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71-79 MACQUARIE STREET, SYDNEY

NOISE AND VIBRATION IMPACT ASSESSMENT FOR CONCEPT PLAN APPLICATION PHASE

TF321-01F03 (REV 0) NOISE ASSESSEMENT REPORT

2 NOVEMBER 2011

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EXECUTIVE SUMMARY

Renzo Tonin & Associates was engaged to undertake a review of noise and vibration factors relating to the proposed residential and serviced apartment development project at 71-79 Macquarie Street, Sydney to accompany an application for a Part 3A Concept Plan approval. The review responds to the following Director Generals requirements;

1. Relevant EPI's, policies and guidelines

Planning provisions applying to the site, including permissibility and the provisions of all plans and policies including:

- *State Environmental Planning Policy (Infrastructure) 2007*
- *Development near Rail Corridors and Busy Roads – Interim Guideline 2008*

3. Urban Design

The sustainable design principles incorporated into the development in terms of sunlight, natural ventilation, wind, reflectivity, visual and acoustic privacy, safety and security, resources, and water and energy efficiency.

4. Environmental and Residential Amenity

The EA must address solar access, acoustic privacy, visual privacy, view loss and achieve a high level of environmental and residential amenity. In this regard, the EA should consider appropriate distances to any adjacent residential buildings and road and rail infrastructure.

16. Air, Noise and Odour Quality

Identify potential air quality, noise and odour impacts, in particular during the construction and operation of the development and appropriate mitigation measures.

From our assessment of the proposed development, the following site specific acoustic factors were identified;

- Traffic noise intrusion from surrounding roads such as Macquarie Street and predominately the Cahill Expressway;
- Airborne rail noise intrusion from train pass-bys associated with the adjacent City Circle railway line into proposed development;
- Ground-borne noise or structure-borne noise and vibration intrusion from train pass-bys associated with the adjacent City Circle railway line into noise-sensitive areas of the proposed development;

- Airborne noise from other ambient noise sources such as ferries located at nearby wharfs and harbour activities as well as general pedestrian noise and activities;
- Operational noise emission from mechanical plant rooms on dedicated floor levels of the building onto areas of the proposed development and existing adjacent buildings; and
- Noise and vibration generated from construction activities and equipment.

This report presents an assessment of the above acoustic factors in terms of current Australian Standards, Railcorp and Department of Planning publications, NSW Office of Environment and Heritage (OEH) Policy and requirements of the City of Sydney Council.

External Noise Intrusion into the Development

External noise intrusion into the development has been assessed in accordance with relevant Australian Standards, SEPP's, Department of Planning publications and OEH Policy documents. The objectives of the noise criteria are to ensure appropriate internal noise amenity for residential dwellings. The major noise intrusion sources were determined to be road traffic and rail noise. Regenerated noise (noise that propagates through a structure as vibration and is radiated by vibrating walls and floor surfaces) can be addressed through the design of the new building structure and the specific requirements will be determined during the detailed design phase.

The relevant internal noise criteria can be readily addressed through appropriate design and specification of the building envelope. Our assessment has established that a combination of laminated glass and double glazing will be required on all external building facades.

Noise Emission Generated by the Development

Noise from mechanical plant such as exhaust systems, air-conditioning, mechanical ventilation and refrigeration associated with the development is to be controlled to meet relevant noise criteria at nearby commercial and residential properties. As details of mechanical plant are not available at this stage of the development, in-principle noise control advice is presented in this report.

Construction Noise

The major construction activities proposed on this site are demolition and excavation works, concrete pours and general building works. Construction and building work is to be managed in accordance with the NSW Interim Construction Noise Guideline so as to minimise disruption to the local community and the environment. As details of construction equipment and operating times are not available at this stage of the project, in-principle noise and vibration measures are provided in this report.

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1 INTRODUCTION

Renzo Tonin & Associates was engaged to conduct an environmental noise assessment of the proposed residential and serviced apartment development at 71-79 Macquarie Street, Sydney for the Concept Plan Application submission. This report presents a preliminary assessment of noise intrusion into and operational noise emission from the development in terms of current Australian Standards, SEPP's, Railcorp and Department of Planning publications, NSW Office of Environment and Heritage (OEH) Policy and requirements of City of Sydney Council. The assessment primarily responds to the following Director General's requirements;

1. Relevant EPI's, policies and guidelines

Planning provisions applying to the site, including permissibility and the provisions of all plans and policies including:

- *State Environmental Planning Policy (Infrastructure) 2007*
- *Development near Rail Corridors and Busy Roads – Interim Guideline 2008*

3. Urban Design

The sustainable design principles incorporated into the development in terms of sunlight, natural ventilation, wind, reflectivity, visual and acoustic privacy, safety and security, resources, and water and energy efficiency.

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The EA must address solar access, acoustic privacy, visual privacy, view loss and achieve a high level of environmental and residential amenity. In this regard, the EA should consider appropriate distances to any adjacent residential buildings and road and rail infrastructure.

16. Air, Noise and Odour Quality

Identify potential air quality, noise and odour impacts, in particular during the construction and operation of the development and appropriate mitigation measures.

The following site specific acoustic factors were identified;

- Traffic noise intrusion from surrounding roads such as Macquarie Street and predominately the Cahill Expressway;
- Airborne rail noise intrusion from train pass-bys associated with the adjacent City Circle railway line into proposed development;

- Ground-borne noise or structure-borne noise and vibration intrusion from train pass-bys associated with the adjacent City Circle railway line into noise-sensitive areas of the proposed development;

- Airborne noise from other ambient noise sources such as ferries located at nearby wharfs and harbour activities as well as general pedestrian noise and activities. These type of noise is perceived as a series of discrete noise events;

- Operational noise emission from mechanical plant rooms on dedicated floor levels of the building onto areas of the proposed development and existing adjacent buildings; and

- Noise and vibration generated from construction activities and equipment

In regards to acoustic privacy, this is generally satisfied through the requirements of the Building Code of Australia which all new residential development would need to comply.

Further detailed discussion of the identified acoustic factors is set out within this report. The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 NOISE AND VIBRATION INTRUSION

2.1 Road Traffic Noise Intrusion

2.1.1 Assessment Criteria

Road traffic noise from the surrounding road network, including Macquarie Street on the eastern boundary and Cahill Expressway to the south, should be assessed against the following guidelines and Standards;

1. State Environment Planning Policy (Infrastructure) 2007 (the "ISEPP')
2. "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
3. Australian Standard AS2107:2000 "Recommended Design Sound Levels and Reverberation Times for Building Interiors"

The objectives of the aforementioned noise criteria are to ensure specific internal noise levels are obtained within habitable areas of the residential development. As the ISEPP is the only statutory requirements, it is considered to be the primary noise criteria.

2.1.2 Acoustic Review and Recommendations

Control of road noise intrusion for multi-level apartment buildings is addressed through appropriate design of the building envelope. Whilst orientation of building layouts can assist in reducing the construction requirements, other design principles generally determine the aspect of rooms within multi-level developments. Therefore assessment of noise intrusion from road traffic can be assessed prior to the issue of a construction certificate rather than prior to the issue a Development Consent as the acoustic requirements are unlikely to affect the overall built form. Acoustic recommendations are generally constrained to the specification of windows and doors.

An assessment of road traffic noise intrusion involves the undertaking of long-term noise monitoring on site to establish the extent of existing external road traffic noise, calculation of noise levels to any inaccessible locations (in particular high levels) and/or to account for shielding provided by the subject development, and calculation of internal noise levels to determine the required building envelope design.

Therefore, long-term (unattended) noise monitoring should be conducted during the Project Application phase to determine the extent of road traffic noise levels at the development site. Long-term monitoring would be conducted at the relevant assessment locations, for a period of at least one (1) week.

Renzo Tonin & Associates has previously conducted long-term traffic noise surveys on various parts of the Sydney City CBD. Based on results of these projects, it has been observed that traffic noise levels are typically in the order of 70 to 75dB(A) during peak hour. Typical building façade treatment to achieve compliance with noise levels of 35dB(A) inside bedrooms, as

required by the ISEPP, would be through the use of acoustically sealed laminated glass or double-glazed windows.

2.2 Rail Noise and Vibration Intrusion

2.2.1 Assessment Criteria

The proposed development is located approximately 6m from the nearest City Circle rail way line. New residential developments in proximity to rail corridors are to be assessed against the following;

1. State Environment Planning Policy (Infrastructure) 2007 (the "ISEPP')
2. "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008

The Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline", Section 3.6.3 outlines the following documents which recommend train vibration criteria for residential buildings.

1. Assessing Vibration: A technical guideline (DECC 2006)
2. German Standard DIN 4150, Part 3 1999
3. British Standard BS 7385 Part 2 1993
4. Australian Standard AS2670.2 1990

The above documents have been reviewed and the criterion for assessment of vibration from train pass-bys is to be as follows:

- Assessing Vibration: A technical guideline (DECC 2006)
- British Standard BS6472:1992 *"Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)"*

The criteria curves presented in BS6472:1992 are identical to those in Australian Standard AS2670.2 1990 and International Standard 2631-2:1989.

In addition, Table 2.4 of the Department of Environment Climate Change and Water's document "Assessing Vibration: A technical guideline (DECCW 2006)" presents acceptable vibration dose values for intermittent vibration.

2.2.2 Acoustic Review and Recommendations

In regard to rail noise intrusion, it is expected that road noise would determine the acoustic design of the building envelope, in particular at upper levels of the development. Nevertheless, the ambient noise surveys recommended as part of the road traffic noise investigation will include appropriate monitoring locations for rail noise.

In regard to rail vibration the noise-sensitive floors in this development are separated by basement carpark and from the pedestrian link between Macquarie Street and Circular Quay both provide an additional "buffer zone" to the transmission of vibration for the railway line.

Nonetheless a detailed noise and vibration survey should be conducted during the Project Application phase.

2.3 Other Noise Sources

Noise intrusion from ferries berthed at nearby wharfs and general ambient noise from other activities in the project vicinity will be assessed in accordance with Australian Standard AS2107:2000 "Recommended Design Sound Levels and Reverberation Times for Building Interiors".

Similar design goals to those required for road and rail noise intrusion are recommended for these ambient noise sources. The internal noise goals should be achieved by implementing specific noise control measures such as acoustically sealed laminated windows.

Noise from ship horns are not considered as they are sounded only for safety and emergency reasons.

3 NOISE EMISSION

3.1 Mechanical Plant

Noise emission associated with mechanical plant such as rooftop exhausts, air-conditioning and refrigeration serving the development should be assessed to nearby residential and commercial properties. Although at this stage details of mechanical plant have not been finalised, the following in-principal advice is provided.

- Acoustic assessment of mechanical services equipment will need to be undertaken during the detailed design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in OEH's Industrial Noise Policy;

- An assessment of site noise emission involves the undertaking of long-term noise monitoring at the nearest most potentially affected neighbouring residential or commercial premises, calculation of noise emission levels from proposed equipment, and determination of acoustic control measures if required.

- Therefore, long-term (unattended) noise monitoring should be conducted during the Project Application phase to determine the noise goals applicable to the final design of the project. Long-term monitoring would be conducted at the relevant assessment locations, for a period of at least one (1) week.

- As noise control treatment can affect the performance of the mechanical services system, it is recommend that consultation with an acoustic consultant be made during the initial phase of mechanical services system design in order to reduce the need for revision of mechanical plant and noise control treatment.

- Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following where necessary:

    - strategic positioning of plant away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises,
    - commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
    - acoustically lined and lagged ductwork;
    - acoustic screens and barriers between plant and sensitive neighbouring premises; and/or
    - partially-enclosed or fully-enclosed acoustic enclosures over plant.

- Mechanical plant shall have their noise specifications and their proposed locations checked prior to their installation on site; and

- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery – Mechanical Vibration".

3.2 Construction Noise

The nature of the construction processes proposed for the development does not present difficulties in ensuring that the associated noise limits at surrounding properties are achieved. The major construction activities proposed on this site are demolition works, excavation works, concrete pours and general building works.

Construction and building work will be adequately managed so as to minimise disruption to the local community and the environment.

The NSW Interim Construction Noise Guideline sets out management noise levels and time restrictions for construction activities. The aims of the guideline are to control and manage noise on all building sites within the local area.

Since detail of the construction equipment such as exact type, size, number and operating time are not know at this stage, in-principle noise control measures are provided in Section 3.2.1 which may be implemented to minimise any noise exceedances to the noise sensitive receptors where that may occur.

3.2.1 General Engineering Noise Control

Implementation of noise control measures, such as those suggested in Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-1981, Appendix E, Table E1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table E2 in Appendix E presents typical examples of noise reductions achievable after treatment of various noise sources. Table E3 in Appendix E presents the relative effectiveness of various forms of noise control treatment.

Table 1 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table 1 – Relative Effectiveness Of Various Forms Of Noise Control, dB(A)

Noise Control Method	Practical Examples	Typical noise reduction possible in practice		Maximum noise reduction possible in practice	
		AS 2436	Renzo Tonin & Assoc.	AS 2436	Renzo Tonin & Assoc.
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	7 to 10	5 to 10	15	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 30	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	15 to 25	15 to 25	60	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436, for this assessment.

Table 2 below identifies possible noise control measures which are applicable on the construction plant likely to be used on site.

Table 2 – Noise Control Measures for Likely Construction Plant

Plant Description	Screening	Acoustic Enclosures	Silencing	Alternative Process
Concrete Saw	✔	✔	x	x
Jack hammers	✔	x	✔	x
Mobile Crane	✔	✔	✔	x
Front End Loader	✔	x	✔	x
Pneumatic Hand Tools (general)	✔	✔	✔	✔
Bulldozer	✔	x	✔	x
Tracked Excavator	✔	x	✔	x
Concrete Trucks	✔	x	✔	x
Delivery Trucks	✔	x	✔	x
Dump Trucks	✔	x	✔	x
Truck (> 20 tonne)	✔	x	✔	x
Welders	✔	✔	x	x
Cherry Picker	✔	x	✔	x
Concrete Pump	✔	✔	✔	✔
Power Generator	✔	✔	✔	x
Light commercial vehicles	✔	x	✔	x
Silenced Air Compressor	✔	✔	✔	✔

To ensure efficient noise attenuation performance is achieved using any of the methods listed above, it is recommended acoustic engineers work closely with the construction contractors and carry out preliminary testing prior to commencement of works.

In addition to physical noise controls, the following general noise management measures should be followed:

- Plant and equipment should be properly maintained
- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel
- Avoid unnecessary noise when carrying out manual operations and when operating plant
- Any equipment not in use for extended periods during construction work should be switched off
- Noise compliance monitoring for all major equipment and activities on site should be undertaken prior to their commencement of work on site.
- In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.
- Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.

Where noise level exceedances cannot be avoided, then consideration should be given to implementing time restrictions and/or providing periods of repose for neighbouring receptors.

4 CONCLUSION

Renzo Tonin & Associates have completed an acoustic assessment of road traffic noise, ground-borne rail noise and vibration impacts onto the proposed residential development in accordance with the Director General's requirements.

Noise and vibration intrusion from the various ambient sources such as road, rail and harbour activities can be addressed through appropriate design and specification of the building envelope. The necessary site surveys, analysis and design should commence during the Project Application phase. From our review of the Concept Plan the proposal does not require reconfiguration of the overall concept design.

Appropriate controls can be incorporated into the building design to achieve a satisfactory accommodation environment consistent with the intended quality of the building and relevant standards.

In principle acoustic advice and noise management measures have been provided to appropriately address noise emission during the construction and operational phases of the development.

We confirm that a detailed acoustic assessment will be undertaken during the Project Application phase of the development.

APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background Noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A):	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
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.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.