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PITT STREET NORTH OVER STATION DEVELOPMENT

Appendix U - Acoustic Report

State Significant Development Development Application (SSD DA)

23 June 2020

Revision [C]

Issue for DPIE

SMCSWSPS-RT&A-SPS-OSN-NA-REP-000002

Sydney Melbourne Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

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19.6.2020	Issue for DPIE	4	C	R Corbett		N Tselios

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Table 1: SEARs requirements

Item	Description of Requirement (EIS report)	Reference
SEARS Plans and Documents	Construction noise and vibration report	Construction Noise and Vibration Management Plan to be prepared during the Construction Certificate Phase
	Operational noise and vibration impact assessment	Operational noise and vibration impacts are assessed in this report

Table 2: Concept approval of Conditions of Consent

Item	Description of Requirement	Section Reference (this report)	Comments
DC B15	Future detailed development application(s) shall provide analysis and assessment of the impacts of construction and include: a. Construction Traffic Management Plan as per condition B18(b) b. Cumulative Construction Impact Assessment (i.e. arising from concurrent construction activity) c. Noise and Vibration Impact Assessment d. Community Consultation and Engagement Plans e. Construction Waste Management Plan f. Air Quality Management Plan The plans referred to above may be prepared as part of a Construction Environmental Management Plan prepared and implemented under the conditions of any consent granted by future development applications, having regard to the Construction Environmental Management Framework and Construction Nosie and Vibration Strategy prepared for the City Metro City and Southwest (CSSI 7400)	-	Identifies need to prepare CNVMP at the CC stage of the development.

Item	Description of Requirement	Section Reference (this report)	Comments
DC B16	Future detailed development application(s) must demonstrate the following noise and vibration requirements consistent with the construction works at the site approved under CSSI 7400 can be met: (a) Vibration from construction activities does not exceed the vibration limits set out in the British Standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration. (b) "…to impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, the Applicant must review the construction methodology and, if necessary, propose additional mitigation measures." (c) Advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures.	Construction Noise and Vibration Management Plan to be prepared during the Construction Certificate Phase and in consultation with the Heritage Consultant	Relevant criteria is presented in Section 8 this report.
DC B21	Noise and Vibration Impact Assessment that identifies and provides a quantitative assessment of the main noise generating sources and activities during operation and including consideration of noise and vibration impacts associated with commercial development above a train station. Details are to be included outlining any mitigation measures necessary to ensure the amenity of future sensitive land uses on the neighbouring sites is protected during the operation of the development. The Noise and Vibration Impact Assessment must address the conclusions and recommendations of the concept stage Report dated August 2018 prepared by Pulse Acoustic Consultancy.	The Over Station Development is Base Building only. Noise and vibration impacts from the commercial building relate to mechanical plant and equipment located within the podium, on level 9 and the roof top. This is assessed in Section 7 of this report	In principle recommendations are made in Section 7 of this report. The site is capable of complying with Condition B21

Table 3 – Update since previous submission

Type of Change	Description of Change	Section Reference (this report) – Include page no
Formatting	Addition of information to title page	Title page
Additional information	Addition of SEARs and Conditions of Consent at beginning of report	Page iv, before Introduction
Update of text	Update of introduction as per Urbis brief	Section 1 - Introduction

1 Introduction

This report has been prepared to accompany a detailed State Significant Development (SSD) development application (DA) for a commercial mixed-use (Over Station Development (OSD) above the new Sydney Metro Pitt Street North Station. The detailed SSD DA is consistent with the Concept Approval (SSD 17_8875) granted for the maximum building envelope on the site, as proposed to be modified.

The Minister for Planning, or their delegate, is the consent authority for the SSD DA and this application is lodged with the NSW Department of Planning, Industry and Environment (NSW DPIE) for assessment.

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARS) Dated 25 October 2019.

The detailed SSD DA seeks development consent for:

- Construction of a new commercial tower approximately 38 storeys.
- The tower includes a maximum GFA, excluding floor space approved in the CSSI.
- Integration with the approved CSSI proposal including though not limited to:
    - Structures, mechanical and electronic systems, and services; and
    - Vertical transfers.
- Use of spaces within the CSSI 'metro box' building envelope for the purposes of:
    - Retail tenancies;
    - Commercial lobby and commercial amenities;
    - Car parking spaces within the podium for the purposes of the commercial premises; and
    - Loading and services access.
- Utilities and services provision.
- Stratum subdivision (staged).

1.1 The Site

The site is located within the Sydney CBD. It has three separate street frontages, Pitt Street to the west, Park Street to the south and Castlereagh Street to the east. The area surrounding the site consists of predominantly commercial high-density buildings and some residential buildings, with finer grain and heritage buildings dispersed throughout.

The site has an approximate area of 3,150.1sqm and is legally described as follows:

- 252 Pitt Street (Lot 20 in DP1255509)

Source: Urbis

Figure 1 – Location Plan

1.2 Sydney Metro Description

Sydney Metro is Australia's biggest public transport program. A new standalone railway, this 21st century network will revolutionise the way Sydney travels.

There are four core components:

1. Sydney Metro Northwest (formerly the 36km North West Rail Link)

This project is now complete and passenger services commenced in May 2019 between Rouse Hill and Chatswood, with a metro train every four minutes in the peak. The project was delivered on time and $1 billion under budget.

2. Sydney Metro City & Southwest

Sydney Metro City & Southwest project includes a new 30km metro line extending metro rail from the end of Metro Northwest at Chatswood, under Sydney Harbour, through new CBD stations and

southwest to Bankstown. It is due to open in 2024 with the ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney Metro City & Southwest will deliver new metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and new underground metro platforms at Central Station. In addition it will upgrade and convert all 11 stations between Sydenham and Bankstown to metro standards.

In 2024, customers will benefit from a new fully-air conditioned Sydney Metro train every four minutes in the peak in each direction with lifts, level platforms and platform screen doors for safety, accessibility and increased security.

3. Sydney Metro West

Sydney Metro West is a new underground railway connecting Greater Parramatta and the Sydney CBD. This once-in-a-century infrastructure investment will transform Sydney for generations to come, doubling rail capacity between these two areas, linking new communities to rail services and supporting employment growth and housing supply between the two CBDs.

The locations of seven proposed metro stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays.

The NSW Government is assessing an optional station at Pyrmont and further planning is underway to determine the location of a new metro station in the Sydney CBD.

4. Sydney Metro – Western Sydney Airport

Metro rail will also service Greater Western Sydney and the new Western Sydney International (Nancy Bird Walton) Airport. The new railway line will become the transport spine for the Western Parkland City's growth for generations to come, connecting communities and travellers with the rest of Sydney's public transport system with a fast, safe and easy metro service. The Australian and NSW governments are equal partners in the delivery of this new railway.

The Sydney Metro Project is illustrated in the figure below.

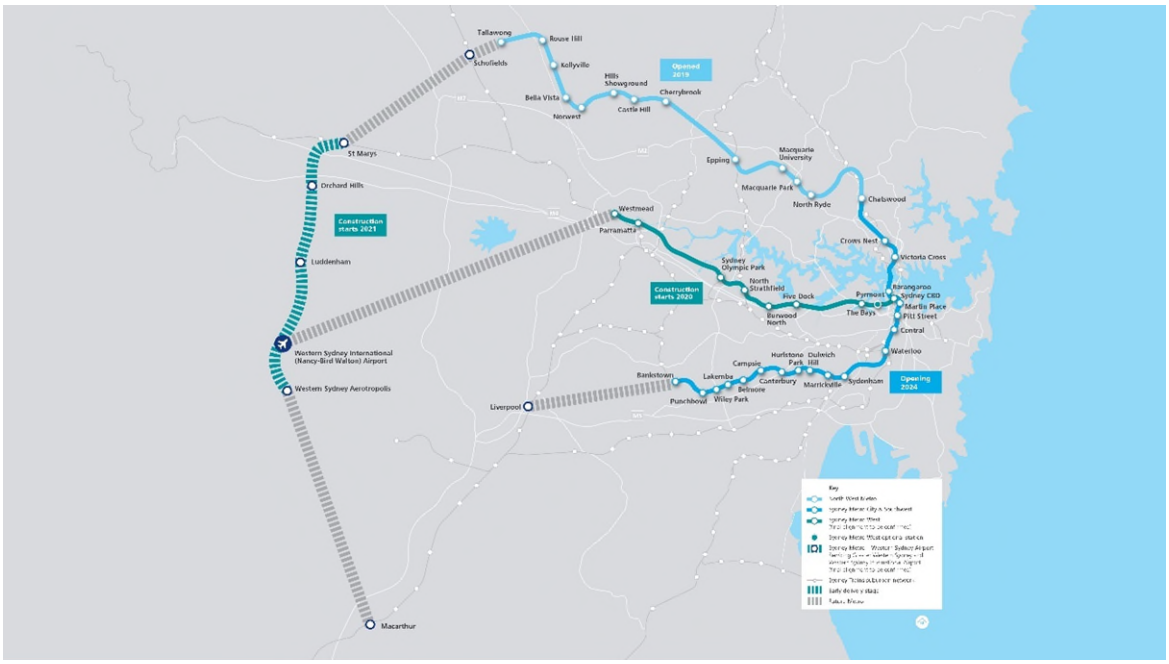
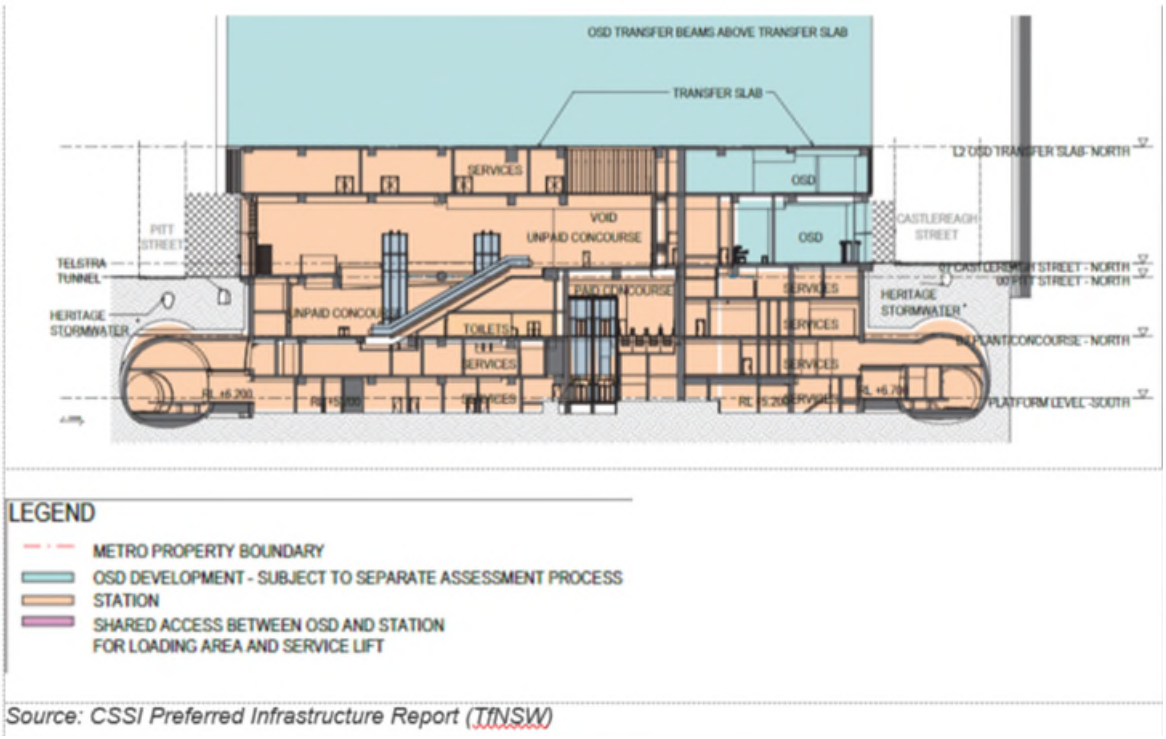


Figure 2 – Sydney Metro Alignment Map

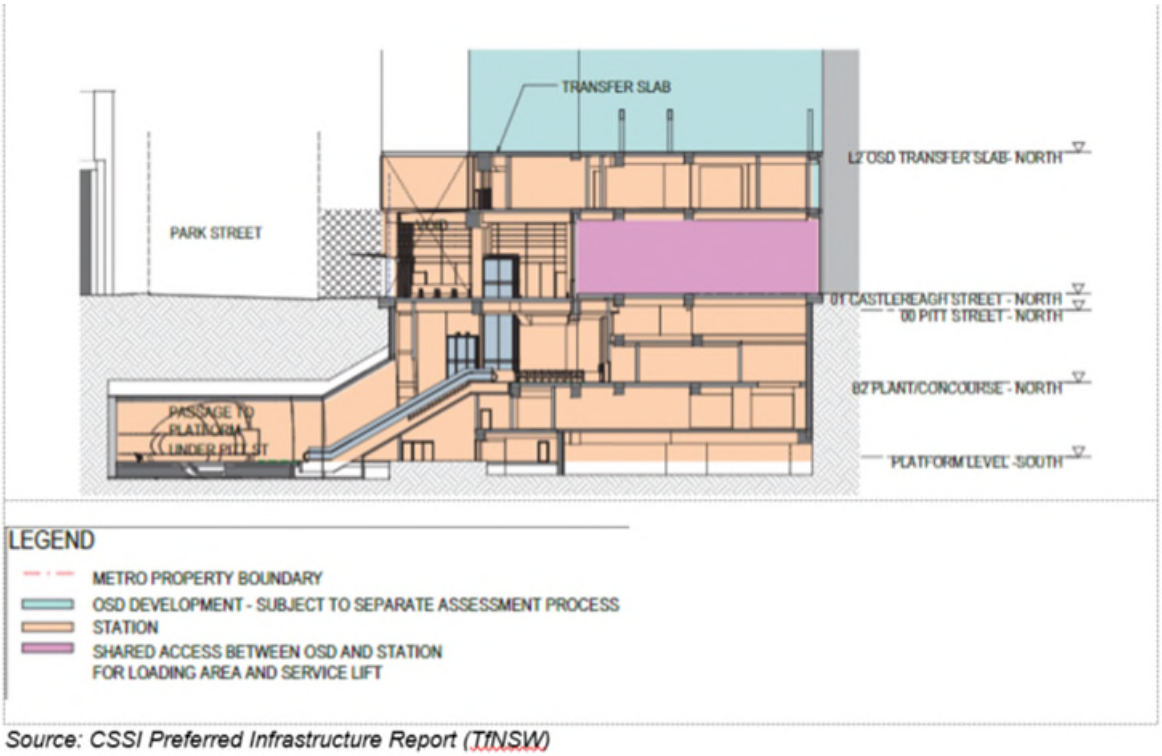
On 9 January 2017, the Minister for Planning approved the Sydney Metro City & Southwest - Chatswood to Sydenham project as a Critical State Significant Infrastructure project (reference SSI 15_7400) (CSSI Approval). The terms of the CSSI Approval includes all works required to construct the Sydney Metro Pitt Street Station, including the demolition of existing buildings and structures on both sites (north and south). The CSSI Approval also includes construction of below and above ground works within the metro station structure for appropriate integration with over station developments.

The CSSI Approval included Indicative Interface Drawings for the below and above ground works at Pitt Street North Metro Station site. The delineation between the approved Sydney Metro works, generally described as within the "metro box", and the Over Station Development (OSD) elements are illustrated below. The delineation line between the CSSI Approved works and the OSD envelope is generally described below or above the transfer slab level respectively.



Source: CSSI Preferred Infrastructure Report (TfNSW)

Figure 3 - Pitt Street Station – North (East-West Section)



Source: CSSI Preferred Infrastructure Report (TfNSW)

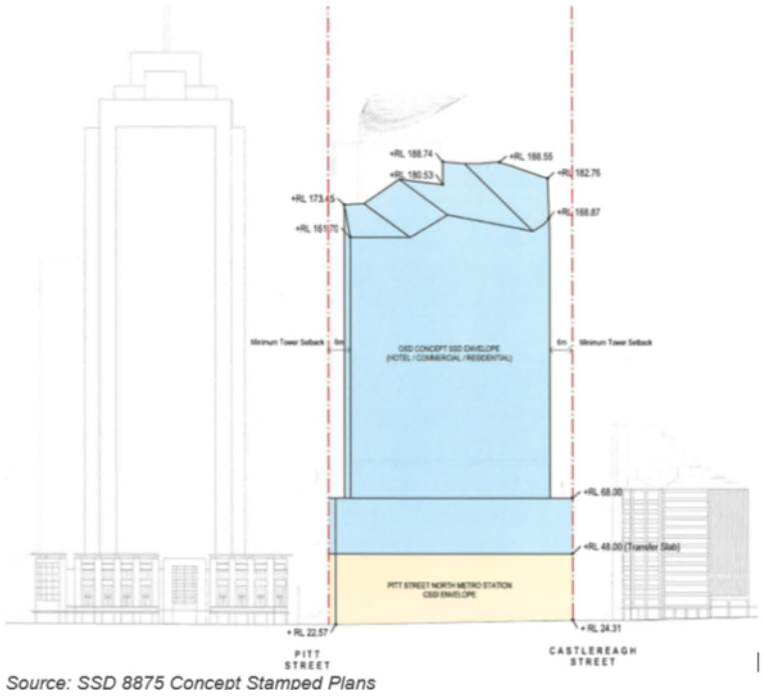
Figure 4 - Pitt Street Station – North (North-South Section)

The Preferred Infrastructure Report (PIR) noted that the integration of the OSD elements and the metro station elements would be subject to the design resolution process, noting that the detailed design of the "metro box" may vary from the concept design assessed within the planning approval.

As such in summary:

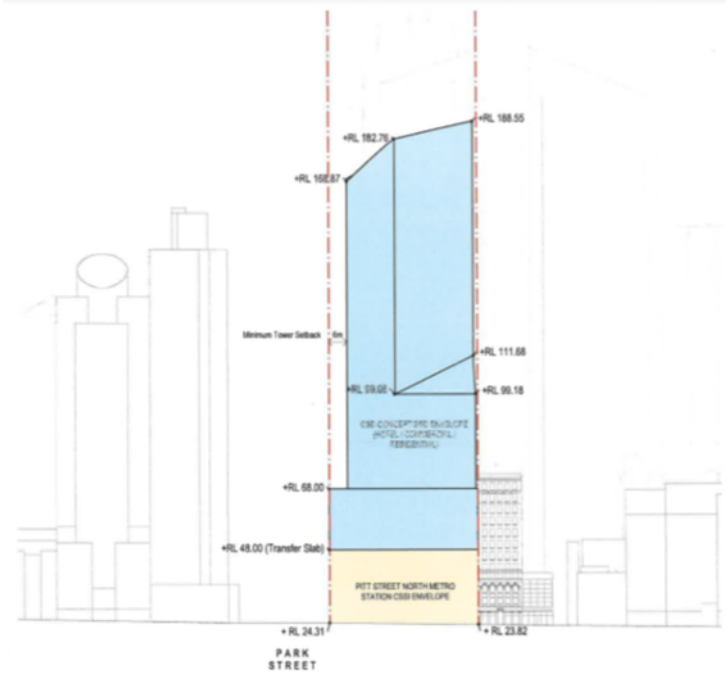
- The CSSI Approval provides consent for the construction of all structures within the approved "metro box" envelope for Pitt Street North.
- The CSSI Approval provides consent for the fit out and use of all areas within the approved "metro box" envelope that relate to the ongoing use and operation of the Sydney Metro.
- The CSSI Approval provides consent for the embellishment of the public domain, and the architectural design of the "metro box" envelope as it relates to the approved Sydney Metro and the approved Pitt Street North Station Design & Precinct Plan.
- Separate development consent however is required to be issued by the NSW DPIE for the use and fit-out of space within the "metro box" envelope for areas related to the OSD, and notably the construction and use of the OSD itself.

As per the requirements of clause 7.20 of the Sydney Local Environmental Plan 2012, as the OSD exceeds a height of 55 metres above ground level (among other triggers), development consent is first required to be issued in a Concept (formerly known as Stage 1) DA. This is described below.



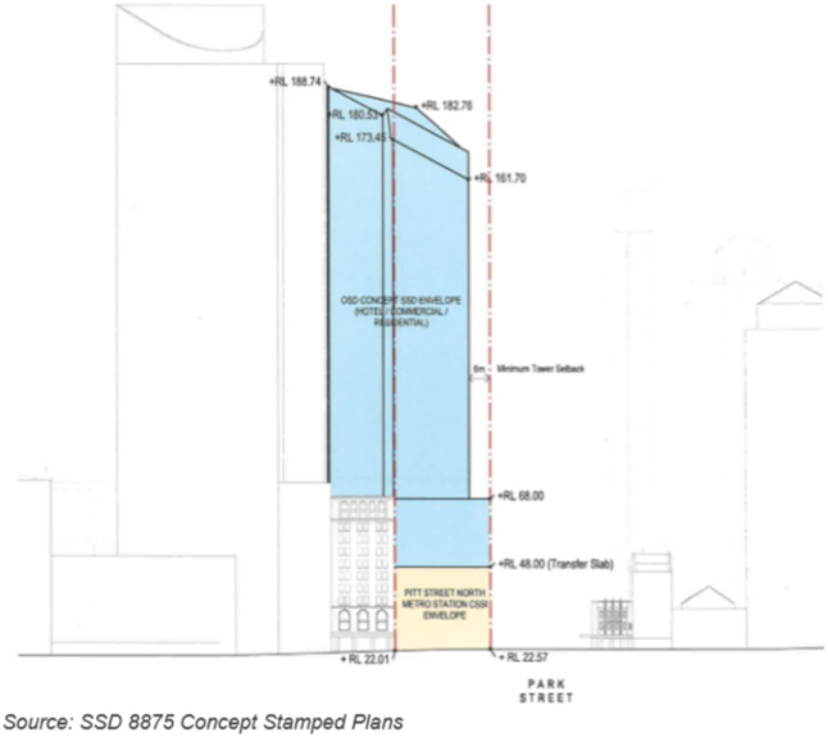
Source: SSD 8875 Concept Stamped Plans

Figure 5 - Pitt Street North Concept SSD DA – Envelope – South Elevation



Source: SSD 8875 Concept Stamped Plans

Figure 6 - Pitt Street North Concept SSD DA – Envelope – East Elevation



Source: SSD 8875 Concept Stamped Plans

Figure 7 - Pitt Street North Concept SSD DA – Envelope – West Elevation

Executive summary

This report presents an assessment of noise and vibration intrusion into, and operational noise from the proposed Pitt Street North Over Station Development. The North Tower is proposed to be a commercial tower.

This study examines the effects of external noise intrusion on the proposed development from nearby ambient noise such as traffic noise, and noise from the surrounding premises including both Residential and Commercial properties.

Noise and vibration measurements undertaken by Renzo Tonin & Associates and GHD have been used to determine the acoustic environment across the proposed development site. Reference is made to the Pitt Street North Over Station Development Acoustic report prepared by GHD Pty Ltd for the Stage 1 DA, which is referenced in the Consolidated Consent dated 28.10.2019.

This assessment relates to the Pitt Street North Over Station Development commercial base building only. Future tenancies may be subject to individual development application approvals and further acoustic assessments depending on the use of the space (e.g. Licensed Restaurant, commercial gymnasium etc).

As a result of our assessment of the following potential acoustic items were identified;

- Existing traffic and urban noise from Pitt, Castlereagh and Park Streets intruding into the development;
- Future vibration and ground borne noise associated with the operation of the Sydney Metro;
- Noise associated with surrounding other commercial premises intruding into the development;
- Mechanical services noise emission from the proposed commercial building; and
- Noise and vibration emission from construction activities and equipment.

This report presents an assessment of the above acoustic components in terms of City of Sydney Council's Development Control Plan 2012, and Australian Standards.

Green Star may also be considered for this development, however this will be addressed separately in design documentation.

The measured ambient noise levels are used to determine criteria in accordance with the City of Sydney Council's DCP 2012 and the NSW Environment Protection Authority's policies.

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. Appendix A contains a glossary of acoustic terms used in this report.

2 Site and surrounds

The site is bound by Pitt Street to the west, Park Street to the south, and Castlereagh Street to the east. It is currently surrounded by residential, hotels, and commercial premises in an urban environment.

Long-term and short-term noise monitoring has been undertaken at the site to determine the existing acoustic environment.

Figure 8- Site Location and Surrounds

3 Criteria

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARS) Dated 25 October 2019. Specifically, this report has been prepared to respond to the SEARS requirements summarised in Table 4 below.

Table 4: SEARs requirements

Item	Description of Requirement (EIS report)	Reference
SEARS Plans and Documents	Construction noise and vibration report	Construction Noise and Vibration Management Plan to be prepared during the Construction Certificate Phase
	Operational noise and vibration impact assessment	Operational noise and vibration impacts are assessed in this report

This report has also been prepared in response to the following Condition of Consent for the State Significant Development Concept (SSD 8875) for the OSD summarised in Table 5.

Table 5: Concept approval of Conditions of Consent

Item	Description of Requirement	Section Reference (this report)	Comments
DC B15	Future detailed development application(s) shall provide analysis and assessment of the impacts of construction and include: g. Construction Traffic Management Plan as per condition B18(b) h. Cumulative Construction Impact Assessment (i.e. arising from concurrent construction activity) i. Noise and Vibration Impact Assessment j. Community Consultation and Engagement Plans k. Construction Waste Management Plan l. Air Quality Management Plan The plans referred to above may be prepared as part of a Construction Environmental Management Plan prepared and implemented under the conditions of any consent granted by future development applications, having regard to the Construction Environmental Management Framework and Construction Nosie and Vibration Strategy prepared for the City Metro City and Southwest (CSSI 7400)	-	Identifies need to prepare CNVMP at the CC stage of the development.

Item	Description of Requirement	Section Reference (this report)	Comments
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DC B21	Noise and Vibration Impact Assessment that identifies and provides a quantitative assessment of the main noise generating sources and activities during operation and including consideration of noise and vibration impacts associated with commercial development above a train station. Details are to be included outlining any mitigation measures necessary to ensure the amenity of future sensitive land uses on the neighbouring sites is protected during the operation of the development. The Noise and Vibration Impact Assessment must address the conclusions and recommendations of the concept stage Report dated August 2018 prepared by Pulse Acoustic Consultancy.	The Over Station Development is Base Building only. Noise and vibration impacts from the commercial building relate to mechanical plant and equipment located within the podium, on level 9 and the roof top. This is assessed in Section 7 of this report	In principle recommendations are made in Section 7 of this report. The site is capable of complying with Condition B21

Condition B16 will be addressed in detail in the Construction Noise and Vibration Management Plan to be prepared during the Construction Certificate Phase and in consultation with the Heritage Consultant. General details for construction noise and vibration are presented in Section 8 of this report.

Conditions 21 has been addressed in the body of this report.

These criteria have been reproduced at the beginning of this report for reference.

4 Noise Intrusion Criteria

4.1 Traffic Noise Criteria

A number of documents were taken into consideration when determining suitable traffic criteria for the proposed commercial development site. These included:

- City of Sydney Council's Central Sydney Development Control Plan 2012
- Australian/ New Zealand Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors

The site is bound by Pitt Street, Castlereagh Street and Park Street Sydney.

The site may consider Green Star acoustic points during the design phase that may affect the acoustic design of the facade. Any variations to the facade design presented below as a result of this will be communicated with the client.

Table 6 summarises the recommended design sound levels for building interiors in the proposed development.

Table 6: Recommended Internal Noise Criteria for Road Traffic Noise

Occupancy	Recommended Noise Level dB(A), LAeq, 1 hour
Commercial	
Board and conference rooms	30-40
General office areas	40-45
Meeting rooms	40-45
Open plan office	40-45
General Retail area	<50
Lobbies	45-50

4.2 Rail (Metro) Vibration

The proposed commercial tower has the potential to be impacted on by rail vibration from the operation of the Sydney Metro.

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 commercial 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 affecting the proposed development is quantified using the following Standards:

- 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 EPAs document "Assessing Vibration: A technical guideline (EPA 2006)" presents acceptable vibration dose values for intermittent vibration in offices.

Table 7: Acceptable VDVs for intermittent vibration m/s$^{1.75}$

Period	Preferred VDV m/s1.75	Maximum VDV m/s1.75
Offices		
Day time (7am – 10pm)	0.4	0.8
Night time (10pm – 7am)	0.4	0.8

5 Measured and predicted noise levels

5.1 Long-term Noise Survey

Renzo Tonin & Associates have previously undertaken extensive long-term noise monitoring in the vicinity of the site at a number of locations along Pitt and Castlereagh Streets, Sydney both to the north and the south over the development site.

The noise loggers record noise levels on a continuous basis and stores data every fifteen minutes, including spectrum data. The noise logger was calibrated before and after measurements and no significant deviation in calibration was noted. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as Type 2 instruments suitable for field use.

The results of the long-term monitoring were used along with short-term measurements on the Pitt, Park and Castlereagh Street boundaries of the Pitt Street North Over Station development. This includes the long term monitor installed at 260 Pitt Street, Sydney, which formed part of the Chatswood to Sydenham EIS.

Recommendations for the acoustic design of the glazed facades of the development are presented in Section 6 of this report.

5.2 Short-term Noise Surveys

In addition, short term noise measurements were undertaken at the proposed development site on Wednesday 15th January 2020 along Pitt Street, Park Street and Castlereagh Street at the site boundaries at Ground Level.

The results of the short-term monitoring were corelated with the results of the previous long term monitoring and long-term monitoring data was adjusted accordingly.

5.3 Measured Traffic Noise Level

The design traffic noise levels are taken from the representative maximum $L_{Aeq,\ 1hour}$ for the week during the day time (7am to 10pm) and night time (10pm-7am) periods. The design external traffic noise levels are facade corrected and represent traffic noise levels at Ground Level. Noise modelling tools have been used to predict traffic noise levels at the residential facades, taking into consideration shielding provided by the commercial use podium at the base of the building. Results are presented Table 8 below.

Table 8: Representative Day and Night Traffic Noise Levels

Facade	Survey Period	Measured Maximum Traffic Noise Level LAeq, 1hour at Monitoring Location, 1m from the facade*	Measured Maximum Traffic Noise Level LAeq, T at Monitoring Location, 1m from the facade*
Pitt Street Facade – Ground Level	Day time (7am to 10pm)	LAeq, 1 hour - 70 dB(A)	LAeq, 15 hour – 67 dB(A)
	Night time (10pm to 7am)	LAeq, 1 hour - 64 dB(A)	LAeq 9 hour - 62 dB(A)
Park Street facade - Ground Level	Day time (7am to 10pm)	LAeq, 1 hour – 72dB(A)	LAeq, 15 hour - 68 dB(A)
	Night time (10pm to 7am)	LAeq, 1 hour - 66 dB(A)	LAeq 9 hour - 64 dB(A)
Castlereagh Street facade - Ground Level	Day time (7am to 10pm)	LAeq, 1 hour – 72 dB(A)	LAeq, 15 hour -69 dB(A)
	Night time (10pm to 7am)	LAeq, 1 hour - 63 dB(A)	LAeq 9 hour - 61 dB(A)

Free-field measurements refer to an external noise measurement location at least 15m from any wall, building or other reflecting surfaces on the opposite side of the road, and at least 3.5m from any wall, building or other surface behind or at the side of the microphone which would reflect sound

Facade corrected measurements refer to an external noise measurement location located 1m from the facade of a building. Facade corrected values are 2.5dB higher than free-field values.

Facade corrected values are presented in this table in accordance with the EPA's Road Noise Policy 2011. The ISEPP does not specify whether reported external noise levels are free-field or facade corrected.

5.4 Existing Noise Environment at Development Site

The results of the long-term noise monitoring have been summarised in accordance with Noise Policy for Industry requirements published by NSW Environmental Protection Authority (EPA) and are presented in Table 9 below.

Table 9: Measured Site Background Noise Level

Location	Representative Background Noise Levels in dB(A)	Day1	Evening2	Night3
Pitt Street Facade	LA90	59	57	53
	LAeq	63	60	57
Castlereagh Street Facade	LA90	58	58	57
	LAeq	61	59	58

Notes:

Day, Evening & Night assessment periods are defined in accordance NSW EPA's Noise Policy for Industry as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays. As results were affected by construction noise weekend day and Saturday morning, Sunday results have been presented for the Day time period
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays

The representative background noise levels (LA90) are used in defining external noise emission from the development such as mechanical ventilation and air-conditioning systems in accordance to Environment Protection Authority's publications.

5.5 Summary of Ambient Octave Band Data

The table below presents a summary of the octave band data collected at the proposed development site to be used to establish criteria and to use for assessments.

Table 10: Summary of octave band data measured on site

Measured Event	Descriptor, Period	Octave Band Centre Frequency Hz, dB								
		31.5	63	125	250	500	1k	2k	4k	8k
Ambient Day time	L90, 7am – 6pm	63	69	71	60	53	49	47	42	37
Ambient Evening	L90, 6pm – 10pm	58	57	56	52	52	50	48	45	41
Ambient Night time	L90, 10pm – 7am	58	53	51	53	51	49	40	40	26

5.6 Vibration Impacts from Sydney Metro

Vibration impacts on the Pitt Street North Over Station Development from the use of the Sydney Metro rail movements has been assessed by Linewide. It is the responsibility of Linewide to ensure that track vibration isolation is sufficient that vibration levels compliant with residential/commercial development (based on EPA Assessing Vibration – A Technical Guideline).

Linewide have confirmed the incorporation of track isolation treatments in order to meet the acceptable VDV requirements of the on EPA's Assessing Vibration – A Technical Guideline without the need for additional vibration attenuation.

In regard to vibration associated with the Station Box, the vibration impacts on OSD has been addressed in the Stage 3 ISD acoustic report. With respect to Station Box vibration generation, the primary vibration source will be plant and equipment. Vibration isolation treatments associated with plants and equipment typically involve the inclusion of vibration isolation mounts in the plant and equipment design. Plant and equipment vibration isolation specifications are included in the Stage 3 Acoustic Design Report for the Station ISD buildings.

6 Control of external noise

6.1 Glazing

To achieve the criteria outlined in Table 1 with windows closed, the following table presents the recommended glazing acoustic performances for the proposed development.

Given that the development is a base building, the arrangement of the fit-outs at this stage is unknown. The acoustic performance of the glazing, therefore, is based on general office areas.

Table 11: Recommended acoustic performance of glazing assembly

Facade	Level(s)	Occupancy	Required Acoustic Rating of Glazing Assembly, Rw
Commercial			
Pitt Street Facade (west)	Level 1 and above	General office areas	Rw 34
		Lobbies	Rw 31
		Retail	Rw 31
Park Street Facade (south)	Level 1 and above	General office areas	Rw 34
		Lobbies	Rw 31
		Retail	Rw 31
Castlereagh Street facade (east)	Level 1 and above	General office areas	Rw 34
		Lobbies	Rw 31
		Retail	Rw 31
Northern facade	Level 1 and above	General office areas	Rw 31
		Lobbies	Rw 28
		Retail	Rw 28

Notes:

No responsibility is taken for use of or reliance upon untested glazing construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.

The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification to account for room volumes and finishes, along with any changes to the use of the space.

The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.

All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.

7 External noise emission

7.1 Sydney City Council

Conditions set out in the Standard Conditions of Development Consent from the City of Sydney Council, relating to noise are:

7.2 City of Sydney Council Standard Conditions- Noise

5 NOISE - GENERAL

a. The emission of noise associated with the use of the premises including the cumulative operation of any mechanical plant and equipment, and air conditioning shall comply with the following:

i. *The LAeq, 15 minute noise level emitted from the use must not exceed the project specific noise level for that receiver as determined in accordance with the NSW EPA Industrial Noise Policy. Noise must be measured in accordance with the Industrial Noise Policy and relevant requirements of Australian Standard AS 1055-1997 Acoustics – Description and measurement of environmental noise.*

ii. *Project specific noise levels shall be determined by establishing the existing environmental noise levels, in complete accordance with the assessment LA90, 15 minute / rating LA90, 15 minute process to be in accordance with the requirements for noise monitoring listed in the NSW EPA Industrial Noise Policy and relevant requirements of Australian Standard AS1055-1997 Standard AS 1055-1997 Acoustics – Description and measurement of environmental noise.*

iii. *Modifying factors in Table 4.1 of the NSW EPA Industrial Noise Policy are applicable.*

a. An LAeq,15 minute noise level emitted from the use must not exceed the LA90, 15 minute noise level by more than 3dB in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed inside any habitable room of any affected residence or noise sensitive commercial premises provided that;

i. Where the LA90, 15 minute noise level is below the threshold of hearing, Tf at any Octave Band Centre Frequency as defined in Table 1 of International Standard ISO 226 : 2003- Normal Equal-Loudness-Level Contours then the value of Tf corresponding to that Octave Band Centre Frequency shall be used instead.

ii. The LAeq,15 minute noise level and the LA90,15 minute noise level shall both be measured with all external doors and windows of the affected residence closed;

iii. The relevant background noise level (LA90, 15 minute) is taken to mean the day, evening or night rating background noise level determined in complete accordance with the methodology outlined in the NSW EPA Industrial Noise Policy and

Australian Standard AS1055.1997 Acoustics – Description and measurement of environmental noise.

iv. *Background noise shall be established in the absence of all noise emitted from the use but with the ventilation equipment normally servicing the affected residence operating. Background noise measurements are to be representative of the environmental noise levels at the affected location.*

v. *Modifying factors in Table 4.1 of the NSW EPA Industrial Noise Policy are applicable. Internal Noise measurements are not to be corrected for duration.*

The measured external octave band data measured at the proposed development site are presented in Table 10, above and comply with the City of Sydney criteria outlined above.

7.3 EPA Requirements

It is to be noted that the EPA's Industrial Noise Policy has recently been replaced by the Noise Policy for Industry (NPfI).

7.3.1 Noise Policy for Industry (NPfI)

The NSW EPA Noise Policy for Industry is applied to commercial and retail premises (generally limited to noise from heating, ventilation, air conditioning and refrigeration, and energy generation equipment) as per Section 1.4 of the NPfI.

For this purpose, noise from commercial and retail development as outlined in the paragraph above, will be referred to as 'industrial noise' in this section of the report.

The NSW EPA Noise Policy for Industry assessment has two components:

1. Controlling intrusive noise impacts in the short-term for residences; and
2. Maintaining noise level amenity for particular land uses for residences and other land uses;

7.3.1.1 Project intrusive noise levels

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15minute}$ Intrusiveness noise level = Rating Background Level (RBL) plus 5dB(A)

7.3.1.2 Amenity noise trigger levels

The NPfI amenity trigger levels are designed to maintain noise level amenity for particular land uses, including residential and other land uses. The NPfI recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and other sensitive receivers in Table 2.2 of the NPfI. To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level for industrial developments = recommended amenity noise level (NPfI Table 2.2) minus 5 dB(A)

Table 12: NPfI Amenity Criteria - Recommended L_{Aeq} noise levels from industrial noise sources at the listed receivers [NSW NPfI Table 2.2]

Type of receiver	Indicative Noise Amenity Area	Time of day	Recommended amenity noise level $L_{Aeq(Period)}$
Residence	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See Column 4	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
Commercial premises	All	When in use	65

Note:

Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am

On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

7.3.1.3 Project amenity noise levels

The project amenity noise levels for different time periods of a day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels ($L_{Aeq,\ period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for **total** industrial noise experienced at a receiver location. However, when assessing a **single** development and its impact on an area, "project amenity noise levels" apply.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new industrial noise source is determined as follows:

$L_{Aeq,period}$ Project amenity noise level = $L_{Aeq,period}$ Recommended amenity noise level – 5dB(A)

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$L_{Aeq,15minute}$ = $L_{Aeq,period}$ + 3dB(A)

The following table presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant from the commercial component of the development.

Proposed restaurants at this stage of the assessment should be assumed to be licensed and assessed in accordance with the requirements of Liquor and Gaming NSW.

Noise associated with the operation of a licensed premises should be assessed to the L&GNSW standard noise condition.

The L&GNSW Standard Noise Condition states:

"The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) by more than 5dB between 7:00am and 12:00 midnight at the boundary of any affected residence.*

The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) between 12:00 midnight and 7:00am at the boundary of any affected residence.*

Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 7:00am.

Interior noise levels which still exceed safe hearing levels are in no way supported or condoned by the NSW Office of Liquor, Gaming and Racing. This is a minimum standard. In some instances the Board may specify a time earlier than midnight in respect of the above condition.

**For the purposes of this condition, the LA10 can be taken as the average maximum deflection of the noise emission from the licensed premises."*

Table 13: Project noise trigger level for noise emission from mechanical plant (EPA NPfI)- Residential Receivers

Time of Day	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
	Rating Background Level (RBL) L_{A90}	Intrusiveness Trigger Level, $L_{Aeq, 15minute}$ (RBL+5)	Recommended Amenity Noise Level (RANL), $L_{Aeq, period}$	Project Amenity Noise Level (PANL), $L_{Aeq, period}$	Measured $L_{Aeq, period}$ existing noise levels	Traffic noise exceed the RANL by more than 10dB?	Existing noise level likely to decrease in future?	Exceptions to PANL?	Project Noise Trigger Level $L_{Aeq, 15minute}$ dB(A)
Day (7am to 6pm)	59	64	60	55	63	No	No	None	55
Evening (6pm to 10pm)	57	62	50	45	60	No	No	None	45
Night (10pm to 7am)	53	58	45	40	57	Yes	No	None	40

Explanatory notes:

Column 1 – RBL measured in accordance with the NPfI and outlined in the results of the long-term noise monitoring has been summarised in accordance with NPfI requirements and are presented above.

Column 4 – Project Amenity Noise Level determined based on 'Residential - urban' area in Table 2.2 (Amenity noise levels) of the EPA's NPfI minus 5dB

Column 5 – Measured in accordance with the NPfI

Column 8 - Determined in accordance with Section 2.4 of the NPfI.

Column 9 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level. In accordance with Section 2.2 of the NPfI, $L_{Aeq, 15minute}$ is calculated as $L_{Aeq, period}$ + 3dB(A)

7.3.2 Recommended noise control measures for mechanical plant

Where necessary, noise amelioration treatment will be incorporated in the design to ensure that noise levels comply with the recommended NPfI noise emission criteria noted above.

Although at this stage details of mechanical plant have not been finalised, the following in-principle advice is provided.

Acoustic assessment of mechanical services equipment will need to be undertaken during the detail 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 NPfI and Council's requirements.

As noise control treatment can affect the performance of the mechanical services system, it is recommended 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:

- procurement of 'quiet' plant,
- 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".

A detailed assessment with fully documented acoustic treatments will be undertaken at the detailed design phase of the development, followed by construction/installation supervision of mechanical plant and equipment acoustic treatment. Compliance testing following the installation of the plant should also be undertaken.

8 Construction noise

A detailed Demolition, Excavation and Construction Management Plan is to be prepared for the site prior to the issue of Construction Certificate to comply with Condition B16 detailing the site specific plant and equipment to be used, expected periods of construction, and noise and vibration management treatments and procedures to be implemented.

The section below outlines the relevant criteria associated with demolition, excavation and construction.

8.1 City of Sydney Council Code of Practice

The conditions outlined here need to be observed to comply with the City of Sydney Council's Code of Practice 1992 "Construction Hours/ Noise within the Central Business District" including the 1997 Erratum.

All construction undertaken outside of approved working hours shall be carried out in accordance with the requirements outlined in Council's Code of Practice.

If extended hours of construction are sought for this project, then the construction noise will be required to conform to the following noise criteria, as described in the Code. The Code requires that the average maximum noise level (LA av max) emitted from activities at the construction site and measured over any 15 minute period at any potentially affected location, must not exceed the background noise level by more than the level specified in.

A summary of the requirements set out under Categories 2, 3 and 4 are given in the table below.

Table 14: Category of Working Hours and Construction Noise Criteria

Category	Period of Construction (Hours)	Permissible Noise Level dB(A)
Mondays to Fridays		
4	00:00 to 07:00	Background Noise + 0
2	19:00 to 22:00	Background Noise + 3
4	22:00 to 24:00	Background Noise + 0
Saturdays		
4	00:00 to 07:00	Background Noise + 0
2	19:00 to 22:00	Background Noise + 3
4	22:00 to 24:00	Background Noise + 0
Sundays & Public Holidays		
4	00:00 to 07:00	Background Noise + 0
3	07:00 to 17:00	Background Noise + 3
4	17:00 to 24:00	Background Noise + 0

8.2 Environmental Protection Authority's Construction Noise Guidelines

The Environmental Protection Authority (EPA) released its Interim Construction Noise Guideline (ICNG) in 2009. This document is being referred to as EPA's standard policy for assessing construction noise on new projects.

The key components of the ICNG that can be incorporated into this assessment include:

1. Use of LAeq as the descriptor for measuring and assessing construction noise.

In recent years NSW noise policies including EPA's NSW Industrial Noise Policy (INP) and the NSW Environmental Criteria for Road Traffic Noise (ECRTN) have moved to the primary use of LAeq over any other descriptor. As an energy average, LAeq provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the LA10 descriptor.

Consistent with the latest guideline (ICNG) the use of LAeq as the key descriptor for measuring and assessing construction noise may follow a 'best practice' approach.

2. Application of feasible and reasonable noise mitigation measures

As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects, including the cost of the measure.

3. Quantitative and qualitative assessment

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment.

A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria.

A qualitative assessment is recommended for small projects with a short-term duration where works are not likely to affect an individual or sensitive land use for more than three weeks in total. It focuses on minimising noise disturbance through the implementation of feasible and reasonable work practices, and community notification.

Given the significant scale of the construction works proposed for this Project, a quantitative assessment is carried out herein, consistent with the ICNG's requirements.

4. Management Levels

Residences

Table 15 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 15: Noise at residences using quantitative assessment

Time of Day	Management Level LAeq (15 min)*	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (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 75dB(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, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	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 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

8.3 Summary of Construction Noise Limits

Noise management levels based on background noise levels and the EPA Interim Construction Noise Guidelines are:

Table 16 – Summary of Construction Noise Limits

Receiver	Period	Applicable Criteria LAeq, 15min dB
Residential	Day (7am-6pm)	76dB(A) (being 66dB(A) BG+10dB(A))
	Evening (6pm-10pm)	69dB(A) (being 64dB(A)BG+5dB(A))
	Night (10pm-7am)	66dB(A) (being 61dB(A)+5dB(A)).
Commercial	All times	70dB(A)

9 Conclusion

Renzo Tonin & Associates have completed an assessment of the potential noise impacts to and from the proposed commercial development Pitt Street North - Over Station Development (Commercial Tower).

The primary assessment related to road traffic noise, future Metro rail ground-borne noise and vibration, and existing industrial/ commercial operations on the proposed commercial building. The study of external noise intrusion into the subject development has found that appropriate controls can be incorporated such as glazing into the building design to achieve compliance with acoustic requirements of Sydney City Council's Development Control Plan 2012, SEPP (Infrastructure) 2007 and the Department of Planning's 'Development near rail corridors and busy roads - Interim Guideline'.

In addition, criteria for noise emission from the site has been established and in-principle guidance provided. An assessment of any noise from mechanical plant equipment servicing the buildings shall be undertaken during the detailed design and equipment selection stages to ensure that plant and equipment is designed in accordance with the relevant acoustic criteria, with compliance expected to be easily achieved.

In conclusion, the site is capable of complying with all relevant codes and criteria through careful acoustic planning and treatments.

APPENDIX A Glossary of terminology

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

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
Alternate Solution	An Alternative Solution is a design that complies with the relevant Performance Requirements of the National Construction Code other than by using Deemed-to-Satisfy Provisions.
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.
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-6pm, Evening 6pm-10pm, Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
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. 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 LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
Berm	Earth or overburden mound.
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.
BS	British Standard

Ci	Spectrum Adaptation Term for impact sound pressure level. A value used to modify the measured impact sound pressure level, Ln,w or L'nT,w. Impact sound is generated by a laboratory grade tapping machine placed on the floor to be tested. This tapping machine accurately is intended to simulate noise impact transmitted to the space below caused by a person's footsteps on a floor above. The value is defined in ISO 717-2. The Ln,w or L'nT,w alone is sufficient to characterise the sound from concrete floors. However the measured level does not correlate well with the perceived level for timber joist floors and so the Ci value was developed to compensate. Timber joist floors can have a Ci value slightly positive. Concrete floors with an effective covering such as carpet have Ci values approximately equal to 0dB. Concrete floors with a hard, or less effective covering, can have Ci values varying in between -15dB and 0dB. The Ci value is added to the impact sound pressure level, Ln,w or L'nT,w with positive Ci values being less favourable.
CoRTN	United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)"
Ctr	Spectrum Adaptation Term for the sound reduction index. A value used to modify the measured sound insulation performance of a wall or floor measured in terms of the Rw or the DnT,w so as to more accurately account for low frequency noise transmission from the sound of modern stereo systems. The value is defined in ISO 717-1 which also sets out the test methodology for measuring the sound insulation properties of building elements. The Ctr of a building element varies according to its physical properties. For example, a 90mm cavity brick masonry wall as a Ctr value of -6, as does a wall constructed of 150mm core-filled concrete blocks. By contrast, a brick veneer wall might have a Ctr of -12. The value is added to the Rw or DnT,w. with positive Ctr values being more favourable.
Decibel [dB]	The units of sound measurement. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear, defined as 20 micro Pascal 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 110dB Operating a chainsaw or jackhammer 120dB Deafening
dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in 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 is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.
Deemed-to-Satisfy Provisions	The Deemed-to-Satisfy Provisions are an optional means of achieving compliance with the mandatory Performance Requirements of the National Construction Code. (also see Alternate Solution)
Diffraction	The distortion of sound waves caused when passing tangentially around solid objects.
DIN	German Standard
Discontinuous Construction	A wall system having a minimum 20mm cavity between two separate leaves, where, for other than masonry there is no mechanical linkage between leaves except at the periphery.

DnT,w	Weighted Standardised Field Level Difference A measure of sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in-situ. It is a field measurement that relates to the Rw laboratory measured value but is not equal to it because an in-situ space is not of the same quality as a laboratory space. The value is indicative of the level of speech privacy between spaces. The higher its value the better the insulation performance.
ECRTN	Environmental Criteria for Road Traffic Noise, NSW, 1999
EPA	Environment Protection Authority
Field Test	A test of the sound insulation performance in-situ. See also 'Laboratory Test' The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion. A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.
FIIC	Field Impact Isolation Class. A measure of the noise impact performance of a floor. The value indicates the resistance of the floor to the transmission of impact sound and is measured using a standard tapping machine. It is measured in-situ and is therefore subject to the inherent accuracies involved in such a measurement. The term is defined in ASTM E492 and E1007. It is a field measure of the level of impact sound transmitted to a space via a floor. The equivalent measurement in a laboratory is termed the IIC. The higher the value the better the performance.
Flanking	Flanking is the transfer of sound through paths around a building element rather than through the building element material directly. For example, sound travelling through a gap underneath a door or a gap at the top of a wall.
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.
Free-field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.
Frequency	Frequency is synonymous to pitch. 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.
FSTC	Field Sound Transmission Class A measure of the sound insulation performance of a building element. . It is characterised by the difference in noise level on each side of a wall or floor. It is measured in the field and is therefore subject to the inherent inaccuracies involved in such a measurement. The term was referred to in older superseded versions of the Building Code of Australia and has now been replaced with the term DnT,w.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.
Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
IGANRIP	Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects, NSW DEC 2007

IIC	Impact Isolation Class A measure of the noise impact performance of a floor. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from the operation a standard tapping machine placed on the floor. The term is defined in ASTM E492 and E1007. The higher the number the better the performance.
Impact Noise	The noise in a room, caused by impact or collision of an object onto the walls or the floor. Typical sources of impact noise are footsteps on the floor above a tenancy and the slamming of doors on cupboards mounted on the common wall between tenancies.
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.
INP	NSW Industrial Noise Policy, EPA 1999
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.
Intertenancy wall	Walls that separate buildings or units within a building. They may provide sound resistance or serve as a fire wall. Synonymous with 'party wall'.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
$L_{10(1hr)}$	The L10 level measured over a 1 hour period.
$L_{10(18hr)}$	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L_{90}	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).
L_{Aeq} or L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a steady sound level occurring over the same period of time. When A-weighted, this is written as the L_{Aeq}.
$L_{Aeq(1hr)}$	The L_{Aeq} noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
$L_{Aeq(8hr)}$	The L_{Aeq} noise level for the period 10pm to 6am.
$L_{Aeq(9hr)}$	The L_{Aeq} noise level for the period 10pm to 7am.
$L_{Aeq(15hr)}$	The L_{Aeq} noise level for the period 7am to 10pm.
$L_{Aeq\ (24hr)}$	The L_{Aeq} noise level during a 24 hour period, usually from midnight to midnight.
L_{max}	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amax}.
L_{min}	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L_{Amin}.
Ln,w	Weighted Normalised Impact Sound Pressure Level A measure of the sound level transmitted from impacts on a floor to a tenancy below. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from a standard tapping machine. A lower value indicates a better performing floor.

LnT,w	Weighted Standardised Field Impact Sound Pressure Level As for Ln,w but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The equivalent measurement in a laboratory is the Ln,w. A lower value indicates a better performing floor.
Laboratory Test	The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
NCA	Noise Catchment Area. An area of study within which the noise environment is substantially constant.
NCG	Roads and Maritime 'Noise Criteria Guideline'
NMG	Roads and Maritime 'Noise Mitigation Guideline'
Noise	Unwanted sound
Normalised	A method of adjusting the measured noise indices in a laboratory so that they are independent of the measuring space. The noise level in a room is affected by reverberation in the room. For example, the Ln,w impact sound pressure level measured in a laboratory is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the sound absorption in the receiving room is set at 10m2. This enables all laboratories to report the same value when measured under slightly different conditions. See also 'Standardised'.
NRC	Noise Reduction Coefficient. A measure of the ability of a material to absorb sound. The NRC is generally a number between 0 and 1 but in some circumstances can be slightly greater than 1 because of absorption at the edges of the material. A material with an NRC rating of 1 absorbs 100% of incoming sound, that is, no sound is reflected back from the material. The NRS is the average of the absorption coefficient measured in the octave bands 250Hz, 500Hz, 1kHz & 2kHz which correspond to the predominant frequencies associated with the human voice.
Partition wall	A wall dividing two rooms.
Party wall	A wall dividing two tenancies. Synonymous with 'Intertenancy Wall'.
Pre-construction	Work in respect of the proposed project that includes design, survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, minor clearing (except where threatened species, populations or ecological communities would be affected), establishing ancillary facilities such as site compounds, or other relevant activities determined to have minimal environmental impact (e.g. minor access roads).
RBL	Rating Background Level is the representative LA90 background noise level for a period, as defined in the NSW EPA's noise ploicies.
Reflection	Sound wave reflected from a solid object obscuring its path.
Reverberation Time	The time (in seconds) it takes for a noise signal within a confined space to decay by 60dB. The longer the reverberation time (usually denoted as RT60), the more echoic a room. Longer reverberation times generally result in higher noise levels within spaces.
RING	Rail Infrastructure Noise Guideline, NSW, May 2013
RMS	Root Mean Square value representing the average value of a signal.

Rw	Weighted Sound Reduction Index A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term supersedes the value STC which was used in older versions of the Building Code of Australa. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w. The higher the value the better the acoustic performance of the building element.
R'w	Weighted Apparent Sound Reduction Index. As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The higher the value the better the acoustic performance of the building element.
RNP	Road Noise Policy, NSW, March 2011
Sabine	A measure of the total acoustic absorption provided by a material. It is the product of the Absorption Coefficient (alpha) and the surface area of the material (m2). For example, a material with alpha = 0.65 and a surface area of 8.2m2 would have 0.65 x 8.2 = 5.33 Sabine. Sabine is usually calculated for each individual octave band (or third-octave).
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.
Sole-occupancy Unit	An area within a building for the exclusive use of the owner or occupier.
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 by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.
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 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 of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Spoil	Soil or materials arising from excavation activities.
Standardised	A method of adjusting the measured noise indices in-situ so that they are independent of the measuring space. The noise level in a room is affected by reverberation in the room. For example, the L'n,w impact sound pressure level measured in a room is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the reverberation time in the receiving room is set at 0.5 seconds. This enables the same value to be reported independent of whether the room contains carpet and furnishings and the like. See also 'Normalised'.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by Rw.

Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the Rw or R'w or DnT,w.
Vibration	A mechanical phenomenon whereby oscillations occur about an equilibrium point; a periodic back-and-forth motion of an elastic body or medium, commonly resulting when almost any physical system is displaced from its equilibrium condition.
Wet Area	An area within a building that is supplied with water from a water supply including bathrooms, laundries and sanitary compartments. Excludes kitchens.

APPENDIX B Location of the Noise Surveys