

Overseas Passenger Terminal (Tenancy 5), Circular Quay West - acoustic assessment

Prepared for Jimmys on the Mall | 8 November 2016



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Final

Report J16111RP1 | Prepared for Jimmys on the Mall | 8 November 2016

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Date 8 November 2016

Date 8 November 2016

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Document Control

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1 Introduction

EMM Consulting Pty Ltd (EMM) has been engaged by Jimmys on the Mall Pty Ltd (Jimmys) to provide an acoustic assessment of construction and operational noise associated with a proposed restaurant, bar and micro-brewery at Terminal 5 of the Overseas Passenger Terminal (OPT), Circular Quay West. The proposed restaurant, bar and micro-brewery is referred to as 'the proposed development' throughout this report.

1.1 Glossary of acoustic terms

A number of technical terms are required for the discussion of noise. These are explained in Table 1.1.

Table 1.1 Glossary of acoustic terms

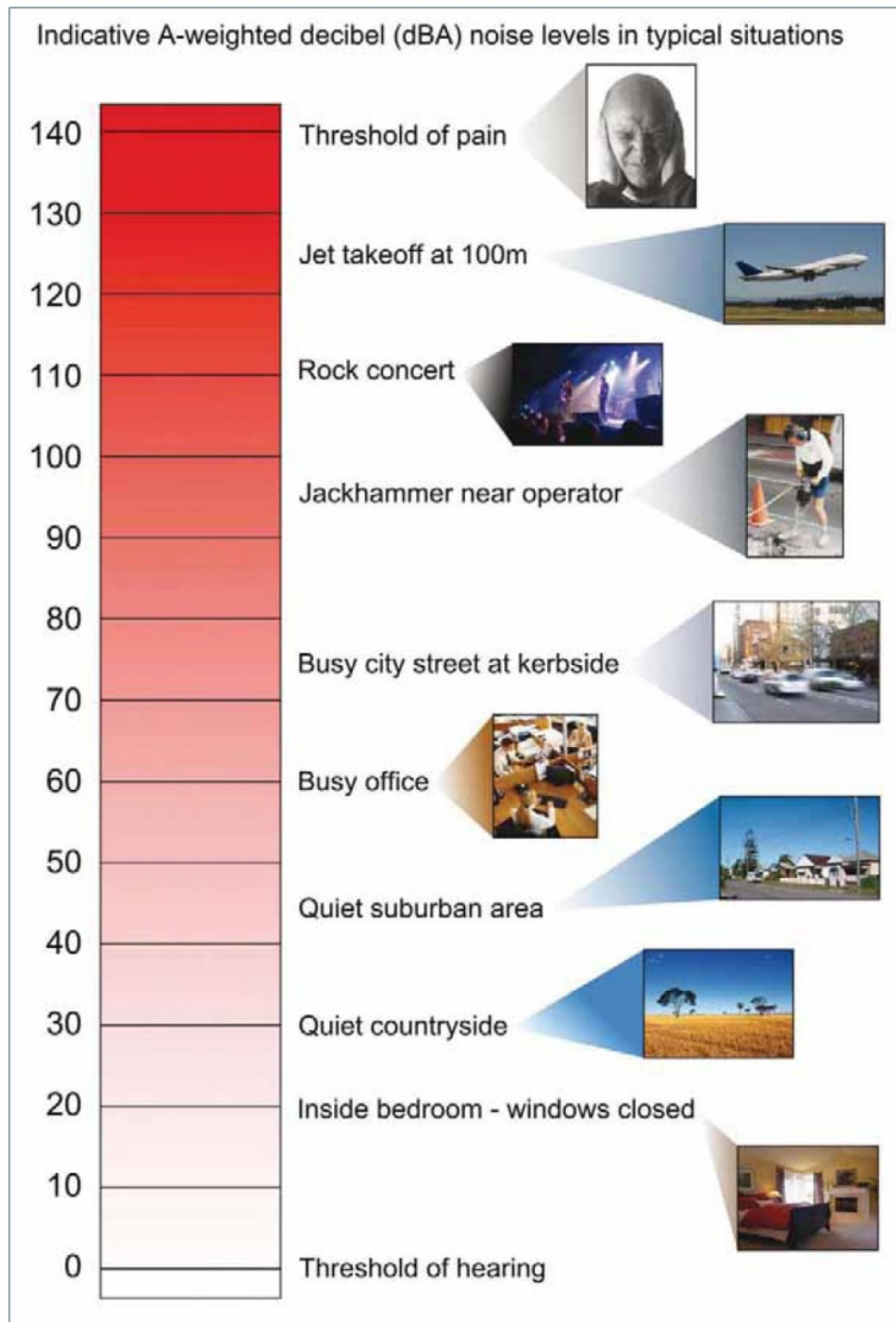
Term	Description
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L ₁	The noise level exceeded for 1% of a measurement period.
L ₁₀	A noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise levels.
L ₉₀	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
L _{eq}	It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period. The L _{eq,15min} descriptor refers to an Leq noise level measured over a 15-minute period.
L _{max}	The maximum root mean squared sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period.
Sound power level	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Temperature inversion	A positive temperature gradient. A meteorological condition where atmospheric temperature increases with altitude.

It is useful to have an appreciation of decibels, the unit of noise measurement. Table 1.2 gives an indication as to what an average person perceives about changes in noise levels:

Table 1.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud

Examples of common noise levels are provided in Figure 1.1.



Source: Road Noise Policy (Department of Environment, Climate Change and Water (DECCW) 2011).

Figure 1.1 Common noise levels

2 Project description

2.1 Overview

This assessment references architectural drawings by Collins and Turner Architects dated July 2016 (Appendix A).

The proposed development seeks to use Tenancy 5 as an indoor and outdoor restaurant and bar (incorporating a micro-brewery) as detailed below:

- fitout, alterations and additions of levels 1 & 2 for use as a restaurant and bar;
- replacement of existing glazing on the northern and eastern elevations, with new window and door openings;
- new ground floor terrace treatment and additional outdoor seating areas;
- new level 1 balcony on the western elevation;
- new outdoor decks on level 1 on the east and north elevations and within the tower drum providing additional outdoor seating;
- new retractable awning/sun shading structure to proposed outdoor seating areas;
- landscaping of outdoor areas; and
- new micro-brewery and bar within a pod structure located outside the OPT building.

2.2 Operating hours

2.2.1 Proposed

The proposal seeks development consent for the following hours of operation (internal and external areas):

- 6 am to 12 midnight Sunday to Thursday inclusive;
- 6 am Friday to 1 am Saturday;
- 6 am Saturday to 1 am Sunday; and
- 6 am to 2 am on January 1.

2.2.2 Existing

The current approved standard trading hours (internal and external areas) under the existing On Premises Liquor Licence are (as amended to apply to the proposed licensed area of the entire tenancy) are 10 am to 12 midnight 7 days a week.

The additional trading hours on public holidays (internal and external areas) are:

- Good Friday, 12 noon to 10 pm;
- Christmas Day, 12 noon to 10 pm; and
- December 31, 6 am to 2 am on January 1.

2.3 Proposed entertainment

Live music (limited generally to amplified music consisting of solo or duos and excluding a designated or purpose built dance floor and DJs) is included in the proposed development.

2.4 Construction

2.4.1 Construction activities and equipment

The proposed development includes the construction of the following elements:

- a new deck and balustrade;
- a new façade level 1 and 2 consisting of sliding/folding elements; and
- a landscaped external area with localised shade structures.

The inside of the existing building will be fitted-out with a new restaurant and bar and the micro-brewery 'pod' will also be inserted in the external space.

2.4.2 Construction hours and timing

Construction is expected to over an approximate five month period. The following standard construction hours are expected:

- 7 am to 6 pm Monday-Friday;
- 8 am to 1 pm on Saturdays; and
- no work on Sundays and public holidays.

3 Existing environment

3.1 Site surrounds

The proposed development is in Tenancy five of the OPT, on the north-western point of Circular Quay.

The OPT surrounds are characterised by a mix of commercial and residential properties to the north-west, west and south-west. To the west and south west, there is generally less high-rise buildings and more town-housing. Approximately 220 m to the west of the site there is the Bradfield Highway, which is a major arterial road.

The Sydney Harbour surrounds the OPT to the east and north. Residential apartments, hotels, commercial shopfronts, offices and the Sydney Opera house are approximately 350 m east of the OPT. To the south of the OPT is the Circular Quay ferry wharves, Circular Quay train station and the Cahill expressway. Past the Cahill expressway there are high-rise hotels and commercial buildings.

Approximately 950 m across the water to the north of the OPT is Kirribilli, which mostly consists of residential apartments and town houses.

3.2 Noise sensitive receivers

The closest noise sensitive residential receivers are on Atherden Street (approximately 130 m to the west of the proposed development), at 8 Hickson Road (approximately 200 m north of the proposed development), along Cumberland Street to the west of the proposed development and along Macquarie Street to the east of the proposed development (ie 350 m across Circular Quay).

Across Bradfield Highway to the west of the proposed development there are also residential noise sensitive receivers (ie in Lower Fort Street).

The closest noise sensitive commercial receiver is the Quay Grand restaurant, which is directly above the proposed development and is also in the OPT. There closest commercial receiver that is not part of the OPT is approximately 50 m to the west of the proposed development.

Noise impacts have been assessed to the noise sensitive receivers (assessment locations) listed in Table 3.1 and shown in Figure 3.1. The assessment locations used are consistent with the Construction and Operation Noise and Vibration Assessment for the 2014 OPT upgrade (AECOM 2014).



Table 3.1 Residential and commercial assessment locations

ID	Location	Approximate distance from proposed development
Residential assessment locations		
R1	7 Atherden Street, The Rocks	140 m south-west
R2	8 Hickson Road, The Rocks	150 m west
R3	36–44 Cumberland Street, The Rocks	170 m west
R4		
R5	13 Lower Fort Street, Dawes Point	250 m north-west
R6	2 Macquarie Street, Sydney	320 m east
R7	3 Macquarie Street, Sydney	340 m south-east
Commercial assessment locations		
N1	132 George Street, The Rocks	220 m south
N2	106–108 George Street, The Rocks	150 m south
N3	100 George Street, The Rocks	80 m south
N4	1–3 Hickson Road, The Rocks	30 m west
N5	27 Circular Quay West, The Rocks	50 m west
N6	Park Hyatt Sydney, 7 Hickson Road, The Rocks	160 m north-west
N7	85 George Street, The Rocks	200 m south-west
N8	Old Sydney Holiday Inn, The Rocks	120 m south-west
N9	Quay Grand, 61 Macquarie Street, Sydney	370 m south-east
N10	Quay Restaurant, Hickson Road, The Rocks	Directly above proposed development

Source AECOM 2014.

3.3 Existing background and ambient noise environment

3.3.1 Unattended noise monitoring

AECOM (2014) completed unattended noise monitoring at four rooftop locations during 2013 to quantify existing background and ambient noise levels at assessment locations surrounding the proposed development. These locations are shown in Figure 3.1. The measured noise levels from each unattended monitoring location are reproduced in Table 3.2.

EMM reviewed the unattended monitoring data and concluded that it was affected by a relatively constant extraneous noise (eg mechanical plant). This is likely as all the noise loggers were placed on rooftops and although the city's noise environment is expected to be high, results in chart form clearly indicate such influences. AECOM (2014) has acknowledged the presence of extraneous noise sources and subsequently removed logger data. Given this, the lowest measured daily ABL from all noise loggers has been chosen by EMM to represent background noise levels (refer to Appendix B for ABLs).

Table 3.2 Background and ambient noise levels

Measurement location	ID	Measured noise level, dB					
		RBL ¹			L _{Aeq} ²		
		Day ³	Evening	Night	Day	Evening	Night
Rooftop of the Holiday Inn, 55 George Street, the Rocks	NL1	61	60	57	63	62	60
Rooftop of the Quay Grand, 61 Macquarie Street, Circular Quay	NL2	63	62	52	66	65	60
Rooftop of 88 Cumberland Street, the Rocks	NL3	61	61	57	64	62	61
Rooftop of the Park Hyatt, 7 Hickson Road, the Rocks	NL4	61	59	56	65	65	61

Source AECOM 2014.

Notes 1. The RBL is an INP term and is used represent the background noise level. The levels adopted as the final RBL are the ;pwest ABL as defined in the INP.

2. The energy averaged noise level over the measurement period and representative of general ambient noise.

3. The day period is 7 am to 6 pm, the evening period is 6 pm to 10 pm, the night period is 10 pm to 7 am.

3.3.2 Attended noise monitoring

Operator attended noise monitoring was conducted between 10 pm and 12 am on 26 July 2016 to quantify and characterise existing background and industrial noise sources. It was conducted using a Brüel and Kjær Type 2250 one-third octave hand-held analyser (serial number 30-082-01). Field calibration of the instrument was completed using a Brüel and Kjær type 4230 calibrator (serial number 14-414-15). The attended noise monitoring was undertaken in accordance with AS 1055-1997 Description and Measurement of Environmental Noise, Parts 1, 2 and 3. Meteorological conditions throughout the attended monitoring period were calm and clear with no winds above 5 m/s or rain. Each measurement was 15 minutes in duration.

Noise levels during the operator attended monitoring was dominated by road traffic noise and general urban hum. Rail, harbour and pedestrian noise were also intermittent. No industrial noise was audible at any of the attended monitoring locations. The results from the attended noise monitoring are shown in Table 3.3. Attended noise monitoring locations are shown in Figure 3.1. The measured L_{A90} noise levels generally correlate well with the adopted RBLs/ABLS from unattended noise monitoring.

Table 3.3 Summary of attended noise monitoring

ID	Location	Coordinates, zone 56H	Start time ¹	Measured noise level dB			Comments
				L _{Aeq}	L _{A90}	L _{Amax}	
A1	The Holiday Inn, George Street (West of Circular Quay)	334335 m East, 6252133 m South	22:26	60	54	76	Road traffic noise from George Street/Hickson Road fairly constant/dominant (60-65 dB), occasional pedestrian conversation (65-70 dB), road traffic noise from Bradfield Highway constant (54 dB), train occasionally audible (55 dB).
A2	44 Cumberland Street/Gloucester Walk (West of Circular Quay)	334240 m East, 6252166 m South	22:49	53	52	63	Road traffic noise from Bradfield Highway and general urban hum from Circular Quay dominant (52 dB), occasional train noise audible (56 dB).
A3	Moore Steps/Circular Quay Grand (East of Circular Quay)	334694 m East, 6251867 m South	23:26	57	52	74	Traffic noise from Macquarie Street and general urban hum/harbour noise dominant (52 dB), occasional pedestrian conversation (65 dB).

Notes 1. All measurements were 15 minutes in duration.

The night-time background noise level spectra (L_{A90} (15 min)) recorded at locations A1, A2 and A3 are presented in Table 3.4. The noise level in each octave band was adjusted where appropriate so the total noise level matched the background noise level for the relevant period.

This was done for the attended measurement A2 as it had the lowest low frequency noise levels (ie 31.5 Hz to 250 Hz). This would therefore produce the most stringent criteria in this range, which is the most important for entertainment noise (as discussed further in Section 4.3).

Table 3.4 Octave band background noise monitoring results

ID	Location	Time ¹	Description	Octave band centre frequency (Hz) background noise level (L_{A90}), dB									Overall dB(A)
				31.5	63	125	250	500	1k	2k	4k	8k	
A1	The Holiday Inn, George Street (West of Circular Quay)	22:26	Measured	22	33	39	44	47	50	47	37	23	54
A2	44 Cumberland Street/Gloucester Walk (West of Circular Quay)	22:49	Measured	17	29	37	42	44	48	43	31	18	52
A3	Moore Steps/Circular Quay Grand (East of Circular Quay)	23:26	Measured	26	31	36	43	46	47	41	29	15	52
Adjusted background noise level spectrum ²			Day	24	36	44	49	51	55	50	38	25	59
			Evening	24	36	44	49	51	55	50	38	25	59
			Night	17	29	37	42	44	48	43	31	18	52

Notes 1. All measurements were 15 minutes in duration.

2. These noise levels have been adjusted where necessary to match the adopted RBL for the relevant period.

4 Noise and vibration criteria

4.1 City of Sydney general noise guideline

The CoS general noise guideline states:

- (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 $L_{Aeq, 15 \text{ minute}}$ 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 $L_{A90, 15 \text{ minute}}$ / rating $L_{A90, 15 \text{ minute}}$ 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 10551997 Acoustics – Description and measurement of environmental noise.
 - (iii) Modifying factors in Table 4.1 of the *NSW EPA Industrial Noise Policy* are applicable.
- (b) An $L_{Aeq, 15 \text{ minute}}$ noise level emitted from the use must not exceed the $L_{A90, 15 \text{ minute}}$ 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 $L_{A90, 15 \text{ minute}}$ noise level is below the threshold of hearing, T_f 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 T_f corresponding to that Octave Band Centre Frequency shall be used instead.
 - (ii) The $L_{Aeq, 15 \text{ minute}}$ noise level and the $L_{A90, 15 \text{ minute}}$ noise level shall both be measured with all external doors and windows of the affected residence closed.
 - (iii) The relevant 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.

4.2 Industrial noise

Noise from industrial sites or processes (eg mechanical plant) in NSW are regulated by the local council, Department of Planning and Environment (DP&E) and/or the Environmental Protection Authority (EPA) and usually have a licence and/or approval conditions stipulating noise limits. These limits are normally derived from operational noise criteria applied at assessment locations. They are based on INP guidelines or noise levels that can be achieved at a specific site following the application of all reasonable and feasible noise mitigation.

The INP guidelines for assessing industrial facilities/processes have been used for this assessment. With respect to the criteria, the guidelines state:

They are not mandatory, and an application for a noise producing development is not determined purely on the basis of compliance or otherwise with the noise criteria. Numerous other factors need to be taken into account in the determination. These factors include economic consequences, other environmental effects and the social worth of the development.

The objectives of noise assessment criteria for industry are to protect the community from excessive intrusive noise and preserve amenity for specific land uses.

To ensure these objectives are met, the EPA provides two separate criteria: intrusiveness criteria and amenity criteria. The fundamental difference being intrusiveness criteria apply over 15 minutes in any period (day, evening or night), whereas the amenity criteria apply to the entire assessment period (day, evening or night).

4.2.1 Intrusiveness

The intrusiveness criteria require that $L_{Aeq (15 \text{ min})}$ noise levels from the subject site during the relevant operational periods (ie day, evening and night) do not exceed the relevant RBL for each assessment location by more than 5 dB. Table 4.1 provides the intrusive noise criteria determined for each assessment location based on adopted RBLs.

Table 4.1 Intrusive noise criteria

Assessment location	Period ¹	Adopted RBL, dB(A)	Intrusive criteria dB, $L_{Aeq (15min)}$
All residential ²	Day	59	64
	Evening	59	64
	Night	51	56

Notes 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night: all remaining periods.

2. As per the INP, industrial noise limits at commercial assessment locations are governed by the amenity criteria.

4.2.2 Amenity

The assessment of amenity is based on noise criteria specific to the land use. The criteria relate only to industrial noise and exclude road or rail noise. Where the measured existing industrial noise approaches recommended amenity criteria, it needs to be demonstrated that noise levels from new industry will not contribute to existing industrial noise.

Residential assessment locations potentially affected by the subject site have been categorised in the INP urban amenity category. The corresponding recommended amenity criteria for the subject site are given in Table 4.2. No adjustment to the acceptable recommended noise amenity level was necessary during all periods since there was no significant level of existing industrial noise observed at the assessment locations.

Table 4.2 **Amenity criteria**

Assessment location	Indicative area	Time period	Recommended noise level dB(A), $L_{Aeq(period)}$	
			Acceptable	Maximum
Residential (R1-R7)	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial (N1-N9)	All	When in use	65	70

Source: INP (EPA 2000).

4.2.3 Project specific noise level

The project-specific noise level (PSNL) is the lower of the calculated intrusive or amenity criteria and is provided in Table 4.3 for all assessment locations.

Table 4.3 **Project specific noise levels**

Receiver type	Assessment location	Period ¹	dB(A)		
			Intrusive criteria $L_{Aeq(15-min)}$	Amenity criteria $L_{Aeq(period)}$	Project specific noise level (PSNL)
Residential	All (R1-R9)	Day	64	60-65	60 $L_{Aeq(15-min)}$
		Evening	64	50-55	50 $L_{Aeq(15-min)}$
		Night	56	45-50	45 $L_{Aeq(15-min)}$
Commercial	All (N1-N10)	When in use	-	65-70	65 $L_{Aeq(period)}$

Notes 1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; evening: 6 pm to 10 pm; night: all remaining periods.

4.3 Entertainment noise

4.3.1 City of Sydney entertainment noise

The CoS Entertainment Noise Guideline states:

- (a) The $L_{A10,15minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,15minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 5 dB between the hours of 7 am and 12 midnight when assessed at the boundary of any affected residence.
- (b) The $L_{A10,15minute}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,15minute}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) between the hours of 12 midnight and 7 am when assessed at the boundary of any affected residence.

- (c) Notwithstanding compliance with (a) and (b) above, noise from the use when assessed as an $L_{A10,15\text{minute}}$ enters any residential use through an internal to internal transmission path is not to exceed the existing internal $L_{A10,15\text{minute}}$ (from external sources excluding the use) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed within a habitable room at any affected residential use between the hours of 7 am and 12 midnight. Where the $L_{A10,15\text{minute}}$ noise level is below the threshold of hearing, T_f 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 T_f corresponding to that Octave Band Centre Frequency shall be used instead.
- (d) Notwithstanding compliance with (a), (b) and (c) above, the noise from the use must not be audible within any habitable room in any residential use between the hours of 12 midnight and 7 am.
- (e) The $L_{A10,15\text{minute}}$ noise level emitted from the use must not exceed the background noise level ($L_{A90,15\text{minute}}$) in any Octave Band Centre Frequency (31.5 Hz to 8kHz inclusive) by more than 3dB when assessed indoors at any affected commercial premises.

Note: The $L_{A10,15\text{minute}}$ noise level emitted from the use is as per the definition in the Australian Standard AS1055-1997 Acoustics – Description and measurement of environmental noise. The background noise level $L_{A90,15\text{minute}}$ is to be determined in the absence of noise emitted by the use and be representative of the noise sensitive receiver. It is to be determined from the assessment L_{A90} / rating L_{A90} methodology in complete accordance with the process listed in the NSW EPA Industrial Noise Policy and relevant requirements of AS1055.1997.

Note: Suitably qualified Acoustic Consultant means a consultant who possesses the qualifications to render them eligible for membership of the Australian Acoustics Society, Institution of Engineers Australia or the Association of Australian Acoustic Consultants at the grade of member.

4.3.2 Residential

Clause (a) of the CoS Entertainment Noise Guideline states that the $L_{A10 (15 \text{ min})}$ noise level emitted from the use must not exceed the background noise level ($L_{A90 (15 \text{ min})}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 5 dB between the hours of 7 am and 12 midnight when assessed at the boundary of any affected residence.

Clause (b) of the CoS entertainment guideline states that $L_{A10 (15 \text{ min})}$ noise level emitted from the use must not exceed the background noise level ($L_{A90 (15 \text{ min})}$) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) between the hours of 12 midnight and 7 am when assessed at the boundary of any affected residence.

The $L_{A10 (15 \text{ min})}$ CoS entertainment noise criteria have been set by offsetting the adopted background noise spectrum for each period at each assessment location.

Only external noise criteria are assessed as there are no residential assessment locations with internal to internal transmission paths to the proposed development (clause (c)). Table 4.4 provides the residential entertainment noise criteria.

Table 4.4 External single (1/1) octave background noise levels and entertainment criteria

Assessment location	Description	Time	Octave band centre frequency (Hz) background noise level, $L_{A10(15min)}$ dB								
			31.5	63	125	250	500	1k	2k	4k	8k
Residential (R1-R9)	Background noise level	Day	24	36	44	49	51	55	50	38	25
		Evening	24	36	44	49	51	55	50	38	25
		Night	16	28	36	41	43	47	42	30	17
	Residential entertainment noise criteria	Day	29	41	49	54	56	60	55	43	30
		Evening	29	41	49	54	56	60	55	43	30
		Night (10 pm to 12 am)	21	33	41	46	48	52	47	35	22
		Night (12 am to 7 am)	17	29	37	42	44	48	43	31	18

4.3.3 Commercial

The $L_{A10(15min)}$ noise level emanating from the use must not exceed the existing $L_{A10(15min)}$ noise level by more than 3 dB in the 31.5 Hz-8 kHz frequency bands (inclusive) when assessed indoors at any commercial premises (Entertainment clause (e)).

Noise sensitive commercial uses (ie hotels and business buildings) are usually provided with mechanical ventilation (ie air conditioning) which will typically set the background noise level. The noise limits set are therefore based on Noise Rating (NR) curves used in mechanical services design, suitable to noise sensitive commercial uses (NR 40). Table 4.5 sets out the internal single octave background noise levels and entertainment criteria for noise sensitive commercial assessment locations. This criteria has been used for all commercial assessment locations, which is highly conservative for assessment locations which are not hotels or business building (ie the Quay Restaurant).

Table 4.5 Internal single octave background noise levels and entertainment noise criteria

Assessment location	Description	Space	Octave band centre frequency (Hz) noise criteria, dBA								
			31.5 ¹	63	125	250	500	1k	2k	4k	8k
Commercial (N1-N10)	Representative $L_{A90(15min)}$ background noise level ²	All	38	41	41	40	41	40	38	36	33
	Criteria $L_{A10(15min)}$	All	41	44	44	43	44	43	41	39	36

Notes: 1. Energy at 31.5Hz is not stated on the Noise Rating curve. Value has been estimated by taking the difference between 63 Hz and 125 Hz frequency bands.
2. Based on Noise Rating curve (NR40) for mechanical ventilation.

4.4 Office of Liquor, Gaming and Racing

Noise from licensed venues is also governed by the Office of Liquor, Gaming and Racing (OLGR). The OLGR noise criteria for music and patron noise that would apply are as follows:

The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 5dB between 7 am and midnight at the boundary of any affected residence.

The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) between midnight and 7 am 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 midnight and 7 am.

For the purpose of this condition, the L_{A10} can be taken as the average maximum deflection of the noise emission from the licensed premises.

This is consistent with the CoS Entertainment Noise criteria.

4.5 Construction noise

4.5.1 City of Sydney Code of Practice 'Construction Hours/Noise within the Central Business District'

Construction noise criteria for developments within the CoS are provided by the CoS Code of Practice 'Construction Hours/Noise within the Central Business District' (CoS construction code) (1992). Table 4.6 provides a summary of allowable construction noise levels and categories of working hours as per the CoS construction code method. The CoS construction code allows for the background noise level plus 5dB in shoulder periods (7 am to 8 am) and 10 dB in day periods (8 am to 7 pm on weekdays and 8 am to 5 pm on Saturdays).

The boundary where the CoS construction code applies does not extend to the proposed development site and stops on the southern point of Circular Quay. However, the CoS Council boundary extends to the area of the proposed development so construction noise criteria has been derived using the CoS construction code.

Table 4.6 Categories of working hours, and noise criteria

Day	Period	Category	Criteria
Monday to Friday	00.00-07.00	4	Background + 0 dB(A)
	07.00-08.00	1	Background + 5 dB(A)
	08.00-19.00	1	Background + 5 dB(A) + 5 dB() to be determined on a site basis
	19.00-23.00	2	Background + 3 dB(A)
	23.00-24.00	4	Background + 0 dB(A)

Table 4.6 Categories of working hours, and noise criteria

Day	Period	Category	Criteria
Saturday	00.00-07.00	4	Background + 0 dB(A)
	07.00-08.00	1	Background + 5 dB(A)
	08.00-17.00	1	Background + 5 dB(A) + 5 dB() to be determined on a site basis
	17.00-23.00	2	Background + 3 dB(A)
	23.00-24.00	4	Background + 0 dB(A)
Sundays and public holidays	00.00-07.00	4	Background + 0 dB(A)
	07.00-17.00	3	Background + 3 dB(A)
	17.00-24.00	4	Background + 0 dB(A)

Notes

1. All noise levels to be $L_{A\text{ av max (15 min)}}$ measured at the nearest nominated occupancy.
2. The permissible noise level must be complied with during each 15 minute period during the relevant period.
3. Background is 'background noise level' ie RBL.

Source: City of Sydney Code of Practice 'Construction Hours/Noise within the Central Business District' (1992).

Using Table 4.6, the CoS construction noise criteria for the proposed construction hours are shown in Table 4.7.

Table 4.7 Construction noise criteria, CoS construction code

Assessment location	Day	Period	RBL, dB(A)	Criteria, dB(A)
Residential R1-R9	Monday to Friday	00.00-07.00 ¹	51	51
		07.00-08.00	59	69
		08.00-19.00	59	69
	Saturday	00.00-07.00	51	51
		07.00-08.00	59	69
		08.00-17.00	59	69

Notes

1. The night period has been used as a substitute for this period.

4.5.2 Interim Construction Noise Guideline (NSW EPA)

The Department of Environment and Climate Change, *Interim Construction Noise Guidelines* (ICNG) (DECC 2009), provides guidelines for the assessment and management of noise from construction works. The ICNG quantitative approach is described below. It is more suited to longer periods of construction rather than intermittent maintenance or servicing.

i Noise management level

The ICNG suggests the following time restriction for construction activities where the noise is audible at residential premises:

- Monday to Friday 7 am to 6 pm;
- Saturday 8 am to 1 pm; and
- no construction work is to take place on Sundays or public holidays.

It is expected that construction will occur during standard ICNG hours only.

Table 4.8 is an extract from the ICNG and provides noise management levels for residential receivers for day and out of hours periods.

Table 4.8 ICNG residential noise management levels

Time of day	Management level $L_{eq}(15\text{ min})$	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 + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15\text{-min}}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, 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; and • 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 strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see Section 7.2.2.

Source: ICNG 2009.

In summary, the ICNG noise management levels (NMLs) for activities during the standard hours are 10 dB above the existing background levels. For activities outside of the above hours the noise levels should be no more than 5 dB above the existing background levels.

The NMLs for residential and commercial land uses for the proposed development are provided in Table 4.9.

Table 4.9 Construction noise management levels (NMLs)

Location	Day-time RBL, dB(A)	NML, L_{Aeq} (15 min) dB
Residential (R1-R9)	59	69
Commercial (N1-N10) ¹	-	70

Notes: 1. From Section 4.1.3 of the ICNG.

4.6 Construction vibration

4.6.1 Human comfort

i General discussion on human perception of vibration

Humans are sensitive to vibration and they can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2 1975. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 4.10.

Table 4.10 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 H-80 Hz.

Source: German Standard DIN 4150 Part 2 1975.

Table 4.10 suggests that people will just be able to feel floor vibration at levels of about 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

ii Assessing vibration – a technical guide

Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006) is based on guidelines contained in *BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz)*.

The guideline BS 6472 – 2008 presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration levels below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration levels are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community member(s).

The guideline BS 6472 – 2008 defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 4.11.

Table 4.11 Examples of types of vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, eg occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is 3 or fewer these would be assessed against impulsive vibration criteria.

a. Intermittent vibration

Intermittent vibration (as defined in Section 2.1 of the guideline BS 6472 – 2008) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time. This is the most relevant type of vibration for the proposed development.

Intermittent vibration is representative of activities such as impact hammering or rolling.

Section 2.4 of the guideline BS 6472 – 2008 provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz - 80 Hz. To calculate VDV the following formula is used (refer Section 2.4.1 of the guideline):

$$VDV = \left[\int_0^T a^4(t) dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, $a(t)$ is the frequency-weighted rms of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 4.12 from Table 2.4.2 of *Assessing Vibration: a technical guideline* (DEC 2006).

Table 4.12 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value, $\text{m/s}^{1.75}$	Maximum value, $\text{m/s}^{1.75}$	Preferred value, $\text{m/s}^{1.75}$	Maximum value, $\text{m/s}^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

There is a low probability of adverse comment or disturbance to building occupants at vibration levels below the preferred values. Adverse comment or complaints may be expected if vibration levels approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

4.6.2 Structural vibration criteria

Most commonly specified “safe” structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure.

In terms of the most recent relevant vibration damage criteria, *Australian Standard (AS) 2187.2 - 2006 Explosives - Storage and Use - Use of Explosives* recommends the frequency dependent guideline values and assessment methods given in *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* be used as they are “applicable to Australian conditions”.

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4.13 and graphically in Figure 4.1.

Table 4.13 Transient vibration guide values – minimal risk of cosmetic damage

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz - 15 Hz	15 Hz and Above
1	Reinforced or framed structures industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	N/A
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

AS2187 states that the guide values in Table 4.13 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration gives rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 4.13 may need to be reduced by up to 50%.

Sheet piling activities (for example) are considered to have the potential to cause dynamic loading in some structures (eg residences) and it may, therefore, be appropriate to reduce the transient values by 50% for this activity.

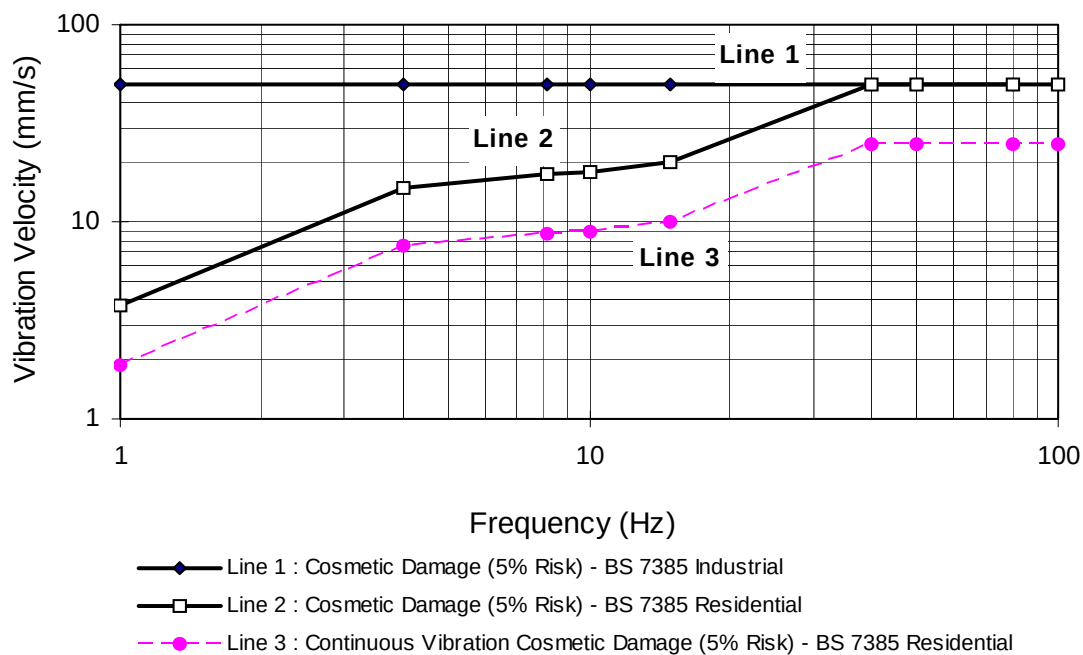


Figure 4.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 4.13, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 4.13 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 4.13.

It is noteworthy that, additional to the guide values nominated in Table 4.13, the standard states that:

Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

Also that:

A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

4.7 Road traffic noise

4.7.1 Operation

The Road Noise Policy (RNP) (Department of Environment, Climate Change and Water NSW 2011) states:

In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Given that the noise environment surrounding the proposed development is already highly saturated with road traffic noise, it is assumed that there will be no material difference in traffic volumes as a result of the proposed development.

4.7.2 Construction

The ICNG does not provide specific criteria for road traffic noise impacts. Road traffic noise impacts from the construction of the proposed development will be relatively short-term and it is likely that any changes in road traffic noise levels will be imperceptible as per the RNP.

5 Noise assessment methodology

5.1 Noise modelling

This section presents the methods and assumptions used to model noise levels from the operation and construction of the proposed development.

Operational and construction noise levels from the proposed development were modelled using Brüel and Kjær Predictor Version 11 software. 'Predictor' calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. The model considers factors such as:

- the lateral and vertical location of noise sources;
- source to assessment location distances;
- ground effects;
- atmospheric absorption;
- surrounding buildings; and
- topography of surrounding the proposed development.

5.1.1 Operation

i INP assessment

It is assumed that the proposed development will not alter or add to any existing mechanical plant at the OPT. Therefore industrial noise has not been assessed further, as it is assumed that the industrial noise criteria outlined in Section 4.2 will continue to be satisfied by the proposed development.

ii Entertainment and patron noise

Source levels adopted for the music and patron noise assessment are presented in Table 5.1. The music source level is based on an internal reverberant sound pressure level measurement of a small live duo or solo performer, or 'background music' at a bar/restaurant. The music source levels are based on the reverberant sound pressure typical of performers or music played through the audio system being for the purpose of background/ambient music. This is considered appropriate as the proposal is for a bar and restaurant.

The patron noise sound power level has been adopted based on data available in published documents and EMM measurements.

It is worth noting that there are many factors which influence the magnitude of patron noise, including the number of people and mix, their behaviour, age, demographic, level of alcohol consumption and the level of background noise, to name a few. It is difficult to apply a typical sound power level based on number of people alone and conservative sound power levels have been adopted to account for potential high patron noise levels which are appropriate given the capacity of the proposed development.

The noise model was based on the following main assumptions:

- a small live duo/solo artist is located either on the ground or first floor, generating the sound power level presented in Table 5.1;
- either windows closed with standard 4 mm glazing or windows open at the proposed development (results are presented for both); and
- patrons are located externally on outdoor areas/decks and these areas are at full capacity. Outdoor area capacity has been modelled as the total external seating as indicated in DA drawings for each respective outdoor area.

Table 5.1 Music and patron octave band centre frequency noise levels

Description	Assessed music and patron noise levels, $L_{A10(15min)}$, Hz									Overall dB (A)
	31.5	63	125	250	500	1k	2k	4k	8k	
Music noise, Lp,rev ¹	53	64	71	76	78	81	78	74	70	85
Patron noise sound power level (>20 patrons ²)	-	70	81	81	87	89	83	75	-	93

Notes: 1. Internal reverberant sound pressure level.

2. Multiple point sources were used within the noise model to represent the proposed development operating at capacity.

iii Awning

The proposed development includes a glazed awning over the proposed northern level 2 deck. The intention of this awning is to reduce noise egress from patrons on the deck into commercial properties above the proposed development also in the OPT. This awning has been incorporated the noise model and noise predictions have been made to the nearest commercial property in the OPT (the Quay Restaurant) and all other assessment locations. It was conservatively assumed that the awning will be constructed using standard 4 mm glazing and extends to at least the edge of the proposed northern level 2 deck (as per architectural drawings September 2016). In practice, 10.38 mm laminated glazing may need to be used for structural reasons.

5.1.2 Construction

Construction noise levels have been assessed for the demolition and construction of existing decks, and the insertion of the micro-brewery 'pod'. The construction equipment will likely be boom lifts for scaffolding, a crane to lift the micro-brewery 'pod' into place and standard hand held power tools. All construction noise sources were modelled together to represent worst case noise levels.

The sound power levels and expected quantities for this equipment are provided in Table 5.2. They have been adopted based on data available in published documents and EMM measurements.

Table 5.2 **Representative equipment sound power levels and quantities**

Equipment	Sound power level, $L_{Aeq(15min)}$ dB	Quantity
Boom lift	92	4
Crane	105	1
Hand tools ¹ (grinder, drills, saws etc)	110	4

Notes 1. This sound power level is for a combination of hand tools.

6 Noise assessment results

6.1 Operation

6.1.1 Residential

Predicted external noise levels from the operation of the proposed development are provided in Table 6.1. The results are separated by a “/” symbol to delineate between a windows closed and windows open scenario at the proposed development, respectively. The predicted noise levels represent a worst case operational scenario (ie the proposed development is at full capacity) and this is assessed against all periods.

The predicted $L_{A10(15 \text{ min})}$ external noise levels from the operation of the proposed development with windows open and windows closed satisfy the City of Sydney (CoS) entertainment noise criteria for all residential assessment locations, during all periods.

6.1.2 Commercial

The predicted internal noise levels from the proposed development at each noise sensitive commercial assessment location are provided in Table 6.2. The external $L_{A10(15 \text{ min})}$ noise level for each octave band has been reduced based on typical 4 mm glazing data to provide an internal noise level.

The results are separated by a “/” symbol for a windows closed and windows open scenario at the proposed development, respectively. The predicted noise levels represent a worst case operational scenario (ie the proposed development is at full capacity) and this is assessed against all periods.

The predicted $L_{A10(15 \text{ min})}$ internal noise levels from the operation of the proposed development with windows open and windows closed satisfy the CoS commercial entertainment noise criteria for all commercial assessment locations, during all periods.

Predicted $L_{A10(15 \text{ min})}$ internal noise levels satisfy CoS commercial entertainment noise criteria at the Quay Restaurant. However, noise predictions have been made with the assumption that windows at the Quay Restaurant are closed (ie external noise predictions have been reduced based on standard 4 mm glazing to provide an internal noise level). It is understood that the Circular Quay Grand does open its windows during some periods of operation. It is clear that the glass awning proposed is reducing noise egress from the development to the Circular Quay Grand as predicted internal noise levels are higher at other assessment locations which are further away but more exposed to noise from the development (eg assessment location 4, which is exposed to noise egress from the western deck of the proposed development). Additionally, if windows are open at the Circular Quay Grand restaurant patrons will be more accepting of higher background noise levels, which will occur regardless of the proposed development.

Table 6.1 Predicted external music and patron octave band centre frequency noise levels, windows closed/windows open, full capacity (residential)

Description	Assessment location/period	Predicted octave band centre frequency (Hz) noise level, L _{A10} (15 min), dB									Exceedance
		31.5	63	125	250	500	1k	2k	4k	8k	
	R1	10/14	20/25	28/32	27/35	31/36	32/38	24/32	12/24	0/9	0
	R2	10/14	21/25	29/32	28/35	33/37	34/38	27/34	16/27	0/16	0
	R3	11/15	23/27	32/36	32/39	37/42	39/44	32/40	21/30	0/18	0
	R4	10/14	20/25	28/32	27/35	32/38	34/40	27/36	16/28	0/12	0
	R5	6/10	17/21	26/29	25/31	31/35	35/39	28/34	16/26	0/5	0
	R6	8/12	19/24	28/32	28/35	33/37	34/39	27/34	14/24	0/0	0
	R7	5/9	16/20	25/28	25/31	30/34	31/36	24/31	10/20	0/0	0
Entertainment noise criteria	Day	29	41	49	54	56	60	55	43	30	-
	Evening	29	41	49	54	56	60	55	43	30	-
	Night (10 pm to 12 am)	21	33	41	46	48	52	47	35	22	-
	Night (12 am to 7 am)	17	29	37	42	44	48	43	31	18	-

Notes 1. As this is a modelling exercise, results below 20 dB have been presented as their actual value. In practice these noise levels are rarely audible.

Table 6.2 Predicted internal music and patron octave band centre frequency noise levels, windows closed/windows open (commercial)

Assessment location	Predicted octave band centre frequency (Hz) noise level, L _{A10} (15min), dB									Exceedance
	31.5	63	125	250	500	1k	2k	4k	8k	
N1	0/0	0/2	0/5	0/4	0/0	0/0	0/0	0/0	0/0	0
N2	0/0	0/4	2/6	0/6	0/0	0/0	0/0	0/0	0/0	0
N3	0/1	4/10	8/13	4/12	1/6	0/2	0/0	0/0	0/0	0
N4	8/12	20/25	27/30	25/31	25/28	22/25	14/20	13/22	0/14	0
N5	6/10	16/21	22/26	20/28	20/25	16/22	9/17	7/19	0/10	0
N6	0/0	8/12	14/17	12/19	12/16	9/13	1/8	0/8	0/0	0
N7	0/0	0/2	1/5	0/3	0/0	0/0	0/0	0/0	0/0	0
N8	0/0	4/9	8/12	4/12	2/7	0/3	0/1	0/2	0/0	0
N9	0/0	0/5	7/10	4/11	4/8	0/5	0/0	0/0	0/0	0
N10 (Quay Restaurant)	14/18	23/29	28/32	24/32	22/27	17/24	9/18	7/20	0/13	
Entertainment noise criteria	41	44	44	43	44	43	41	39	36	-

Notes 1. As this is a modelling exercise, results below 20 dB have been presented as their actual value. In practice these noise levels are rarely audible.

6.2 Construction

6.2.1 Residential

Predicted construction noise levels are provided in Table 6.3. It is proposed that construction will only occur during standard ICNG hours (ie Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm and no construction work is to take place on Sundays or public holidays) Therefore results have been assessed for these periods using the CoS construction code and the ICNG criteria.

Construction noise levels are predicted to satisfy ICNG NMLs at all assessment locations. Exceedances of up to 7 dB are expected under the CoS construction code criteria during the 7 am to 8 am period, however this criteria does not technically apply.

None of the predicted construction levels exceed the ICNG highly affected noise level of 75 dB.

Table 6.3 Predicted construction noise levels, dB (residential)

Assessment location	Day	Period	Predicted $L_{Aav \text{ max (15 min)}}$ noise level	CoS construction code criteria, $L_{Aav \text{ max (15 min)}}$	Exceedance	Predicted $L_{Aeq \text{ (15 min)}}$ noise level	ICNG NML, $L_{Aeq \text{ (15 min)}}$	Exceedance
R1	Monday to Friday	07.00- 08.00	51	51	0	48	69	0
		08.00- 19.00	51	69	0	48	69	0
	Saturday	08.00- 17.00	51	69	0	48	69	0
R2	Monday to Friday	07.00- 08.00	56	51	Up to 5	53	69	0
		08.00- 19.00	56	69	0	53	69	0
	Saturday	08.00- 17.00	56	69	0	53	69	0
R3	Monday to Friday	07.00- 08.00	62	51	Up to 7	59	69	0
		08.00- 19.00	62	69	0	59	69	0
	Saturday	08.00- 17.00	62	69	0	59	69	0
R4	Monday to Friday	07.00- 08.00	54	51	Up to 3	51	69	0
		08.00- 19.00	54	69	0	51	69	0
	Saturday	08.00- 17.00	54	69	0	51	69	0
R5	Monday to Friday	07.00- 08.00	52	51	Up to 1	49	69	0
		08.00- 19.00	52	69	0	49	69	0
	Saturday	08.00- 17.00	52	69	0	49	69	0

Table 6.3 Predicted construction noise levels, dB (residential)

Assessment location	Day	Period	Predicted L _{Aav} max (15 min) noise level	CoS construction code criteria, L _{Aav} max (15 min)	Exceedance	Predicted L _{Aeq} (15 min) noise level	ICNG NML, L _{Aeq} (15 min)	Exceedance
R6	Monday to Friday	07.00- 08.00	58	51	Up to 7	55	69	0
		08.00- 19.00	58	69	0	55	69	0
	Saturday	08.00- 17.00	58	69	0	55	69	0
R7	Monday to Friday	07.00- 08.00	53	51	Up to 2	50	69	0
		08.00- 19.00	53	69	0	50	69	0
	Saturday	08.00- 17.00	53	69	0	50	69	0

6.2.2 Commercial

Predicted construction noise levels for commercial assessment locations are expected to marginally exceed ICNG NMLs at assessment locations N4. The predictions are for a worst case scenario and therefore it is likely that the predicted exceedances will be temporary if they do occur. None of the predicted construction levels exceed the ICNG highly affected noise level of 75 dB. It is clear that the existing structure at the OPT is providing shielding for assessment location N10 (the Quay Restaurant) as predicted construction noise levels are lower than those at adjacent assessment locations N4 and N5.

Table 6.4 Predicted L_{Aeq} (15 min) construction noise levels (commercial)

Assessment location	Predicted noise level	NML	Exceedance
N1	41	70	0
N2	43	70	0
N3	50	70	0
N4	75	70	5
N5	70	70	0
N6	61	70	0
N7	36	70	0
N8	50	70	0
N9	52	70	0
N10 (Quay Restaurant)	65	70	0

7 Noise management and mitigation

7.1 Operation

There is no requirement for noise management and mitigation during the operation of the proposed development. It is unlikely the nature of sound emissions from the proposed development will cause any community response or change in the surrounding acoustic environment. The predicted $L_{A10(15\text{ min})}$ total noise levels from the proposed development are generally lower than the measured noise levels so it is highly likely that entertainment noise propagating from the proposed development will be masked by other sound sources (ie road traffic and other entertainment noise). There are also social and economic benefits from the proposed development.

7.2 Construction

There are no predicted exceedances of ICNG noise criteria at residential assessment locations during the construction of the proposed development. Assessment locations N4, N5 and N10 are close to the proposed development and may be temporarily affected by construction noise from the proposed development. It is therefore recommended that construction noise is managed through the following work practices:

- scheduling respite periods for intensive works;
- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- regular identification of noisy activities and adoption of improvement techniques;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- minimising the use of equipment that generates impulsive noise;
- use of broadband audible reverse alarms ("growlers") on vehicles and elevating work platforms used on site; and
- minimising the movement of materials and plant and unnecessary metal-on-metal contact.

Under the CoS construction code criteria, works may be restricted during the 7 am to 8 am period.

8 Conclusion

EMM has completed an operational and construction noise assessment for the proposed development at the OPT.

The proposed development will not alter or add to any existing mechanical plant at the OPT and therefore it is expected that industrial noise criteria will continue to be satisfied at all assessment locations.

The predicted noise levels from the operation of the proposed development do not exceed the CoS entertainment noise criteria for all assessment locations. Noise from the facility will likely be masked by the relatively elevated noise levels in such a vibrant environment. Such venues and activities are not uncommon in this district and provide a social benefit to the community.

Construction noise levels are predicted to satisfy the ICNG criteria at all residential assessment locations, with minor exceedances at some commercial assessment locations. It is expected that if these exceedances do occur they will be temporary due to the dynamic nature of construction work. Nonetheless, the proponent will manage construction noise using the universal work practices outlined in Section 7.2.

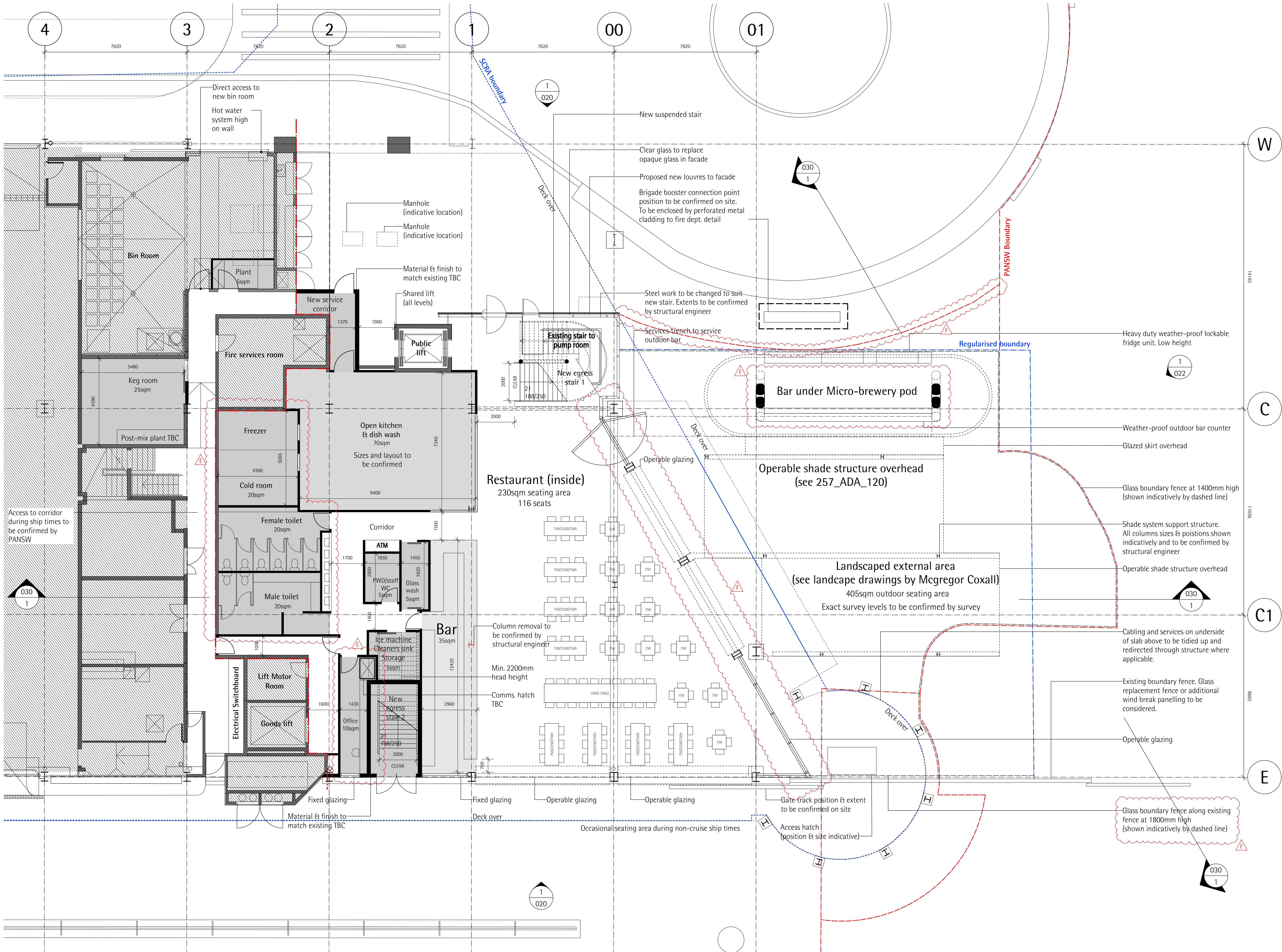
It is recommended that an acoustic assessment of the proposed development's internal acoustics be completed during the final design stage. This would include an assessment of the internal acoustic environment's suitability and expected response to patron noise and proposed audio systems. It is also recommended that the audio system be designed by a qualified professional.

References

AECOM, "Overseas Passenger Terminal Upgrade Construction and Operation Noise and Vibration Assessment". Report prepared by AECOM 2014 for the Sydney Ports Corporation 2014.

Appendix A

Architectural plans



Note: All proposed new structural elements are shown indicatively. Sizes & positions are indicative only and to be reviewed & confirmed by structural engineer

Internal Layouts Note: All internal toilet layouts are subject to further detailed planning and consultant coordination. All internal toilet layouts are indicative only and may be subject to change through detailed planning and coordination.

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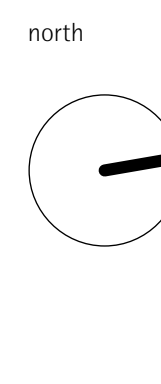
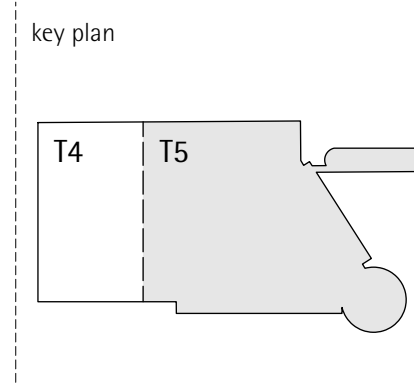
based on cad drawings provided by JFW Architects 09.04.15

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notes
01 do not scale; dimensions govern
02 all dimensions are in millimeters
03 all dimensions to be verified on site
04 collins and turner are to be notified of any discrepancies
Scale bar
0.5m 1m 2.5m 5m 7.5m

rev	date	issued	note
A	05.08.16	SK	DRAFT Issue for SSD
B	24.08.16	SK	Issued for SSD
C	29.08.16	SK	Issued for SSD
D	16.09.16	SK	General updates
E	22.09.16	SK	General updates
F	29.09.16	SK	Glazing line (North) & bar under micro-brewery

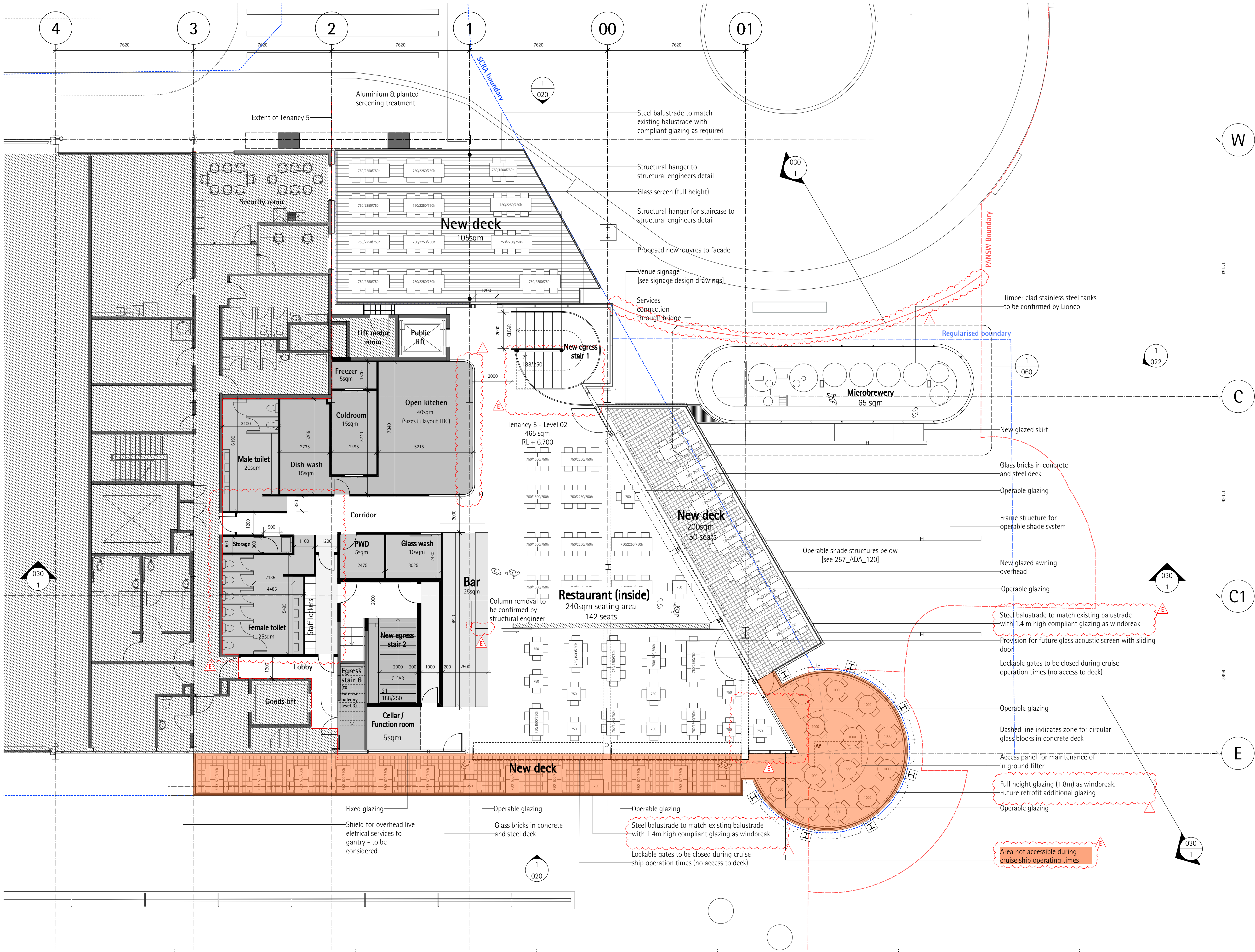
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project
Tenancy 5
Overseas Passenger Terminal
Circular Quay West
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drawing title
scale
date
drawn by
drawing number+ revision

Level 1 Proposed
1:200 @ A3
July 2016
SK
257_ADA_012 F



Note: All proposed new structural elements are shown indicatively. Sizes & positions are indicative only and to be reviewed & confirmed by structural engineer

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based on cad drawings provided by JFW Architects 09.04.15

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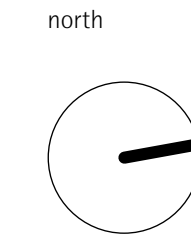
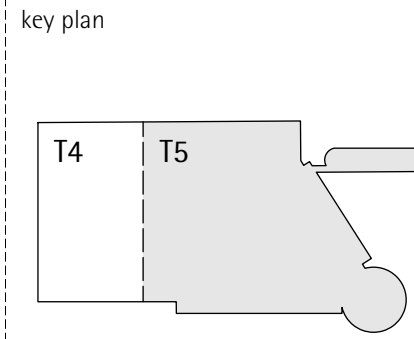
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0.5m 1m 2.5m 5m 7.5m

rev	date	issued	note
A	05.08.16	SK	DRAFT Issue for SSD
B	24.08.16	SK	Issued for SSD
C	29.08.16	SK	Issued for SSD
D	16.09.16	SK	General updates
E	22.09.16	SK	General Updates
F	29.09.16	SK	PANSW boundary line

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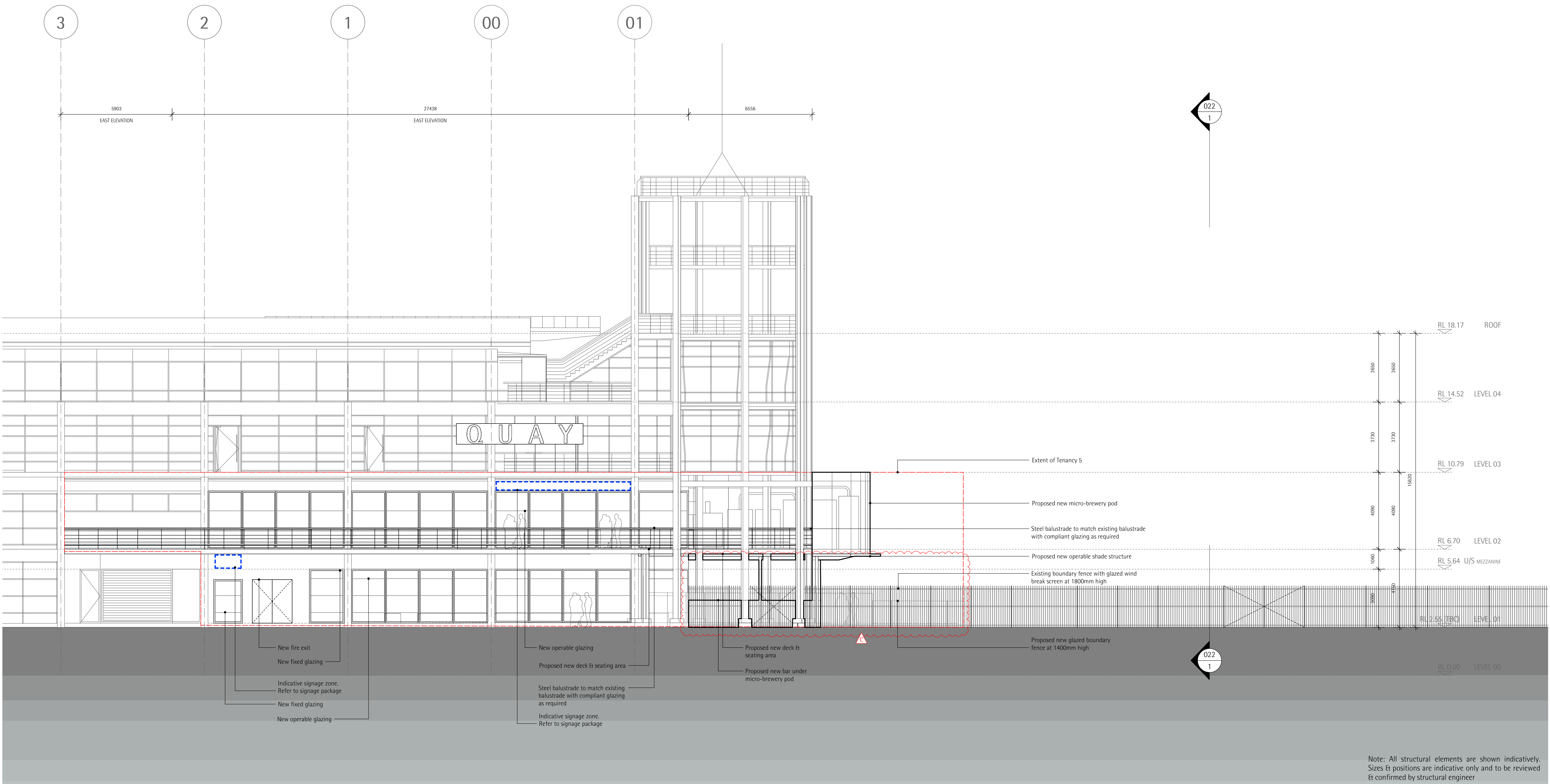
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Level 2 Proposed

scale
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July 2016
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architect

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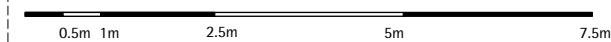
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notes

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- 02 all dimensions are in millimeters
- 03 all dimensions to be verified on site
- 04 collins and turner are to be notified of any discrepancies

scale bar



rev	date	issued	note
A	05.08.16	SK	DRAFT Issue for SSD
B	24.08.16	SK	Issue for SSD
C	29.09.16	SK	L02 awning & bar under micro-brewery pod

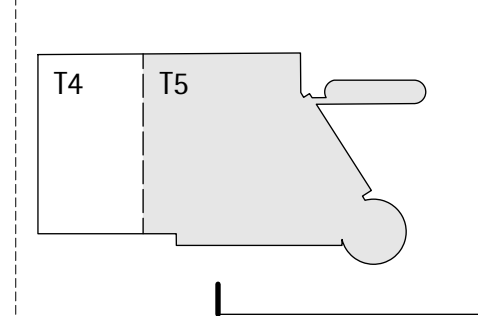
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key plan



north

project

Tenancy 5
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Circular Quay West

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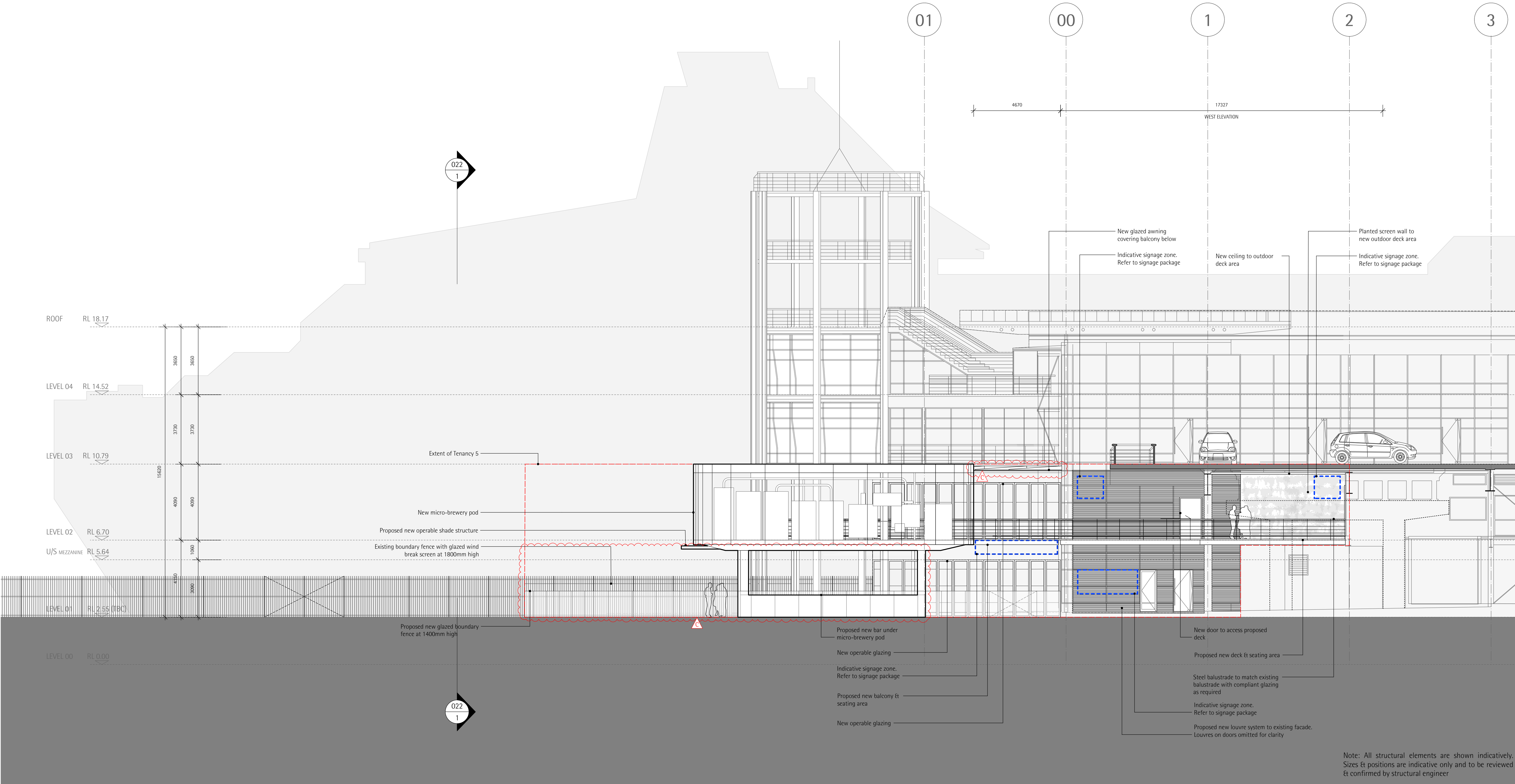
Elevation East

1:200 @ A3
July 2016
SK

257_ADA_020 C

based on cad drawings provided by JPW Architects 09.04.15

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Note: All structural elements are shown indicatively.
Sizes & positions are indicative only and to be reviewed
& confirmed by structural engineer

Appendix B

AECOM (2014) ABLs

Unattended Monitoring ResultsTable 27 Existing background (L_{90}) and ambient (L_{eq}) noise levels, dB(A)

Measurement Date	L_{90} Background Noise Levels			L_{eq} Ambient Noise Levels		
	Day ³	Evening ³	Night ³	Day ³	Evening ³	Night ³
Holiday Inn, 55 George Street, The Rocks						
Tuesday 23 July, 2013		60 ¹	56 ¹		62 ¹	59 ¹
Wednesday 24 July, 2013	61 ¹	60	57 ¹	64 ¹	62	60
Thursday 25 July, 2013	61 ¹	60	57	63 ¹	62	60
Friday 26 July, 2013	61	62	57 ¹	63	63	61 ¹
Saturday 27 July, 2013	62 ¹	61	58	64 ¹	64	61
Sunday 28 July, 2013	60	59	57	63	61	60
Monday 29 July, 2013	61 ¹	59	57	63 ¹	62	60
Tuesday 30 July, 2013	61	61	57 ¹	63	62	60 ¹
Wednesday 31 July, 2013	1	1	1	1	1	1
RBL	61	60	57	-	-	-
Log Average L_{eq}	-	-	-	63	62	60
Quay Grand, 61 Macquarie Street, East Circular Quay						
Wednesday 24 July, 2013		62	52 ¹		65	61 ¹
Thursday 25 July, 2013	63	63	53	66	65	62
Friday 26 July, 2013	63	63	52	66	65	61 ¹
Saturday 27 July, 2013	60 ¹	60	53	65 ¹	65	61
Sunday 28 July, 2013	59	60	51	66	64	59
Monday 29 July, 2013	63 ¹	62	52	65 ¹	65	60
Tuesday 30 July, 2013	63	62	51 ¹	66	65	61 ¹
Wednesday 31 July, 2013	63 ¹	63 ¹	51 ¹	66 ¹	66 ¹	60 ¹
RBL	63	62	52	-	-	-
Log Average L_{eq}	-	-	-	66	65	60
Destination NSW Office, Level 2, 88 Cumberland Street						
Wednesday 13 November, 2013		61	57		63	61
Thursday 14 November, 2013	61	60	57	64	62	59
Friday 15 November, 2013	61 ¹	62 ¹	58 ¹	64 ¹	66 ¹	62 ¹
Saturday 16 November, 2013	60 ¹	60 ¹	58 ¹	63 ¹	64 ¹	60 ¹
Sunday 17 November, 2013	60 ¹	59 ¹	57 ¹	61 ¹	60 ¹	59 ¹
Monday 18 November, 2013	60 ¹	59 ¹	1	62 ¹	60 ¹	1
RBL	61	61	57	-	-	-
Log Average L_{eq}	-	-	-	64	62	61

Measurement Date	L ₉₀ Background Noise Levels			L _{eq} Ambient Noise Levels		
	Day ³	Evening ³	Night ³	Day ³	Evening ³	Night ³
Park Hyatt, 7 Hickson Road, The Rocks						
Friday 08 November, 2013		59	56		64	61
Saturday 09 November, 2013	²	60	57 ¹	²	65	62 ¹
Sunday 10 November, 2013	61 ¹	59 ¹	57 ¹	66 ¹	67 ¹	62 ¹
Monday 11 November, 2013	61 ¹	60 ¹	56 ¹	65 ¹	64 ¹	61 ¹
Tuesday 12 November, 2013	60 ¹	59 ¹	56 ¹	65 ¹	65 ¹	61 ¹
RBL	61¹	59	56	-	-	-
Log Average L_{eq}	-	-	-	65¹	65	61

Notes:

1. Denotes periods which were affected by rain or wind noise and have been omitted from RBL determination.
2. Denotes periods which were affected by extraneous sources obviously not part of the typical noise environment and have been omitted from RBL determination.
3. Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays and Public Holidays, evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday and Public Holidays, night is defined as all other times.



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