need to provide 20 dB(A) noise reduction, which would typically be provided by a standard façade.

The above analysis does include rare events such as New Year's Eve where higher levels of noise generation might be expected, and for which additional mitigation is not warranted.

6 METRO NOISE AND VIBRATION IMPACTS ON THE SUBJECT DEVELOPMENT

The Metro will be completed prior to occupation of the subject development, therefore only operational noise and vibration impacts on the subject development from the Metro need to be considered.

The Metro is underground in the vicinity of the subject development, so the impacts will largely be limited to those produced by ground-borne vibrations and ventilation openings.

Noise and vibration impacts from the Metro have been assessed as part of the EIS for that project. The EIS Statement (May 2016) Technical Paper 2 Noise and Vibration (SLR, 28/4/2016) establishes noise and vibration criteria for the project that are broadly in accordance with SEPP, Department of Planning and EPA guidelines.

6.1 TRACK ISOLATION

We have been advised by Sydney Metro (refer Appendix 1) that the track in the vicinity of Barangaroo be provided with "high attenuation" track and that all relevant receivers have been considered when assessing noise/vibration levels.

With this treatment in place, it is expected that residential receivers above the railway track at Barangaroo will be subject to noise and vibration levels below the assessment criteria.

On this basis, the proposed development would not need to incorporate additional railway vibration mitigation, as the "at track" treatment proposed to be installed by the Metro will fully mitigate ground borne vibration impacts for the expected uses in the subject development.

As the Metro will be completed prior to the construction of Barangaroo Central, prior to final design it would be prudent to confirm the conclusions of the previous assessment by measurement (that is, that tactile vibration and structure-radiated noise levels will comply with the recommendations of the DNRCBR guideline without further treatment).

6.2 NOISE FROM RAILWAY VENTILATION SYSTEMS

The referenced railway EIS technical paper also indicates the criteria that will be used to assess noise emissions from tunnel and station ventilation systems based on monitoring conducted for that project. Table 103 (repeated below) nominates the noise criteria that will be applied to the Barangaroo Station:

Location	Operational Noise Source	Nearest Receiver Type	Address	Distance to Nearest Boundary or Facade	Reference[2]	External Noise Criteria (dBA)[1]
Victoria Cross Station	N Service building	Residential	31 Mclaren Street, North Sydney	40 m	B18	56
		Commercial	194 Miller Street, North Sydney	20 m	N/A	65
	S Service building (incl Traction substation)	Commercial	65 Berry Street, North Sydney	<10 m	N/A	65
Barangaroo Station	N Service building and ventilation risers	Residential	14-16 High St, Millers Point	20 m	B12	45
	S Service building and ventilation risers	Residential	66 High St, Millers Point	20 m	B12	45
	Traction Substation and minor ventilation risers	Residential	New proposed developments	10 m	B12	45

It is noted that future residential receivers have been addressed in the assessment. Compliance with the recommendations of the technical paper adequately address any potential impacts to the most sensitive of the land uses proposed for Central Barangaroo.

Notwithstanding that above assessment, it is noted that the proposed MOD 9 for Central Barangaroo seeks to amend Barangaroo Concept Plan with changes to building height, overall GFA and an adjustment to land use zoning and not seeking detailed consent for particular uses. When detailed DA plans are prepared for particular stages of the precinct, the relevant acoustic assessment can be made to inform the design and assessment of the proposal. Any residual impacts from the railway can be addressed as required to maintain an appropriate level of amenity for the future uses.

7 NOISE FROM OTHER SOURCES WITHIN THE BARANGAROO PRECINCT OUTSIDE BARANGAROO CENTRAL

The potential noise sources include plant and equipment and activities at the Crown resort. Noise emissions from these properties will be limited by the consent conditions applying to those developments.

Notwithstanding, it is noted that the proposed MOD 9 for Central Barangaroo seeks to amend Barangaroo Concept Plan with changes to building height, overall GFA and an adjustment to land use zoning and not seeking detailed consent for particular uses. When detailed DA plans are prepared for particular stages of the precinct, the relevant acoustic assessment can be made to inform the design and assessment of the proposal. Any residual impacts from other nearby developments can be addressed as required to maintain an appropriate level of amenity for the future uses.

8 OPERATIONAL NOISE GENERATION

Potential noise sources on the site would include activity based noise sources (principally from food and beverage and entertainment outlets) and plant and equipment emissions. The development will also generate additional vehicle movements on the adjacent road network.

The guidelines used to assess noise emissions generated by the various noise sources are summarised in the table below.

Table 3 – Summary of Noise Emission Regulations and Authorities

Noise Sources	Authority / Guideline
On-site Noise Sources - Generally	EPA - Noise Policy for Industry
Traffic Generation on Public Roads	EPA - Road Noise Policy
Licensed Premises	Liquor and Gaming – Typical Approval Conditions

8.1 ASSESSMENT GUIDELINES

8.1.1 EPA – Noise Policy for Industry

The Noise Policy for Industry (NPfI) provides guidelines for assessing noise impacts from industrial developments, but can also be used as a guideline for other development. These would typically be applied to stationary plant and equipment (except for emergency plant that operates in case of emergency, power failure or infrequent testing) as well as non-residential related vehicle movements, commercial activities such as noise from loading docks, etc.

The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The NPI has two requirements which must be complied with, namely an amenity criterion and an intrusiveness criterion.

8.1.1.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A).

Rating background noise levels for the area have been established from long term unattended noise monitoring as detailed in Section 4.2.

8.1.1.2 Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment. The NPfI sets out acceptable noise levels for various land uses. Table 2.2 on Page 11 of the policy has three categories to distinguish different residential areas. They are rural, suburban and urban.

Pursuant to Section 2.4 of the NPfI, 'Urban' areas are defined as those that have acoustical environments which incorporate the following characteristics:

Urban - an area with an acoustical environment that:

- Is dominated by 'urban hum' or industrial source noise
- Has through traffic characteristically heavy and continuous traffic flows during peak periods
- Is near commercial districts or industrial districts
- Has any combination of the above,

  Where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

The residential receivers are best described as being in an "Urban" environment.

The NPfI requires project amenity noise levels to be calculated in the following manner;

- $L_{Aeq,15min}$ = *Recommended Amenity Noise Level – 5 dB(A) + 3 dB(A)*

The proposal is located in an urban environment within close proximity to commercial districts and major arterial roads. On this basis, the 'Urban' category has been adopted, with the following amenity noise emission objectives.

Table 4 – NPfI Amenity Acceptable Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residence	Urban	Day	58
		Evening	48
		Night	43
Commercial premises	All	When in use	63
Active recreation area	All	When in use	53

The amenity and intrusiveness levels should be assessed using the cumulative emissions from the whole development. The amenity criteria applying to receivers already subject to higher levels of traffic or "industrial" may also be modified in accordance with the procedures outlined in the NPfI. This analysis should be undertaken using data obtained from noise monitoring that has been recommended to occur after major construction activity in the area has abated, and prior to construction.

8.1.1.3 Maximum Noise Levels

The guideline is intended to prevent adverse sleep impacts at night for residential receivers. Sleep arousal is a function of both the noise level and the duration of the noise. Sleep arousal criteria in the Noise Policy for Industry include an assessment of *average* ($L_{eq(15min)}$) and momentary peak noise events (L_{max}) from noise events.

The NPfI assesses potential sleep arousal impacts with a two-stage test:

- Step 1 – Section 2.5 Maximum noise level event assessment from the NPfI states the following:

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

- *$L_{Aeq,15min}$ 40dB(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 greater,*

a detailed maximum noise level event assessment should be undertaken.

- Step 2 - If there are noise events that could exceed the average/maximum criteria detailed in the tables above, then an assessment of sleep arousal impact is required to be carried out taking into account the level and frequency of noise events during the night, existing noise sources, etc. This test takes into account the noise level and number of occurrences of each event with the potential to create a noise disturbance. As is recommended in the explanatory notes of the NPfI, this more detailed sleep arousal test can be conducted using the guidelines in the EPA Road Noise Policy.

8.1.2 Licenced Premises - Liquor and Gaming

Liquor and Gaming typically impose separate and more stringent conditions in respect of patron and music noise emissions from licensed premises. The typical requirements are set out below:

- That the L_{10} noise level emitted from the premises shall not exceed 5dB above the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) between the hours of 7.00am to 12.00 midnight when assessed at the boundary of the nearest affected residential premises.
- L_{10} noise level emitted from the premises shall not exceed the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) after midnight when assessed at the boundary of the nearest affected residential premises.
- After midnight, noise emissions are to be inaudible within any habitable room in nearby residential properties.

8.1.3 Traffic Movements on Existing Local Roads

EPA Road Noise Policy provides guidelines for the assessment of land use developments having the potential to create additional traffic movements on local roads. The intent of the Policy is to prevent adverse noise impacts on existing land uses from noise generated by these additional movements.

Table 5 - Criteria for Traffic Noise for New Developments (Residential)

Land Use Development	Time of Day	Criteria for Acceptable Traffic Noise Level Arterial / Sub-Arterial Roads - dB(A)
Residential	Day (7am to 10pm)	60 $L_{Aeq\ (15hr)}$
	Night (10pm to 7am)	55 $L_{Aeq\ (9hr)}$

However, if existing or future noise levels exceed those in the table above, the provisions of Section 3.4 of the Road Noise Policy apply. The Policy relevantly states "*an increase of up to 2dB represents a minor impact that is considered barely perceptible to the average person*". The Policy implies that it is not typically reasonable to mitigate such a small increase in noise.

8.1.4 Emergency, Back-Up Power Generation and Infrequently Operating Plant

Relaxed criteria are usually applied to plant that operates infrequently. This typically applies to emergency power generation equipment and for fire emergency ventilation plant. This plant rarely operates in an emergency, but is subject to regular testing. For residential receivers noise emissions from plant that typically operates less than 4 hours per month can be up to 15 dB(A) higher than the background noise level (day and evening) and 10 dB(A) above the background noise level (night). For other receivers a 10 dB(A) increase above the relevant amenity criterion would be acceptable.

8.2 ASSESSMENT OF OPERATIONAL NOISE IMPACTS

Noise impacts from the development have been addressed for the following:

- Retail and commercial uses;
- Traffic noise generation on existing roadways.
- Services and other stationary plant

Each of these uses are to be addressed in greater deal with each individual use and development DA's. Notwithstanding, commentary in this regard has been provided in principle.

8.2.1 Retail and Commercial Uses

There would be a mix of commercial development including office, general retail and food and beverage uses.

Retail and office uses have a low risk of generating environmental noise impacts. Noise impacts would generally be limited to deliveries and movement of materials which would occur within an enclosed basement.

Food and beverage and entertainment outlets/venues will potentially generate higher levels of noise.

Sound generated within enclosed premises typically can be mitigated by closing the façade and including building acoustic treatments as required to contain noise. The requirements for the enclosure of these noise sources can be determined for each tenancy based on the type of use envisaged, hours of operation, proximity to sensitive receivers, etc.

The predominant source of environmental noise emissions from entertainment and food and beverage outlets will be patrons utilising external dining areas. External dining is seen as socially desirable, but noise emissions generated by these activities are, by their nature, more difficult to mitigate.

A level of noise impact is to be expected, given the nature of the proposed uses and the sites location within the Sydney CBD.

Planning initiatives have been explored in this report to maximise the benefit of external seating whilst reasonably protecting the acoustic amenity of existing residences, and minimising impacts on future residential dwellings within Central Barangaroo.

It is outside the scope of this study to determine in detail the actual impacts from external dining, and the actual activities proposed given the preliminary nature of the design, how many restaurants will take up external dining and the location of those restaurants on the site.

8.2.1.1 Future Residents within Central Barangaroo

The mitigation of noise impacts would involve the implementation of a suite of physical treatment and management practices to address impacts, particularly at night. This may include:

- Placement of outdoor dining spaces where they can be screened from the residential dwellings. Typically they would be located under solid awnings or set back within building overhangs.
- Use of absorptive linings to surfaces where practical to prevent excessive reverberation.
- Limiting of outdoor music noise levels, whether recorded or live.
- Time/external patron/activity restrictions.
- Façade and wintergarden treatments, and the adoption of "windows closed" criteria to the proposed dwellings may be employed to further reduce noise intrusion into habitable spaces of apartments above.

A plan of management should be developed once planning of the precinct is more advanced. The plan of management should evolve from a detailed assessment of potential noise impacts from external dining spaces. It should indicate the physical and management controls that must be implemented in the design of the development, and in the planning and operation of individual tenancies. It should also develop noise generation/emission limits and strategies that balance the retail and social benefit of the food and beverage outlets with residential amenity.

8.2.2 Existing Residents Outside the Development Site

The residential receivers on High Street and north of the Hotel Palisade, and the future residential occupants of the Crown Resort and Lendlease developments would be the most impacted receivers in respect of noise emissions from food and beverage outlets. The cumulative noise emissions to these receivers should fully comply with criteria established using NPfI guidelines, as well as complying with licencing conditions imposed on the tenancies.

A high-level review of outdoor dining areas has been undertaken for potential noise emissions to the residential dwellings.

Noise from external dining areas have been assessed in principle based on indicative seating areas around the perimeter of the precinct. In this regard, the likely cumulative noise impacts of the development can be determined. Noise emissions from these uses have been based on the following:

- A sound power level per patron of 74dB(A) L_{eq} or 77dB(A) L_{10} with 1 in 2 talking at any one time. This noise level would be representative of vocal effort within a loud outdoor dining area.
- Noise breakout from internal areas can be mitigated via acoustic treatments and management controls and as such will be minimal in comparison with outdoor patrons.
- Noise emissions associated with outdoor patrons has been provided in principle. The proposed numbers are not reflective of the final or proposed patron volumes but are included for insight into patron capacities.
- The model assumes that all outdoor dining areas are licensed.

Preliminary analysis had been undertaken to provide an indication of the approximate patron numbers that may be located around the perimeter of the site prior while complying with normal Liquor and Gaming licencing noise levels before midnight. Additional numbers of patrons would be permissible where they are

screened from the existing residences subject to an assessment of noise impact to the residences within Central Barangaroo.

- East perimeter – 50
- West perimeter -600
- South perimeter – 150
- North - perimeter <50

After midnight, background noise levels are lower and the Liquor and Gaming standard criteria are more stringent. Consequently, limited patron numbers would be permitted, particularly on the north, east and south sides. Music played externally at a background level is likely to be possible (depending on the location of the restaurant and the affected receivers) prior to midnight. After, midnight the ability to play external music and achieve compliance with the inaudibility requirement is likely to be limited.

However, it should be noted that:

- The actual limits and patron number and music noise levels would depend on the distribution along the length of the site, the size of individual licensed premises, and the final background noise level given that it may increase as a result of activation of the Barangaroo site.
- Not all tenancies will necessarily operate into the evening period,
- Not all tenancies will incorporate outdoor seating, and
- Not all tenancies will be licensed and less stringent criteria apply to these venues.

A detailed assessment of outdoor dining areas will be conducted as part of future approvals and the development of the plan of management recommended above.

8.3 TRAFFIC GENERATION ON EXISTING ROADS

The potential for traffic generation on existing roads has been assessed using the ARUP 'Transport Management and Accessibility Plan – Mod 9' dated 28th June 2021.

Section 5.2.4 of the assessment indicates:

- A comparison of the traffic generation forecast under the TMAP August 2015 (Mod 8) and the proposed modification (Mod 9) has been undertaken and is summarised in Table 9 and illustrated in Figure 4 of the ARUP report.
- This indicates that, under the proposed amendment to the Concept Plan, the total volume of traffic generated by the entire precinct will be slightly higher when compared with that previously assessed in the TMAP August 2015 (Mod 8).

In this regard we note:

- The potential for traffic noise generation would have been assessed under previous modifications and found not to produce adverse impact;
- Compared to Mod 8, the predicted increase in vehicle movements is very small and not sufficient to produce any audible difference in traffic noise.

On this basis, we can confirm that the potential for additional traffic noise generation under this modification will be negligible and as such compliant with the RNP.

8.4 MECHANICAL PLANT

The proposal will include ancillary mechanical services plant *(e.g. air conditioning, condensing units, ventilation fans, etc)*. As detailed plant selections and plans are not available at this stage, it is not possible to carry out a detailed examination of the ameliorative measures that may be required in order to achieve the project acoustic objectives.

The cumulative level of noise emissions from all plant and equipment should comply with criteria established using NPfI guidelines. It is noted that at locations where activity noise emissions are close to the criteria, the cumulative impact of activity and plant noise should comply with the criteria. This may require plant noise limits to be further lowered at these locations so that the combined noise emissions do not exceed the permissible levels.

Once planning of the precinct is more advanced, noise emission limits for plant and equipment associated with separable portions in the development should be established so as achieve the overall precinct criteria.

9 CONSTRUCTION NOISE AND VIBRATION

The principal objective of this study is to undertake an evaluation of works to be performed during the operation of the various activities during construction and develop a management plan to ensure noise and vibration:

1. Does not excessively impact on the sensitive receivers.
2. Is minimised to all surrounding receivers.
3. Does not exceed OH&S standards at surrounding receivers.
4. Is monitored when potentially high noise and vibration generating activities are being used.

This assessment will formulate/present the relevant noise and vibration objectives for which construction activities should be managed to comply with. Additionally, effective mitigation measures have been recommended where possible to ensure noise and vibration objectives are achieved and impacts are minimised.

The principal issues to be addressed in this Section are:

- Identification of the noise and vibration standards which will be applicable to this project.
- Formulation of a strategy for construction activities to comply with the standards identified in the above point.
- Development of demolition and excavation methods which will minimise the impact on surrounding uses.

The expected activities can be expected to include:

1. Demolition of any existing structures
2. Excavation of soil and sandstone.
3. Construction of proposed facility.

9.1 CONSTRUCTION NOISE MANAGEMENT LEVELS

Noise emanating from the construction site has been assessed in accordance with the recommendations of the EPA ICNG.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic compromises between construction sites and potential noise affected receivers.

Table 6 – Construction Noise Management Levels

Management level, L_{Aeq} (15min)	**How to Apply**
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 75 dB(A)	• The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur

Where construction works may be required to be undertaken outside of normal construction hours, following is typically adopted.

Table 7 – Construction Noise Management Levels- Out of Normal Hours

Management level, L_{Aeq} (15min)	**How to Apply**
Noise affected RBL + 5dB	• 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

The ICNG provides guidance on construction noise management levels for sensitive uses other than residential dwellings. These uses as detailed in the following Table.

Table 8 – Construction Noise Management Levels

Land Use	Management Level, $L_{Aeq\ (15min)}$ (applies when properties are being used)
Commercial and Retail Outlets	70dB(A)

A summary of noise emission goals for both standard hours of construction and outside standard hours are presented.

Table 9 – Construction Noise Emission Objectives

Location	Time of Day	"Noise Affected" Level dB(A) $L_{eq\ (15min)}$	"Highly Noise Affected" Level dB(A)$L_{eq(15min)}$
Residences	Standard construction hours	RBL + 10dB(A)	75
	Outside recommended standard hours	RBL + 5dB(A)	-
Commercial Development	When in use	70	N/A

9.2 CONSTRUCTION VIBRATION

Vibration goals for the amenity of nearby land users are those recommended by the EPA document *Assessing Vibration: A technical guideline.* These levels are presented below:

Table 10 – Construction Vibration Management Levels

Location	Time	Peak velocity (mm/s)	
		Preferred	Maximum
Continuous Vibration			
Residences	Daytime	0.28	0.56
Commercial	When in use	0.56	1.12
Impulsive Vibration			
Residences	Daytime	8.6	17
Commercial	When in use	18	36

9.3 ASSESSMENT OF CONSTRUCTION NOISE

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken. Work close to the eastern and western boundaries of the site will potentially impact existing residential dwellings and the Crown Resort respectively.

A detailed acoustic assessment of individual activities cannot be undertaken prior to knowing the activities/construction methods proposed, and their duration and location. The following is discussed in principle.

9.3.1 Excavation Works

Excavation works is expected to have no greater impact on surrounding receivers than the existing site works. Notwithstanding it is expected that rock excavation using hydraulic hammers would likely exceed the residential noise management levels and should be managed in accordance with the management plan.

9.3.2 General Construction Works

- During erection of structure, it is the use of hand tools (angle grinders etc.) and concrete pumps which are the loudest typical activity (sound power levels of approximately 105dB(A)Leq(15min)).
    - Construction noise levels from concrete pumps and the like may marginally exceed the EPA "Noise Affected"/"Background+10dB(A)" management levels at residential receivers. Exceedances of the "Highly Noise Effected" level of 75dB(A) will be typically unlikely.
    - Noise levels at commercial receivers across Hickson Road are unlikely to exceed the 70dB(A) "Noise Affected" level.
- Noise from construction vehicles and material handling are unlikely to exceed the EPA "Noise Effected"/"Background+10dB(A)" management level. Exceedances of the "Highly Noise Effected" noise level are unlikely to occur.
- Slab finishing works (use of helicopter floats or similar) may potentially extend into the evening depending on the size of the slab and weather conditions. Where structure levels are at similar height to the High Street receivers, exceedances of the "Noise Effected"/"Background+10dB(A)" may occur. Exceedances of the "Highly Noise Effected" level of 75dB(A) at the residences would be unlikely to occur.
- Once construction of the building shell is complete, noise from hand tools will be relatively low, as the new building façade will provide considerable noise attenuation. Once the building shell is largely complete, use of hand tools in internal areas is unlikely to exceed EPA recommended levels at any sensitive receiver locations.

9.4 DISCUSSION

In light of the above, we recommend:

- Location of concrete pumps such that they are screened from residential receivers where practical. Where concrete pumps cannot be screened, maximum proximity to residential receivers should be maintained as practical.
- Concrete agitator trucks should not arrive at the site outside of the approved construction hours.
- For activities where acoustic controls and management techniques still cannot achieve the "Noise Management"/"Background+10dB(A)" noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes.

- In any case, close consultation with residential stakeholders should be undertaken to ensure that noise associated with concrete pours and intense construction works is managed accordingly.

Through adoption of the above, noise impacts on nearby development can be suitably managed to prevent unreasonable impact.

Management processes for dealing with construction noise complaints and response procedures are addressed in Section 0.

9.5 CONSTRUCTION VIBRATION

With the exception of the Metro, given the proximity to surrounding receiver locations, there will be no significant vibration impact associated with the construction works.

Construction activities will occur above the Metro and management of certain activities (principally demolition and excavation) will be required in order to protect these assets.

Transport for NSW, Sydney Metro – Technical Services – *Sydney Metro Underground Corridor Protection Technical Guidelines* (dated 16th October 2017, Reference: NWRLSRT-PBA-SRT-TU-REP-000008, Revision 1) provides noise and vibration criteria. The relevant sections from this document are provided below.

All construction activities should have regard for the requirements of the guideline and monitoring requirements imposed by Clause 9.3. An assessment of likely vibration levels should be undertaken as part of the development of the project construction noise and vibration management plan. The plan should include a regime of continuous vibration monitoring of tunnel/asset vibration levels where construction activities are within the nominated distances or where vibration levels are expected to exceed the nominated limits. Vibration monitors should be capable of providing SMS alert if trigger levels are exceeded.

9.3 Noise and vibration

The noise from construction and rail operation must be considered against statutory and project noise vibration limit requirements. TfNSW does not accept liability for the generation of noise and vibration from normal railway operations (including track maintenance), or for its transmission into developments above or adjacent to rail tunnels.

When designing developments above or adjacent to rail tunnels (existing or planned), consideration must be given to operational and construction vibration; as well as ground or structure borne noise emissions in accordance with Developments Near Rail Corridor and Busy Roads – Interim Guideline, Department of Planning, NSW Government 2008.

In planning development construction the following requirements apply.

Any development that occurs within a screening distance of 25 m horizontally from first reserve must consider the vibration on the metro infrastructure with the following assessment criteria of maximum peak particle velocity (PPV):

- 15 mm/s for tunnel and cavern cast insitu concrete linings that are in good condition.
- 20 mm/s at the running tunnels supported using a precast concrete segment lining.

It is important to note that more stringent limits may apply if rail equipment, that is sensitive to vibration, has the potentia to be affected by the development and its construction.

During development construction vibration monitoring may be required of the underground metro support, such as concrete linings. This monitoring must be conducted based on the selection of appropriate trigger levels.

If the vibration levels exceed tolerable limits, then the developer must modify the construction methodology in such a way that the vibration limits are satisfied.

Figure 3: Extract of Section 9.3 *Noise and Vibration*

9.6 NOISE AND VIBRATION MONITORING, REPORTING AND RESPONSE PROCEDURES

Noise and vibration monitoring may either consist of manned and/or unmanned measurements. Active monitoring may be undertaken during the construction work phase of the project if required in the event complaints are received from neighbours. In the event that complaints are received from neighbours the following process should be considered:

1. Determining the offending plant/equipment/process
2. Locating the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implementing additional acoustic treatment in the form of localised barriers, silencers etc.
4. Selecting alternative equipment/processes

Where monitoring is required and indicates exceedances of the noise limits immediate action should be taken to identify any further controls as required to reduce noise emissions so that the noise limits are complied with. Monitoring of the activities following the implementation of these additional controls will be undertaken to confirm compliance.

Vibration monitoring of Metro infrastructure should be undertaken as described above.

9.6.1 Reporting requirements

The following is an example of reporting which may be kept on site;

1. A register of complaints received/communication with the local community shall be maintained and kept on site with information as detailed below.
2. Where noise/vibration complaints require noise/vibration monitoring, results from monitoring shall be retained on site at all times.
3. Any noise exceedances occurring including, the actions taken and results of follow up monitoring.
4. A report detailing complaints received and actions taken shall be presented.
5. All monitoring and reporting shall be conducted in conjunction with the conditions of consent.

9.6.2 Response Procedures

Complaints associated with noise and vibration generated by site activities shall be recorded on a Noise Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager and the general public and their contact telephone number

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form may list:

- The name and address of the complainant (if provided).
- The time and date the complaint was received.
- The nature of the complaint and the time and date the noise was heard.
- The name of the employee who received the complaint.
- Actions taken to investigate the complaint, and a summary of the results of the investigation.
- Indicate what operations were occurring on site at the time of the complaint.
- Required remedial action, if required
- Validation of the remedial action.

- Summary of feedback to the complainant.

9.6.3 Control of Construction Noise

The flow charts that follow illustrate the process followed to assess construction activities prior to the start of work on site and well as the ongoing investigation into noise during the construction period.

9.7 NOISE CONTROL METHODS

The determination of appropriate additional noise control measures will be dependent on the particular activities and the construction equipment and plant identified as requiring future acoustic treatments to those already identified in this report. This section provides an outline of available methods which have previously been used on similar construction sites and may be possible on this site.

9.7.1 Selection of Alternate Appliance or Process

Where a particular activity or plant and equipment is found to generate noise levels that exceed the criteria, it may be possible to select an alternative approach or plant and equipment. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying this activity by use of pneumatic hammers or concrete saws, construction noise levels and/or length of exposure to construction noise levels may be reduced.

9.7.2 Acoustic Barriers

The placement of barriers at the source is generally only effective for static plant. Placing barriers at the source cannot effectively attenuate equipment which is on the move or working in rough or undulating terrain.

The degree of noise reduction provided by barriers is dependent on the amount by which the line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where the barrier does not obstruct line of sight, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers.

9.7.3 Silencing Devices

Where construction methodologies or plant and equipment noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

9.7.4 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

9.7.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes investigating the possibility of locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

9.8 NOISE AND VIBRATION MANAGEMENT PLAN

All future applications for building works should be accompanied by a project specific noise and vibration management plan, which should be updated prior to commencing works, to manage noise and vibration impacts. The plan should be revised as the works proceed in response to changing or latent conditions and to incorporate the results of additional analysis, monitoring or modified work practices implemented to minimise impacts.

The management plan should be prepared in accordance with IGNG guidelines and include:

- Identification of sensitive receivers and applicable noise and vibration management levels
- A description of the main noise or vibration producing activities, processes and equipment that will be employed and an indicative construction programme.
- Proposed construction hours.
- A prediction of likely noise/vibration levels at the most impacted receivers.
- The assessment and recommendation of mitigation methods to be applied where the predicted levels exceed the management levels.
- A monitoring plan including the type and extent of monitoring, reporting procedures.
- Recommended management procedures including complaints handling, response to monitoring exceedences, reporting, site training, etc.
- Community liaison.

Figure 4: Process Flowchart

10 CONCLUSION

This report presents the assessment of noise impacts associated with the proposed Mod 9 application for the Central Barangaroo development. The outcomes of the assessment are:

Traffic Noise Intrusion

Traffic noise intrusion into the development (principally from Hickson Road and the Western Distributer) is capable of being mitigated by adopting appropriate façade constructions and providing alternative ventilation to habitable spaces using the criteria adopted in DNRCBR, Infrastructure SEPP and the ADG.

Operational and Traffic Noise Impacts on Nearby Properties

The following noise emission sources have been identified and addressed in the report:

- Retail food and beverage tenancies (which may have the ability to trade 24 hours per day/7 days per week)
- Mechanical plant and equipment
- Traffic noise generation on public roads

The preliminary assessment undertaken indicates the proposed development is capable of complying with noise emission criteria at all surrounding receivers providing appropriate mitigation and management measures are adopted.

A management plan should be developed in order to regulate development of food and beverage outlets, particularly in respect of external dining, given that they may trade 24 hours. The purpose of the management plan is to ensure a satisfactory balance between enabling community and entertainment uses against the provision of adequate acoustic amenity for existing and future receivers. It should consider the mitigating effect of any treatment provided to the façades of new dwellings within the subject development or to the food and beverage outlets, and recommend noise emission limits for each tenancy so that the noise criteria are not exceeded.

Noise emissions from plant and equipment is capable of being fully mitigated through appropriate siting, selection and treatment. The cumulative noise level from site (including plant and activity-related noise) should not exceed criteria established using the EPA NPfI guideline and (where applicable) liquor licence conditions.

Traffic generation forecasts included with the Mod 9 assessment (Barangaroo Concept Plan (MP06_0612 MOD 9) Transport Management and Accessibility Plan – MOD 09 (Arup, Rev A 28/06/2021) predict, using worst case assumptions, an increase in vehicle movements compared to the MOD 8 assessment. This is partly due to an increased allowance for of bus movements on Hickson Road. The increase in vehicle movements is very minor and traffic noise generated would not be perceptively different to the Mod 8 predictions and assessment, which concluded that there would be no adverse traffic noise impacts.

Construction Noise and Vibration Emissions

The site is surrounded by existing residential, community and commercial uses, and is located above railway infrastructure (metro). As with all major development occurring near sensitive receivers, these receivers will be impacted by construction-related activities. Accordingly, construction noise and vibration emissions should be managed in accordance with the IGNG (generally), Transport for NSW, Sydney Metro – Technical Services – *Sydney Metro Underground Corridor Protection Technical Guidelines* (dated 16th October 2017, Reference: NWRLSRT-PBA-SRT-TU-REP-000008, Revision 1) and Transport for NSW, "Development Near Rail Tunnels" (2018).

Prior to the commencement of construction, a Construction Noise and Vibration Management Plan (in accordance with ICNG recommendations and the recommendations of this assessment) should be developed to manage potential impacts to surrounding receivers. Implementation of this plan will ensure that potential impacts are adequately mitigated.

Metro Noise and Vibration Impacts on the Subject Development

The proposed development would not need to incorporate additional railway vibration mitigation, as the "at track" treatment proposed to be installed by the Metro developers will likely fully mitigate ground borne vibration impacts for all expected uses within the subject development.

Acoustic Logic Consultancy Pty Ltd
Victor Fattoretto
MAAS MIE(Aust)

APPENDIX – ADVICE FROM SYDNEY METRO

Victor Fattoretto

From: Sydney Metro <Sydneymetro@transport.nsw.gov.au>
Sent: Friday, 16 July 2021 11:32 AM
To: Victor Fattoretto
Subject: RE: Barangaroo Station (and adjacent) Track Isolation.

Follow Up Flag: Follow up
Flag Status: Completed

Hello Victor

At Barangaroo Station (and the track alignment either side of the station), the trackform will comprise of Baseplated Concrete Sleepers, with these sleepers and bearers cast within the concrete track slab. This would be considered as 'high attenuation track' as specified within the EIS (this transitions to 'standard attenuation track' beneath the harbour). Therefore, the track design around Barangaroo is considered to exceed the minimum requirements set within the EIS.

The permissible vibration levels vary depending on the purpose/function of the receiver. Sydney Metro have undertaken detailed modelling and testing to ensure that noise and vibration generated by the future trains on the selected trackform will meet all noise and vibration requirements for all relevant sensitive receivers.

This analysis will be validated during the testing and commissioning works that will be completed by Sydney Metro prior to the opening of Sydney Metro City & Southwest. Results from these tests will be submitted to demonstrate compliance with the relevant requirements and gain the required approvals from the Department of Planning, Industry & Environment.

I hope this information is of some assistance, please don't hesitate to contact us again if you have any further questions.

Cheers, James

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