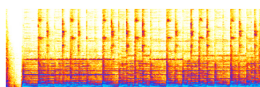


BONDI SURF BATHERS' LIFE SAVING CLUB CONSERVATION & UPGRADE

ACOUSTIC REPORT FOR DEVELOPMENT APPLICATION

Issued

20 April 2021

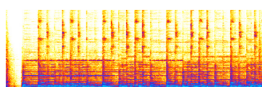


acoustic studio

abn 76 106 325 982
address Unit 27, 43-53 Bridge Road, Stanmore NSW 2048 Australia
tel (+61) 2 9557 6421
fax (+61) 2 9557 6423
email mail@acousticstudio.com.au

Contact for this Report

Jason Cameron
jason.cameron@acousticstudio.com.au



acoustic studio

abn 76 106 325 982
address Unit 27, 43-53 Bridge Road, Stanmore NSW 2048 Australia
tel (+61) 2 9557 6421
fax (+61) 2 9557 6423
email mail@acousticstudio.com.au

Proj & Code	Bondi Surf Bathers' Life Saving Club Conservation & Upgrade		
Doc Title	Acoustic Report for Development Application		
Ref	20210420 LOC.0002.Rep.docx		
Date	20 April 2021	Revision: Issue 2	
Author(s)	Jason Cameron, Isaac Bradbury		
Circulation	Organisation	Location	Delivered Via
Jesse Lockhart-Krause	Lockhart-Krause Architects	Sydney	e-mail
Attachment(s)	Appendices as listed in the Table of Contents		

*Acoustic Studio is a member of the
Association of Australasian Acoustical Consultants*



*This document takes into account the particular instructions and requirements of our Client.
It is not intended for and should not be relied upon by any third party and no responsibility is undertaken
to any third party.*

Table of Contents

1	Introduction	5
2	Project Description	6
2.1	Project Overview	6
2.2	Key Operational Noise Considerations.....	8
2.3	Current Operations	8
2.4	Site Details and Local Sensitive Receivers	11
3	Existing Noise Environment	13
3.1	Noise Survey Approach	13
3.2	Observations	13
3.3	Noise Monitoring Locations	14
3.4	Noise Monitoring Results	15
3.4.1	<i>Long-term unattended noise monitoring.....</i>	<i>15</i>
3.4.2	<i>Short-term attended measurements</i>	<i>16</i>
4	Relevant Standard and Guidelines	17
4.1	Guidelines used for the Operational Acoustic Assessment.....	17
4.2	Guidelines used for the Construction Acoustic Assessment	18
5	Project Operational Noise Criteria	19
5.1	External Noise Emission Criteria - General	19
5.1.1	<i>Local Development and Environment Plans.....</i>	<i>19</i>
5.1.2	<i>Environmental Planning and Assessment Act (EP&A) 1979.....</i>	<i>19</i>
5.1.3	<i>Protection of the Environment Operation Act (POEO) 1997</i>	<i>19</i>
5.1.4	<i>Defining environmental noise criteria.....</i>	<i>21</i>
5.2	External Noise Emission Criteria - Mechanical Plant.....	21
5.2.1	<i>New South Wales Noise Policy for Industry (NPI).....</i>	<i>21</i>
5.2.2	<i>Sleep disturbance</i>	<i>23</i>
5.2.3	<i>Summary of environmental noise criteria for mechanical plant.....</i>	<i>24</i>
5.3	Traffic Noise Criteria	25
5.4	External Noise Emission Criteria – Patrons and Sound Systems.....	26
5.4.1	<i>Waverley Council DCP.....</i>	<i>26</i>
5.4.2	<i>Liquor & Gaming NSW - L_{A10} Noise Condition</i>	<i>26</i>
5.4.3	<i>Sleep disturbance criteria</i>	<i>27</i>
5.4.4	<i>Noise emission criteria for BSBLSC (patrons and sound systems)</i>	<i>29</i>
5.5	Summary of Operational Noise Emission Criteria for the BSBLSC Project.....	30
6	Operational Assessment and Recommendations	31
6.1	Operational Assessment Methodology	31
6.2	Mechanical Plant Noise Compliance	31
6.3	Patron and Sound System Noise.....	33
6.3.1	<i>Patron source noise levels</i>	<i>33</i>
6.3.2	<i>Patron noise assessment.....</i>	<i>33</i>
6.3.3	<i>Sound System Noise from Internal & External Areas.....</i>	<i>34</i>
6.3.4	<i>Sleep disturbance from patrons and sound systems.....</i>	<i>36</i>
6.3.5	<i>Cumulative noise from all BSBLSC venues</i>	<i>36</i>
6.3.6	<i>Discussion of sound system and patron noise from BSBLSC</i>	<i>37</i>
6.4	Traffic Noise Compliance.....	38
6.4.1	<i>Road traffic noise</i>	<i>38</i>
6.4.2	<i>Carparking and loading area noise</i>	<i>38</i>
6.5	POEO Offensive Noise Assessment.....	39
6.6	Summary of Predicted Operational Noise Compliance	40

7	Construction Noise and Vibration Criteria	41
7.1	Construction Noise and Vibration Considerations - Overview	41
7.2	Airborne Noise Management Levels (NML)	42
7.2.1	<i>Airborne noise management levels for residential receivers.....</i>	<i>42</i>
7.2.2	<i>Airborne noise management levels for non-residential receivers</i>	<i>43</i>
7.3	Groundborne Noise Management Levels	44
7.4	Vibration Effects on Structures.....	44
7.5	Vibration Effects on Humans	45
7.6	Vibration Effects on Sensitive Equipment.....	46
8	Construction noise assessment and recommendations	47
8.1	Construction Sequence.....	47
8.2	Hours of work.....	48
9	Construction Noise Assessment Considerations	49
9.1	Noise and Vibration Sources.....	49
9.2	Methodology	51
10	Construction-related Road Traffic Noise.....	53
11	Noise Management and Mitigation Measures.....	54
11.1	General Noise Control Elements.....	54
11.2	Communication and Complaints	56
11.3	Timing of Works	57
11.4	Equipment and Plant Selection.....	57
11.5	Construction Vibration Assessment	58
11.5.1	<i>Vibration sources and methodology</i>	<i>58</i>
11.5.2	<i>Predicted vibration levels</i>	<i>58</i>
11.5.3	<i>Vibration mitigation measures</i>	<i>59</i>
11.5.4	<i>Vibration management approach.....</i>	<i>59</i>
11.5.5	<i>Dilapidation survey.....</i>	<i>59</i>
11.5.6	<i>Vibration monitoring inside the BSBLSC Building.....</i>	<i>60</i>
11.5.7	<i>Groundborne noise controls.....</i>	<i>61</i>
11.6	Noise and Vibration Monitoring and Reporting	61
11.7	Construction Noise and Vibration Compliance.....	62
12	Summary and Conclusions	63
APPENDIX	65
	Noise logger graphs	65

1 Introduction

Acoustic Studio has been engaged to carry out an acoustic assessment to support a Development Application (DA) for the Bondi Surf Bathers' Life Saving Club Conservation & Upgrade Project at Queen Elizabeth Drive, Bondi Beach. Waverley Council is the Proponent.

An operational and construction acoustic assessment has been carried out for the proposal and is detailed in this report - along with the findings and recommendations. It has been prepared as part of the Development Application to be submitted to Waverley Council.

The objectives of this assessment are to:

- Identify noise sensitive receivers that will potentially be affected by the construction and operational phases of the proposed upgraded Bondi Surf Bathers' Life Saving Club.
- Determine existing ambient and background noise levels at the nearest noise sensitive receivers that surround the site.
- Establish the appropriate noise assessment criteria in accordance with the relevant standards and guidelines.
- Carry out an assessment to determine whether the relevant criteria can be achieved based on proposed operations and likely construction methods.
- Where applicable, provide recommendations for any necessary acoustic control measures that will need to be incorporated into the development or use in order to ensure compliance with the assessment criteria.

This report has been prepared with reference to the following documents:

- [1] Waverley Council, Bondi Surf Bathers Life Saving Club (BSBLSC) Restoration and Upgrade Project Preliminary Plan of Management (*BSBLSC_Preliminary Plan of Management_r1.PDF* provided to Acoustic Studio 14/04/21)

2 Project Description

2.1 Project Overview

Waverley Council is commissioning a conservation and upgrade project that has included community consultation and consideration of long-term actions for the site with a number of key changes and improvements to the building.

The draft concept design has been guided by a detailed Conservation Management Plan (CMP) for the site and building, in close collaboration with the NSW Office of Environment and Heritage, which has formally supported the design.

There are limitations with the current building making it increasingly difficult to fulfil the Club's growing water safety and rescue obligations. Bondi is Australia's busiest beach, and the club conducts hundreds of rescues and first aids each year.

The project will address the many functional deficiencies of the current building and aims to:

- provide equality of facilities for females, who now comprise 40% of new membership
- increase space for training and educational programs
- storage for the increasing amount of essential modern-day lifesaving equipment
- provide improved and safer facilities for Nippers
- address workplace health & safety and building code non-compliance issues, poor disabled access, adherence to fire standards, flood damage and general disrepair.

The proposal incorporates a range of uses and spaces in the existing club plus new addition:

Basement:

- Storage and publicly accessible archives

Ground floor:

- Refurbished and repurposed to provide a publicly accessible surf museum and heritage hall (existing building)
- Changerooms (existing building)
- Kiosk, Caretaker, Operations, Radio and First Aid Room
- Publicly accessible Board Room and Administration Offices
- Youth Room
- Publicly accessible courtyard

First Floor:

- Gymnasium

Second Floor:

- Refurbishment of existing Function Room
- Publicly accessible Multi-purpose Training and Meeting Rooms
- External terrace

The project site is shaded blue in the site map below in Figure 1. The proposed site plan is shown in Figure 2.



Figure 1: Plan view of the existing Bondi Surf Bathers' Life Saving Club (BSBLSC) site and the local surrounding area

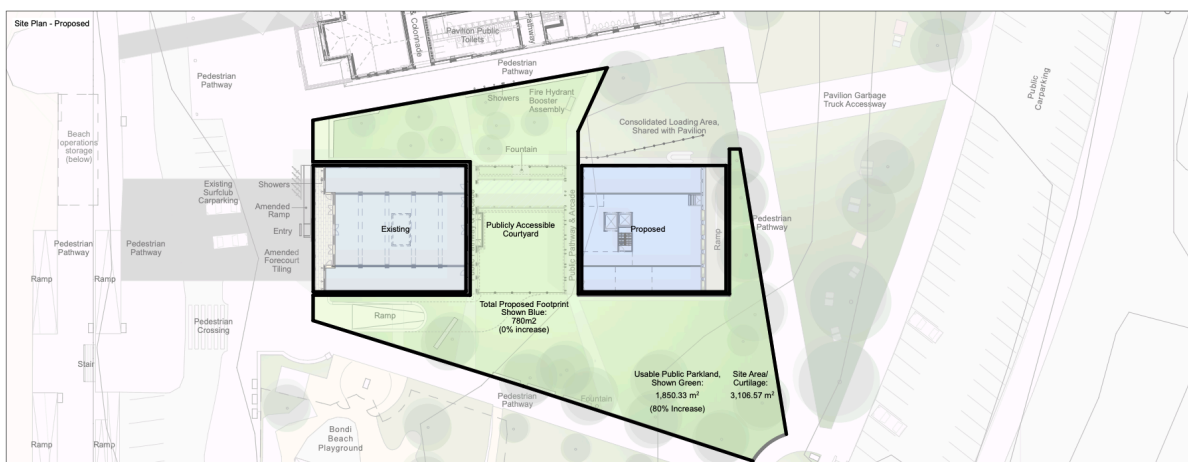


Figure 2: Plan view of the proposed BSBLSC site

2.2 Key Operational Noise Considerations

The key external noise emission considerations from the operation of the proposed BSBLSC works are:

- Breakout noise from building services and plant.
- Patron noise from inside the building.
- Patron noise from the outdoor areas.
- Amplified speech and music.

Noise emissions from each of these spaces / operations may need to be managed to limit environmental noise impacts on nearby residential receivers.

The existing building envelope and both new and existing internal structures will also need to consider the potential for environmental and other occupancy noise to affect noise-sensitive spaces such as the Function Room.

Construction activities may have a temporary noise impact on nearby sensitive receivers.

This noise impact assessment considers these in detail.

2.3 Current Operations

The BSBLSC hours of operation are as follows (as outlined in the Plan of Management [1]):

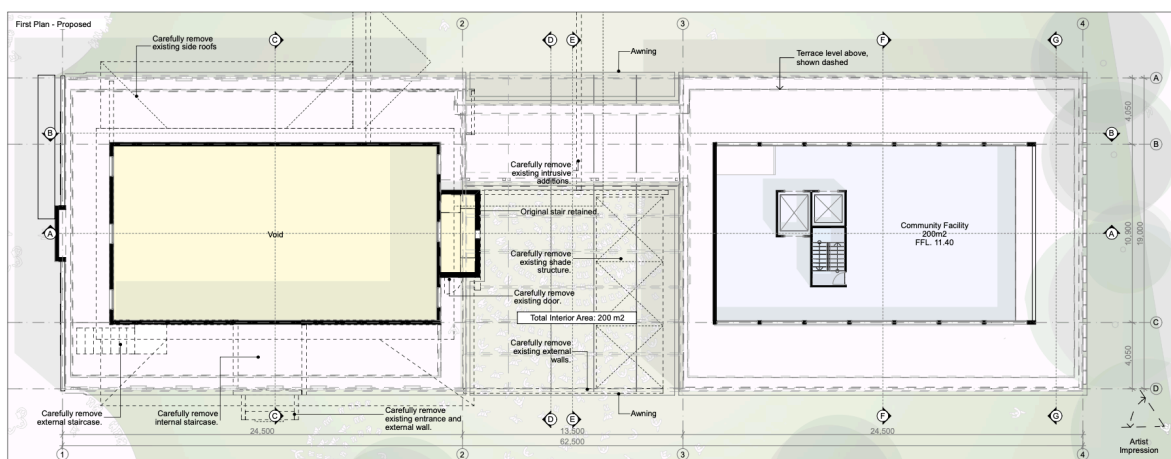
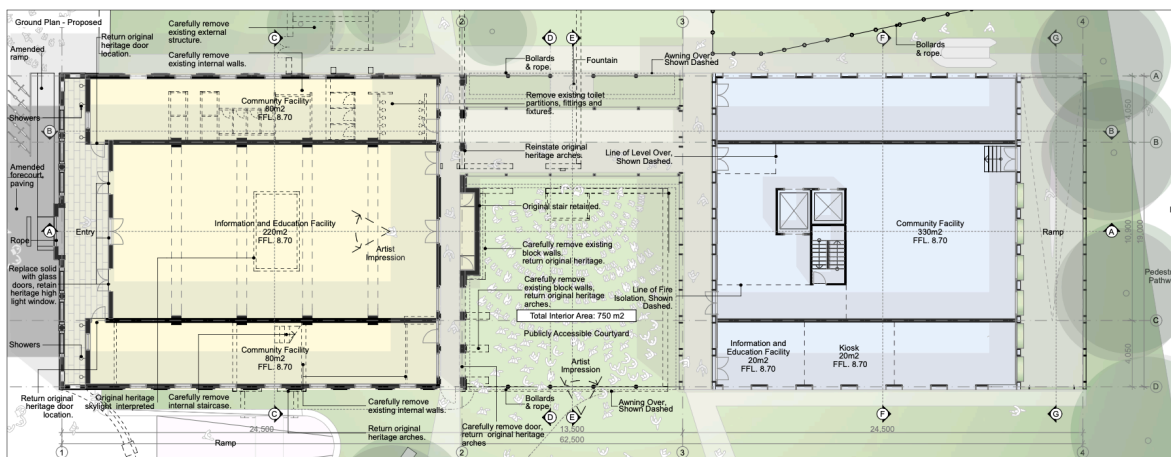
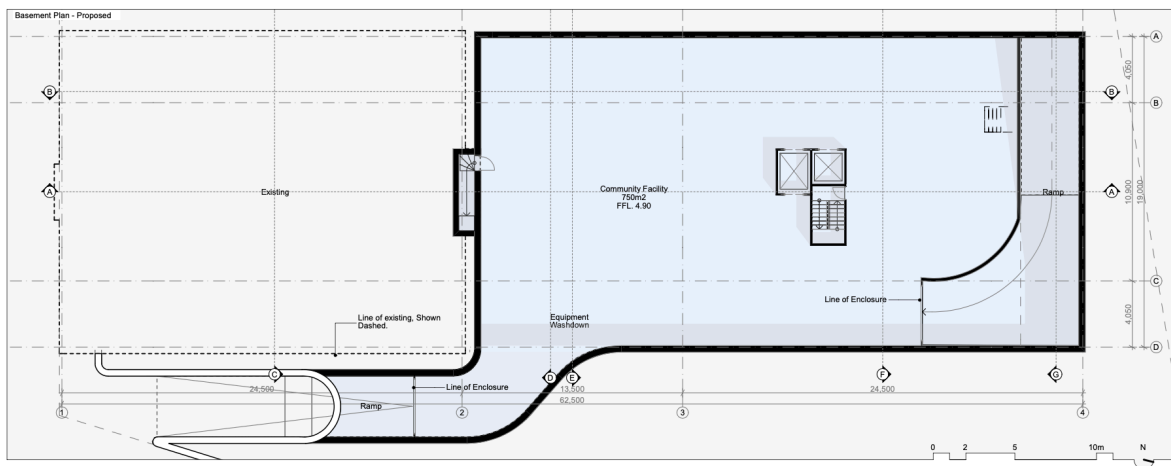
- Function Room: 8:00am to 12:00am, 7 days a week.
- Museum: 10:00am to 4:00pm, weekdays and Saturdays, closed on Sundays.
- Kiosk: 6:00am to 4:00pm, 7 days a week.

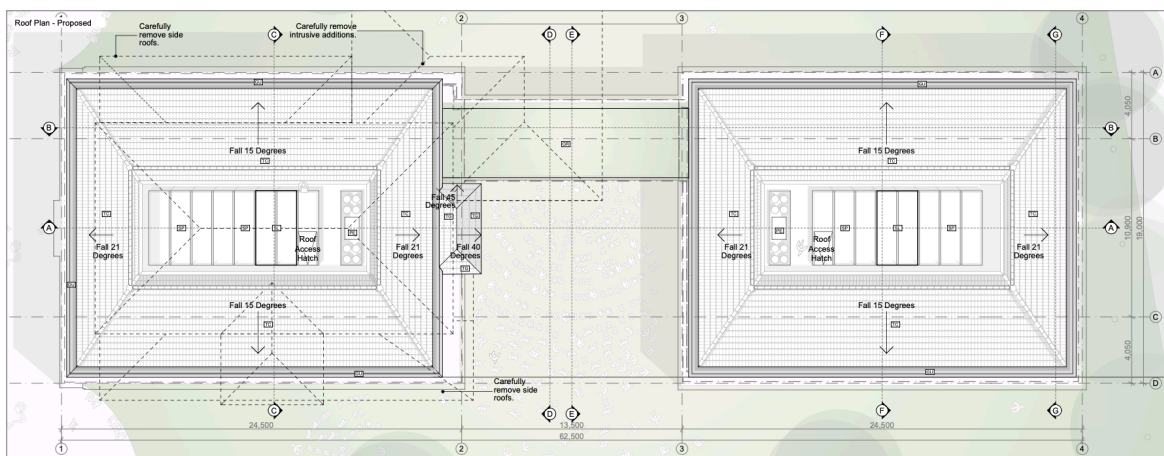
The BSBLSC capacity is as per the Plan of Management [1].

For the purposes of the assessment, Acoustic Studio has been advised that the relevant approximate maximum capacities are as follows. Actual capacities are to be confirmed.

- Internal areas – 500 patrons
- External areas – 500 patrons

The proposed BSBLSC spaces are shown in Figure 3 below.



Page 10 of 73
Doc ref: 20210420 LOC.0002.Rep.docx

2.4 Site Details and Local Sensitive Receivers

The site is located within an urban environment characterised by medium to high levels of activity throughout the day, and during the evening / night at the weekend. There is a continuous flow of traffic during the day and night along Campbell Parade.

A mix of commercial, educational and residential buildings exists around the site. Existing neighbouring buildings or establishments that surround the site include:

- Commercial and retail receivers within Bondi Pavilion - currently undergoing construction works (at approximately 5 m to the West).
- Bondi Park surrounding the BSBLSC (at approximately 5 m).
- Residential buildings along Campbell Parade to the North-East (at approximately 100 m) – being the closest residential receivers.
- Bondi Beach Public School located North (at approximately 100 m) of the site – being the nearest educational property.
- A mixed-use development to the North-West (at approximately 150 m) – being QT Bondi Hotel.

A summary of the nearest sensitive receivers surrounding the development site is presented in Table 2.

Sensitive Receiver	Receiver Type	Approximate distance from site (m, to closest point)
QT Bondi Hotel	Hotel / Residential	150
Residential buildings at Campbell Parade	Residential	100
Bondi Pavilion	Commercial/Retail	5
Bondi Park	Recreational	5
Bondi Beach Public School	Educational	100

Table 2: Nearest noise and vibration sensitive receivers surrounding the Project site

Figure 4 shows the land use of the surroundings. Blue shading represents the project site. Red shading represents the Bondi Pavilion. Green shading is recreational area that is Bondi Park. Orange shading represents the educational receiver, the Bondi Beach Public School (BBPS). Purple shading represents the residential receivers.

Noise logger locations are shown in red: Location 1 from February 2017² at the Bondi Pavilion, and Location 2 from March 2019 at the residential receiver at 1 Beach Road. The February 2017 noise measurement locations were selected for an assessment of construction noise and vibration impacts for the Bondi Pavilion Upgrade and Conservation Project (Stage 1), which was carried out by Acoustic Studio.

² *Acoustic Studio, Bondi Pavilion – Conservation and Upgrade Project, Stage 1, Construction Noise and Vibration Assessment Report, 14 March 2017, Acoustic Studio.*



Figure 4: Location of proposed BSBLSC redevelopment in relation to noise-sensitive receivers

3 Existing Noise Environment

3.1 Noise Survey Approach

Environmental noise assessments for new developments require an understanding of existing environmental noise in the absence of the development, to determine how audible and noticeable the development noise will be once the development is complete.

The BSBLSC site is considered, for acoustic and noise purposes, to affect and be affected by the same receivers and similar sources as the Bondi Pavilion (ensuring correct allowances for distance correction).

Noise survey data for the assessment of the BSBLSC site have been taken from previous surveys in the area, as noted below.

- Noise surveys have been carried out by Acoustic Studio for the Bondi Pavilion Restoration and Conservation Project (BPRCP) DA³ at the site of BPRCP and its surrounds in March 2019 to determine the ambient and background noise levels affecting the site and at the nearest noise sensitive receivers, and to measure the existing noise levels generated by the use of the Bondi Pavilion.
- Noise surveys reported for the BPRCP DA, carried out in February 2017 by Acoustic Studio, for the preparation of a construction noise and vibration assessment for the Bondi Pavilion Upgrade and Conservation Project (Stage 1).

Long-term (unattended) noise monitoring was carried out, in combination with attended measurements and observations.

A summary of the monitoring and results is provided below. Full details are available in the BPRCP DA Acoustic Report.

3.2 Observations

Typically, road traffic around the site is steady along Campbell Parade. Aircraft noise is generally restricted to a few commercial seaplanes, helicopters and passenger jets flying at a distance. There are no industrial noise sources in the near vicinity.

From observations during our site visits, it is noted that both ambient and background noise levels around the BSBLSC Project site are generally dominated by road traffic noise along Campbell Parade plus noise from public activities and the ocean.

³ Waverley Council - *Bondi Pavilion Restoration and Conservation Project, Acoustic Report for Development Application, 29 March 2019, Acoustic Studio.*

3.3 Noise Monitoring Locations

Noise surveys have been carried out by Acoustic Studio at the site and its surrounds Thursday 9th to Thursday 16th February 2017, and from 8th to 22nd March 2019. Long-term noise monitoring to determine the ambient and background noise levels affecting the site and at the nearest noise sensitive receivers.

The 2019 survey was carried out to confirm that environmental noise levels have not changed significantly over two years since the 2017 surveys, and to better represent the nearest residential receivers.

The noise logger equipment used and locations were as follows:

- February 2017: Research Laboratories Environmental Noise Logger (Serial number 878065). Located at the northern boundary of the existing Bondi Pavilion on the rooftop of a storage shed (Location 1 in Figure 4).
- 8th to 14th March 2019: Bruel and Kjaer 2250 Environmental Noise Logger 3659B (Serial number 3010119). Located at the eastern rooftop of the nearest residential receiver building at 1 Beach Road (Location 2 in Figure 4).
- 14th to 22nd March 2019: RTA-02 Technology Environmental Noise Logger (Serial number 038). Located at the eastern rooftop of the nearest residential receiver building at 1 Beach Road (Location 2 in Figure 4).

The loggers recorded L_{A1} , L_{A10} , L_{A90} and L_{Aeq} noise parameters at 15-minute intervals for the measurement periods. The calibration of the noise loggers was checked before and after use and no variation in levels was noted.

These noise monitoring periods were selected to obtain data from typical operations during school Term 1. The noise logging periods met the NSW Noise Policy for Industry (refer Section 4.1) requirement of obtaining seven days' worth of valid "school term" noise monitoring data.

A Brüel & Kjær Hand-held Analyser Type 2250, Serial Number – 2446899 was used to conduct attended noise monitoring to validate the day time noise logger data on the day of installation (14th March 2019). The calibration of the equipment was checked before and after the surveys with no variation in level observed. A windshield was used to protect the microphone of the analyser. Weather conditions were calm and dry during the attended noise surveys.

The noise logger data from Friday 8th to Monday 11th March were used to obtain octave band data of the existing background and ambient noise levels in environmental receiver locations.

Environmental noise measurement times included the most sensitive period that the proposed spaces would be occupied (ie between 10pm and midnight, and internal cleaning at night).

Saiham Siraj and Larry Clark of Acoustic Studio Pty Ltd carried out the 2019 surveys. Saiham Siraj and Hadi Khairuddin of Acoustic Studio Pty Ltd carried out the 2017 surveys.

The surveys were in accordance with the method of measurement described in the *AS/NZS 1055:1997 'Description and measurement of environmental noise', parts 1 and 2*.

3.4 Noise Monitoring Results

3.4.1 Long-term unattended noise monitoring

Unattended noise monitoring was carried out between 8th March and 22nd March 2019 on a rooftop balcony at Location 2, to obtain overall A-weighted background and ambient noise levels.

Weather data was collected from the Bureau of Meteorology web site (www.bom.gov.au). The measured noise levels were processed in accordance with the NSW Noise Policy for Industry (NPI, see Section 5.2.1) to determine the Rating Background Level (RBL) and ambient noise conditions for Day, Evening and Night time periods. The NPI method for determining RBLs was also applied for various operational and construction scenarios, for standard construction hours and out of hours works. These levels are provided in Table 3.

Date	Descriptor	Measured sound level, dB(A)		
		Day (07:00-18:00)	Evening (18:00-22:00)	Night (22:00-07:00)
Friday 8/3/19	Ambient, L _{eq}	59	57	52
	ABL, L ₉₀	51	50	45
Saturday 9/3/19	Ambient, L _{eq}	58	57	55
	ABL, L ₉₀	54	54	50
Sunday 10/3/19	Ambient, L _{eq}	57	55	53
	ABL, L ₉₀	51	48	48
Monday 11/3/19	Ambient, L _{eq}	58	57	52
	ABL, L ₉₀	54	52	45
Tuesday 12/3/19	Ambient, L _{eq}	56	(62 - Weather-affected)	(61 - Weather-affected)
	ABL, L ₉₀	50	(51 - Weather-affected)	(55 - Weather-affected)
Wednesday 13/3/19	Ambient, L _{eq}	59	56	54
	ABL, L ₉₀	56	52	46
Thursday 14/3/19	Ambient, L _{eq}	(72 - Weather-affected)	(70 - Weather-affected)	58
	ABL, L ₉₀	(57 - Weather-affected)	(57 - Weather-affected)	50
Friday 15/3/19	Ambient, L _{eq}	(70 - Weather-affected)	(68 - Weather-affected)	(71 - Weather-affected)
	ABL, L ₉₀	(56 - Weather-affected)	(59 - Weather-affected)	(57 - Weather-affected)
Saturday 16/3/19	Ambient, L _{eq}	(69 - Weather-affected)	(70 - Weather-affected)	(71 - Weather-affected)
	ABL, L ₉₀	(58 - Weather-affected)	(58 - Weather-affected)	(58 - Weather-affected)
Sunday 17/3/19	Ambient, L _{eq}	(64 - Weather-affected)	61	54
	ABL, L ₉₀	(60 - Weather-affected)	54	48
Monday 18/3/19	Ambient, L _{eq}	59	58	57
	ABL, L ₉₀	54	54	50

Date	Descriptor	Measured sound level, dB(A)		
		Day (07:00-18:00)	Evening (18:00-22:00)	Night (22:00-07:00)
Tuesday 19/3/19	Ambient, L _{eq}	64	58	56
	ABL, L ₉₀	57	53	52
Wednesday 20/3/19	Ambient, L _{eq}	64	59	56
	ABL, L ₉₀	56	54	52
Thursday 21/3/19	Ambient, L _{eq}	64	61	56
	ABL, L ₉₀	57	55	52
Weekday construction period	RBL	54 (std hours)	53 (OOH)	49 (OOH)
Saturday construction period	RBL	54, 8am – 1pm (std hours) 54, 1 – 6pm (OOH)	54 (OOH)	50 (OOH)
Overall (2017, for reference, measured at Bondi Pavilion)	Ambient, L _{eq}	61	60	57
	RBL, L ₉₀	53	54	48
Overall (2019, measured at residential receiver at 1 Beach Road)	Ambient, L _{eq}	61	58	54
	RBL, L ₉₀	54	53	49

Table 3: Results of long-term unattended ambient & background noise monitoring at 1 Beach Road, March 2019

3.4.2 Short-term attended measurements

In addition to the overall A-weighted noise levels, 10pm to midnight octave band sound levels were analysed to determine background noise levels in octave bands from 31.5 Hz to 8 kHz. These octave band background sound level data are required for the assessment of patron and sound system noise. The measured noise levels are provided in Table 4.

Location	Period	Date	Descriptor	Measured sound level, dB re 20 µPa									
				Overall L dB(A)	Octave band centre frequency, Hz								
					31.5	63	125	250	500	1k	2k	4k	8k
Location 3: Residential receiver	10pm to 12am (Night)	Friday to Monday 8-11/3/19	L _{eq}	55	69	66	59	55	53	50	45	37	25
			L ₉₀	47	52	53	48	46	45	42	37	29	20

Table 4: Results of short-term ambient & background noise monitoring at residential receivers

4 Relevant Standard and Guidelines

4.1 Guidelines used for the Operational Acoustic Assessment

The following standards and guidelines are considered relevant to the project and have been referenced in developing the project noise criteria:

- Waverley Council Development Control Plan (DCP) 2012.
- Waverley Council Local Environment Plan (LEP) 2012.
- Protection of the Environmental Operations (POEO) Act 1997.
- Environmental Planning and Assessment (EP&A) Act 1979.
- State Environmental Planning Policy (Exempt and Complying Development Codes) 2008.
- NSW EPA Noise Policy for Industry (NPI) 2017.
- Noise Guide for Local Government (NGLG), 2010.

The following documents have been referenced to derive numeric noise criteria where not explicitly provided in the local and state planning documents listed above.

- Liquor and Gaming NSW – L_{A10} Noise Condition.
- World Health Organisation (WHO) “Guidelines for Community Noise” 1999.

Applicable guidelines for road traffic noise impacts are:

- NSW EPA *Road Noise Policy* (2011).
- Australian Standard AS 3671-1989 *Acoustics – Road traffic noise intrusion – Building Siting and Construction* (for guidance only; applies to siting of the receiver buildings).

4.2 Guidelines used for the Construction Acoustic Assessment

This acoustic report does not examine in detail the potential impacts from construction noise and vibration on residential receivers, since methodology and timing of works have not been developed. A full construction noise and vibration impact assessment will need to be prepared by the contractor once the likely construction methods are developed.

The primary references are:

- The EPA *Interim Construction Noise Guideline* (2009)
- The EPA *Assessing Vibration – a Technical Guideline* (2006)

It will be necessary to examine potential impacts from construction vibration on both residential receivers and the existing structures of the BSBLSC building. Early works will include demolition of existing structures and potentially vibration-generating construction activities such as jackhammering.

Once the demolition and construction details for the early works are developed, the contractor would need to determine a construction methodology that will ensure no adverse effects on the any nearby sensitive structures including the historically significant building on site.

Historic buildings and structures have particular requirements for managing vibration effects on their cosmetic finishes and structure. The sensitive structures are to be assessed against Australian and international guidelines and standards, such as:

- Australian Standard AS 2187:2-2006 *Explosives - Storage and Use - Part 2: Use of Explosives*
- British Standard BS 7385:2-1993 *Evaluation and measurement for vibration in buildings Part 2*
- German Standard DIN 4150: Part 3-1999 *Structural Vibration Part 3: Effects of Vibration on Structures*.

Vibration effects on buildings is a specialist acoustic field and will require careful collaboration between the acoustic specialist, the structural engineer, and the construction engineer.

The entire Bondi Park, where the BSBLSC site lies, is a site of heritage significance called Bondi Beach Cultural Landscape. The BSBLSC building itself is of historic significance, and the redevelopment needs to consider the preservation of significant forms and structures. This aspect needs to be considered in the construction vibration assessment.

5 Project Operational Noise Criteria

5.1 External Noise Emission Criteria - General

5.1.1 Local Development and Environment Plans

Waverley Development Control Plan (DCP) 2012 and Local Environment Plan (LEP) 2012 refer to environmental noise impacts in qualitative terms. The DCP Part B General specifically mentions noise for waste and storage, but only uses the term “amenity” (which would include noise) for other items.

A primary aim of the LEP is 1.2(2) (e) “to protect, maintain and accommodate a range of open space uses, recreational opportunities, community facilities and services available to the community”.

The DCP Part D Commercial Development Clause 1.1 refers to the Noise Guide for Local Government, and Clause 1.1.5 states:

- (a) An acoustic report may be required for noise generating uses to demonstrate that noise will be appropriately attenuated between buildings.*
- (b) Air conditioning units and cool-room equipment must be located in a plant room or acoustic enclosure.*
- (c) Speakers should be located and orientated to minimise noise levels to neighbouring properties.*
- (d) The design of the premises shall insulate adjoining/nearby properties from any noise or vibration levels caused by the use of the premises.*

5.1.2 Environmental Planning and Assessment Act (EP&A) 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) regulates the majority of planning approval and environmental impact assessment (EIA) requirements in NSW. Section 111 of the Act requires examination and consideration to the fullest extent possible of all matters affecting or likely to affect the environment by reason of its activities. Acoustic impacts are a common community concern to be addressed in an EIA.

5.1.3 Protection of the Environment Operations Act (POEO) 1997

The *Protection of the Environment Operations Act 1997* enables the Government to set out explicit policies and premise-based Environment Protection Licences (EPLs) which are regulated by the Environment Protection Authority NSW (EPA).

Accepted acoustic practice is to determine criteria in accordance with the POEO Act general provisions against the generation of “offensive noise”, applying numerical criteria obtained from applicable environmental noise policies and guidelines.

Defining “offensive noise” for the purpose of an acoustic assessment is not a simple matter. The Protection of the Environment Operations (POEO) Act 1997 defines “Offensive Noise” as follows:

- (a) *that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:*
 - (i) *is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
 - (ii) *interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
- (b) *that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.*

The “regulations” referred to in (b) above are the POEO (Noise Control) Regulations (2008). Very few of these apply to the proposed BSBLSC, therefore the question of whether the noise emissions are “offensive” reduces, in most cases, to a question of whether it meets part (a) of the definition. There are no clear-cut criteria for this, but consideration can be given to whether;

- the level of noise exceeds applicable goals and guidelines,
- the nature, character or quality of the noise is “offensive” due to such characteristics as tonality, impulsiveness or verbal content, and
- the time at which it is made is problematic, such that it could interfere with sleep, or school examinations, etc.

The EPA Noise Guide for Local Government (DECCW, 2010) provides a checklist for offensive noise which can be applied to any noise-generating activities. In addition to the considerations listed above, the EPA checklist asks:

- Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?
- Does the noise include characteristics that make it particularly irritating?
- Does the noise occur at times when people expect to enjoy peace and quiet?
- Is the noise atypical for the area?
- Does the noise occur often?
- Are a number of people affected by the noise?

The remaining consideration relates to “reasonable measures”. It may be reasonable, for example, to manage a noise issue arising from plant which has been relocated, or re-introduced to the area. It may not be ‘reasonable’, on the other hand, to expect a significant reduction in noise from typical existing patron and sound system noise during normal BSBLSC operating hours.

5.1.4 Defining environmental noise criteria

The noise definitions and conditions provided by the Waverley Council DCP, LEP and POEO are generally focused around a subjective assessment.

Acoustic Studio recommends determining suitable objective criteria for assessing offensive noise, for noise emissions from mechanical plant, sound systems and patrons.

Compliance with the criteria described in sections 5.2 and 5.4 will ensure that the general noise conditions described in this section (5.1) will be met.

5.2 External Noise Emission Criteria - Mechanical Plant

5.2.1 New South Wales Noise Policy for Industry (NPI)

The NPI provides the framework and process for deriving noise goals for consents and licences that enable the EPA to regulate industrial premises that are scheduled under the *Protection of the Environment Operations Act 1997*. The NPI provides additional guidance on assessment of changes to existing premises (infrastructure and / or operations).

The NPI applies to fixed facilities, commercial premises and individual industrial sources such as heating, ventilating and air conditioning (HVAC) equipment. It is also typically applied for general maintenance noise such as cleaning activities. It provides guidance on the methodology for determining limiting noise criteria designed for external noise emissions typically associated with mechanical plant.

The NSW NPI defines environmental industrial noise goals in two ways:

- Intrusiveness Noise Level – controlling intrusive noise impacts in the short term for residences.
- Amenity Noise Level (ANL) – maintaining noise level amenity for particular land uses for residences and other land uses.

Applying the more stringent of the two criteria provides the Project Noise Trigger Level (PNTL).

The goals apply at the most-affected point on or within the residential boundary and are location-dependent. They also depend on the occupancy: residential, commercial, educational, etc.

The NPI considers the following when establishing the criteria:

- The *time of day* that the noise generating development will be in operation, defined by the following:
 - Day (7am to 6pm)
 - Evening (6pm to 10pm)
 - Night (10pm to 7am)

- The existing *Ambient* (L_{eq}) and *Background* noise levels (L_{90}) that surround the site.
- The *type of noise source* and its characteristics. The NPI provides modifying factors for noise sources with certain characteristics that may potentially cause greater annoyance than other noise sources of the same level.

The residential ***intrusiveness*** criterion aims to control short duration noise impacts and is based on the existing background noise level, and is defined as:

$$L_{Aeq,15 \text{ minute}} \text{ from new noise source} \leq \text{Existing long-term } L_{A90, \text{Day/Evening/Night}} + 5.$$

The residential ***amenity*** criterion aims to maintain noise amenity for a particular land use. It defines recommended noise levels, called Acceptable Noise Levels (ANL), for different neighbourhood types. For example, the urban residential ANLs applicable to residential receivers at Bondi Beach are:

- Day time (7am to 6pm) : 55 dBL_{Aeq} (11hrs)
- Evening (6pm to 10pm) : 50 dBL_{Aeq} (4hrs)
- Night time (10pm to 7am) : 45 dBL_{Aeq} (9hrs)

The Project Specific Amenity Level is set 5 dB below the Acceptable Noise Level (ANL) for the receiver type. This is intended to protect the local surroundings from “background noise creep”, whereby the introduction of new noise sources in the area leads to cumulative effects and increasing ambient noise levels over time.

Modification factors apply to the amenity criterion when existing transportation noise exceeds the acceptable noise levels (refer Section 2.4.1 of the NSW NPI). The traffic noise modification factor does not apply to the Evening and Night Time Amenity criteria at residential receivers surrounding the BSBLSC.

The NSW NPI applies “penalty” or “correction” factors to account for particular noise characteristics such as tonal, low frequency dominant, or intermittent noise (refer Appendix C of the NSW NPI). No penalty factors have been applied in this assessment of plant noise, based on the assumption that mechanical plant will be controlled at source to avoid intermittent, tonal, or low-frequency-dominant noise emissions.

In order to determine the Project Noise Trigger Level (PNTL) for residential receivers, the lower (more stringent) of the Intrusiveness and Amenity Levels is adopted. The Intrusiveness noise level is assessed over the noisiest 15-minute period in Day, Evening and Night. The Amenity noise level is assessed over the entire 11-hour Day, 4-hour Evening, and 9-hour Night period. The NPI recommends adding 3 dB to the Project Amenity Level to determine a 15-minute L_{Aeq} equivalent to directly compare against the Intrusiveness noise level.

Any non-operational period is excluded from an NPI assessment. For the BSBLSC, it is assumed that some mechanical plant may be in operation 24 hours a day, and that there will be limited facility maintenance activities (such as external cleaning activities between 6am and 7am, and internal cleaning at night).

5.2.2 Sleep disturbance

The potential for high noise level events at night (10pm to 7am) and effects on sleep should be addressed in noise assessments.

The World Health Organisation (WHO) “Guidelines for Community Noise” 1999 suggest external noise levels of 55 dB L_{Aeq} will result in negligible sleep disturbance effects. This ideal level does not account for intermittent noise events, or periods of higher noise.

The NSW NPI provides guidance on the assessment of sleep disturbance based on the predicted event $L_{Aeq,15min}$ and/or L_{AFmax} noise levels at the receiver. It suggests Sleep Disturbance Screening Criteria of;

- Event $L_{Aeq,15min}$ 40 dB(A) or Night Time RBL+ 5 dB, whichever is the greater, and/or
- Event L_{AFmax} 52 dB(A) or Night Time RBL + 15 dB, whichever is the greater.

If the $L_{Aeq,15min}$ noise level above background is less than 5 dB and/or maximum noise emergence above background is less than 15 dB, then the noise is considered unlikely to cause sleep disturbance. If the screening test level is exceeded, then further assessment of sleep disturbance effects is warranted.

Because the proposed BSBLSC will operate during night-time hours between 10pm and 7am, risks of Sleep Disturbance require assessment. Any plant which may operate 24 hours a day produces a steady noise which will have to meet the Event $L_{Aeq,15min}$ criterion of RBL + 5dB, which is equal to the NPI Intrusiveness criterion. Plant noise would also need to meet the night-time NPI Amenity criteria at residential receivers, which is lower than the Intrusiveness criterion (refer Table 5 below). Therefore, the Sleep Disturbance assessment would relate to other noise sources such as music and patron noise. This is further discussed in Section 5.4.3.

5.2.3 Summary of environmental noise criteria for mechanical plant

Based on the measured noise levels detailed in Section 3.4, and in accordance with the methodology outlined in the NSW NPI, Table 5 details the corresponding limits of allowable noise emission from mechanical plant and general maintenance activities associated with the development at the nearest receiver boundaries.

The existing background and ambient noise levels are higher than the Acceptable Levels for an Urban Environment that define the Amenity Criterion. Therefore, the more stringent Amenity Criterion determines the Project Noise Trigger Level (PNTL). Table 4 below presents the NPI noise criteria.

Period	Noise source / activities	NPI Criteria, dBA			
		Amenity Leq (period)	Residential Intrusiveness Leq (15-minute)	Residential PTNL Leq (15-min)	Residential Sleep disturbance, LAMax
Day (7am-6pm)	Mechanical plant	55 (residential) 60 (hotel) 60 (commercial) 55-60 (walkways, passive – active recreation)	59	58	n/a
		45 (residential) 50 (hotel) 60 (commercial) 55-60 (walkways, passive – active recreation)			
Evening (6pm-10pm)		40 (residential) 45 (hotel) 60 (commercial) 55-60 (walkways, passive – active recreation)	54	43	64

Table 5: NPI project specific criteria for external noise emissions from cleaning and maintenance activities and mechanical plant

5.3 Traffic Noise Criteria

This report assesses changes in character, location and potential increase in traffic noise associated with the project.

Traffic noise due to construction activities is also assessed.

Any additional traffic generated by this proposal needs to be assessed in accordance with the following guidelines:

- NSW EPA *Road Noise Policy* (2011).
- Australian Standard AS 3671-1989 *Acoustics – Road traffic noise intrusion – Building Siting and Construction* (for guidance only; applies to siting of the receiver buildings).

The Road Noise Policy is applicable to traffic-generating developments including major road infrastructure developments. The emphasis is on achieving a reasonable balance between what is achievable on different road types and the sensitivity of different receiver types to road traffic noise. This is not directly relevant to the BSBLSC redevelopment proposal as it does not include any new or upgraded road infrastructure.

The Australian Standard has a different emphasis, in that it aims to identify appropriate intrusive road traffic noise criteria in different building types. This is only relevant for the noise intrusion considerations for proposed noise sensitive spaces inside the BSBLSC.

In the absence of directly applicable guidelines, policies or standards for assessing road traffic noise impacts from the BSBLSC redevelopment project, Acoustic Studio's approach is to examine the increase in traffic noise events and levels for most-affected sensitive receivers.

5.4 External Noise Emission Criteria – Patrons and Sound Systems

5.4.1 Waverley Council DCP

Waverley Council DCP – Part D – Commercial includes the following noise-related clause for outdoor and footpath seating:

2.3.1 Hours of operation and noise

- (a) Hours of operation must finish at least half an hour before the general operational hours of the establishment as determined by Council.*
- (b) In addition to (a), footpath seating (including renewal of existing footpath seating) is not to occur outside of the hours in Table 2.*
- (c) Footpath seating will not be approved if the proposal is of a scale that noise generated will have a significant adverse effect upon nearby residential properties.
Amplified sound emanating from public footpaths or projected onto public footpaths is not permitted.*
- (d) Notwithstanding the hours outlined in table 2, extended dining hours may be granted only on a trial and reviewable basis where the proprietor can demonstrate:*
 - (i) There is a need for longer hours to more closely align with the approved*
 - (ii) operating hours of the premises, and*
 - (iii) The premises has not generally been subject to complaints relating to*
 - (iv) noise and overall operation, and*
 - (v) The additional period will not cause or result in adverse amenity*
 - (vi) impacts on the neighbourhood.*
 - (vii) Extended dining hours will not exceed 10pm in any case and any approval will be subject to a reviewable condition*

This clause does not refer explicitly to objective noise targets for sound systems. Therefore, Acoustic Studio makes reference to guideline noise targets used by Liquor and Gaming NSW.

5.4.2 Liquor & Gaming NSW - L_{A10} Noise Condition

The LGNSW provides the following L_{A10} noise condition that applies to a licenced premise. While it may not be directly applicable to every type of patron and sound system noise from the BSBLSC (such as children's parties), it provides a method of determining quantitative noise targets for these noise sources, which are not explicitly covered by the NSW NPI.

Noise Levels

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 5 dB(A) between 7.00 am to 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 7.00 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 7.00 am as the development consent permits.

The adopted objective criteria for noise emissions are detailed in Table 6. These criteria apply at the boundary of the nearest affected residential receivers.

For the purpose of this assessment the LGNSW criteria are limited to operational noise breakout from the BSBLSC at residential receivers. The relevant LGNSW licensed premises noise criteria have been established for the BSBLSC for the worst-case 10pm to 12 midnight, Sunday Night.

For assessment purposes, the criteria have been determined using the RBL for the relevant assessment periods (in accordance with long term methodology in the NPI for planning developments at the logger location) as shown in Table 6 below. When considering relative distance and exposure to the surrounding receivers, Location 5 (Campbell Parade Residences) is determined to be the worst-case receiver. Therefore, background noise levels at this location (based on those captured from long-term noise logging at 1 Beach Road) have been used to develop the relevant criteria. Achieving compliance at this location will result in compliance achieved at all other residential locations.

Aspects to note regarding the application of the above are:

- Noise from the premises are defined as a statistical measure (the top 10% noise level), but there is no definition as to how long the premise noise is to be measured for. Acoustic Studio has adopted the 15-minute measurement period defined in the NSW NPI).
- The “background level” is not explicitly defined. Acoustic Studio determines the existing background noise level in accordance with the NSW NPI. The Day, Evening and Night time background noise levels are used to determine environmental noise criteria.

5.4.3 Sleep disturbance criteria

The NSW NPI provides guidance on the assessment of sleep disturbance based on the predicted event $L_{Aeq,15min}$ and/or L_{AFmax} noise levels at any residential receiver. It suggests Sleep Disturbance Screening Criteria of;

- Event $L_{Aeq,15min}$ 40 dB(A) or Night Time RBL+ 5 dB, whichever is the greater, and/or
- Event L_{AFmax} 52 dB(A) or Night Time RBL + 15 dB, whichever is the greater.

If the $L_{Aeq,15min}$ noise level above background is less than 5 dB and/or maximum noise emergence above background is less than 15 dB, then the noise is considered unlikely to

cause sleep disturbance. If the screening test level is exceeded, then further assessment of sleep disturbance effects is warranted.

At the nearest residential receivers at Campbell Parade, the sleep disturbance screening levels are 54 dBL_{Aeq(15min)} and 64 dBL_{Amax}.

The sleep disturbance criterion L_{Amax} not exceeding the L_{A90, (15 minute)} by more than 15 dB(A) is a screening criterion, not an absolute goal for the purpose of assessing impact from a project. It applies outside bedroom windows during the night-time period.

If the Sleep Disturbance screening criterion is exceeded, the detailed analysis should cover the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW *Road Noise Policy* (2011).

Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur.
- Time of day (normally between 10pm and 7am).
- Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

A further consideration for sleep awakening is whether the environmental noise has changed. The NSW *Road Noise Policy* (RNP, 2011) Section 5.3 “Response to a Change in Noise Level” states:

While people may express a certain tolerance for their existing noise environment, they may feel strongly about increases in noise. [...] The difference in reported awakenings from sleep was equivalent to a difference of 7 dB in maximum noise levels.

The RNP Section 5.4 “Sleep Disturbance” states that:

From the research on sleep disturbance to date it can be concluded that:

- *Maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
- *One or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.*

The internal noise levels provided in the RNP are related to potential sleep awakenings.

Typically noise impact assessments consider the worst-case scenario, when residential receivers have windows open sufficiently to provide natural ventilation. This would result in approximately 10 dB attenuation from outside to inside, through the open window. This situation is considered likely during warmer seasons.

When windows are closed, the likely sound attenuation through standard windows with poor seals (common in older houses) is approximately 20 dB.

Based on a minimum attenuation of 10 dB(A) with windows open, the first conclusion of the RNP suggests that short term external noises of 60 to 65 dB(A) are unlikely to cause awakening reactions. In addition, external levels of 75 to 80 dB(A) are unlikely to affect

health and wellbeing significantly, provided that these events occur no more than twice in one night.

5.4.4 Noise emission criteria for BSBLSC (patrons and sound systems)

The adopted LGNSW criteria for the proposed BSBLSC redevelopment, including outdoor area noise emissions, are detailed in Table 6.

As noted in section 5.4.2, the background noise level is determined in accordance with the NPI, and noise criteria are determined for Day, Evening and Night-time periods.

The Night-time background noise level is 4 to 5 dB below the Day and Evening background noise levels. This means that if the noise emissions from patrons and sound systems meet Night-time noise targets, then they will also comply with Day and Evening noise targets.

For assessment purposes, the lowest Night-time background noise levels measured in octave bands, adjusted to the overall night time RBL of 49 dB(A), and the associated Project Criteria ($L_{10} \leq L_{90} + 5\text{dB}$) are detailed in Table 6.

The measured existing ambient noise levels (L_{eq}) are also presented for comparison. It can be seen that the LGNSW noise targets are 6 to 12 dB below the prevailing ambient noise at low (“bass”) frequencies 31.5 Hz to 125 Hz. Examining the survey data, there were clear fluctuations in low frequency ambient noise.

Location	Period	Description	Measured background sound level, dB re 20 μPa									
			dB(A)	Octave band centre frequency, Hz								
				31.5	63	125	250	500	1k	2k	4k	8k
Nearest Residential Receiver Boundary	10pm to 7am (Night)	10pm to midnight Background Noise Level, L_{90}	49	54	55	50	48	47	44	39	31	22
		Project Criteria, L_{10}	54	59	60	55	53	52	49	44	36	27
		For reference, current Ambient Noise Level, L_{eq}	55	69	66	59	55	53	50	45	37	25

Table 6: Patron and sound system noise recommended criteria at nearest residential receiver boundary (based on LGNSW 10pm to midnight, background levels measured over four nights)

5.5 Summary of Operational Noise Emission Criteria for the BSBLSC Project

Table 7 below summarises the overall A-weighted environmental noise criteria for all noise sources from the proposed BSBLSC redevelopment project. They apply at the most-affected receiver boundaries.

Period	Plant and Maintenance	Sound systems / patrons	
	NPI PTNL Leq (15-minute), dBA	LGNSW, L ₁₀ (15minute), dBA ≤ RBL+ 5dB	Sleep Disturbance L ₁ (1min), dBA ≤ RBL+ 15dB
Day (7am-6pm)	58 (residential receiver) 55 (commercial receiver)	59	n/a
Evening (6pm-10pm)	48 (residential receiver) 55 (commercial receiver)	58	n/a
Night (10pm-7am)	43 (residential receiver) 55 (commercial receiver)	52 (10pm to midnight)	Sleep Disturbance 64 Sleep Awakening 65

Period	Sound System	Octave band centre frequency, Hz									
	LGNSW	dB(A)	31.5	63	125	250	500	1k	2k	4k	8k
10pm to 7am (Night)	Project Criteria, L ₁₀	54	59	60	55	53	52	49	44	36	27

Table 7: Summary of project noise criteria (overall levels) at nearest residential receivers

6 Operational Assessment and Recommendations

The proposal has been assessed based on information provided by the Architect (Lockhart-Krause) and the Proponent (Waverley Council).

6.1 Operational Assessment Methodology

The acoustic assessment has considered the following:

- The BSBLSC will generally be open and in use between 8am and 12 midnight [1]. Some cleaning and maintenance activities may take place after hours, which includes night time hours.
- Noise levels from the Function Room and outdoor areas have been considered as continuous source over a 15-minute assessment period to provide a worst-case.
- Noise predictions at the nearest residential receiver boundaries consider the total noise contribution from all noise sources.
- Distance attenuation, with conservative estimates for attenuation due to shielding from buildings, intervening topography and ground absorption.
- Lowest measured background noise levels have been used to provide a worst-case scenario.

6.2 Mechanical Plant Noise Compliance

Plant associated with the operation of the BSBLSC redevelopment should be controlled to ensure external noise emissions meet the noise emission criteria, are not intrusive and do not impact on the amenity of nearby receivers.

At this stage, final plant selections and locations have not been made; therefore, a detailed assessment has not been carried out.

Whilst many spaces will be naturally-ventilated, the proposal will include general air conditioning / ventilation for some spaces.

Most plant will operate during opening hours. Some plant (refrigeration plant, for example) will operate 24 hours a day.

In the absence of preliminary plant noise data or locations, Acoustic Studio makes the following general comments:

- The most restrictive noise target for the plant is 55-60 dB(A) on open walkways and passive recreation outdoor spaces near any mechanical inlet, outlet or outdoor unit. This target applies at 1 m from the building façade. The nearest residential receiver is approximately 100 m from the closest point of the development site. Achieving the 55-60 dB(A) criterion at open walkways and outdoor passive recreation areas will ensure compliance with the relevant criteria at all other receivers.
- Location of plant will be an important acoustic control feature for the BSBLSC Project. It is acoustically preferable to locate external plant and inlets / outlets within the basement if this is permissible. Alternatively, plant may be located near existing BSBLSC plant as this is an existing noise source area. Small external plant items such as condensers may be located on the perimeter of the building nearer to the rooms they serve. In these cases, external plant should be located as far as practicable from walkways and grassed areas used for passive recreation (eg near large landscaped garden beds).
- Attenuation and / or internally-lined ductwork may be required for fans in order to meet both internal and environmental noise criteria.
- Noise emissions from the external plant may also be controlled via a combination of;
 - natural screening provided by existing buildings, structure and topography, and
 - additional localised acoustic screening as required.

During the detailed design stage, the acoustic consultant should provide detailed design advice to the architect and mechanical engineer to ensure that noise emissions from mechanical plant are effectively controlled to meet the relevant criteria at the nearest receiver boundaries.

Noise emissions from general maintenance and cleaning activities may need management controls such as time restrictions particularly for external area maintenance activities.

6.3 Patron and Sound System Noise

6.3.1 Patron source noise levels

Table 8 shows typical sound levels expected from different uses and sources in the proposed BSBLSC redevelopment.

The patron source noise levels are considered to be very conservative (i.e. higher than expected in practice), as it is generally unlikely that half of the patrons will be speaking at once. However, this conservative approach has been adopted to account for the potential for worst-case scenario.

Voice generates directional sound, which is frequency dependent. As a conservative screening estimate, no directional attenuation has been accounted for in the environmental noise predictions. This is unrealistic but simplifies the calculations to assist in identifying any potential of environmental risk. If the simple screening calculation without directivity shows no excess of environmental noise criteria, then it is safe to assume that the actual noise levels will be lower and will also comply.

Description	Sound pressure level, dB re 20µPa									
	Overall dB(A)	Octave band centre frequency, Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
L ₁₀ of 1 adult male speaking with moderate voice	59	38	42	52	58	60	52	46	43	37
L ₁₀ of 1 adult male speaking with raised voice	68	50	52	56	62	67	64	57	52	45
L ₁₀ of 500 patrons half speaking all at once	92	74	76	80	86	91	88	81	76	69

Table 8: Sound levels (L₁₀) likely to be generated by patrons visiting the BSBLSC, in the internal areas of the venue (500 people total) or in external areas (500 people total)

6.3.2 Patron noise assessment

Patron noise from the BSBLSC and its outdoor areas has been estimated for the following scenarios. Only moderate shielding has been assumed to account for the building itself providing some screening of noise, due to the reflective surfaces in the courtyard offsetting this shielding benefit to some extent.

- General patron noise from up to 500 people, speaking in raised voices, in internal areas
- Noise from the outdoor areas has been estimated for a total of 500 people.

Receiver	Source location and condition	Description	Sound pressure level, dB re 20 µPa									
			dB(A)	Octave band centre frequency, Hz								
				31.5	63	125	250	500	1k	2k	4k	8k
Residential, Campbell Parade	Internal Areas, 500 people, raised voices, doors open	Internal Sound Level, L ₁₀	92	74	76	80	86	91	88	81	76	69
		Predicted Level at receiver, L ₁₀	44	31	32	36	37	43	40	33	24	14
		Environmental Project Criteria, L ₁₀	54	59	60	55	53	52	49	44	36	27
		Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Existing Ambient, L _{eq}	55	69	66	59	55	53	50	45	37	25
		Quieter than or equal to existing ambient?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	External Areas, 500 people, raised voices	External Sound Level, L ₁₀	92	74	76	80	86	91	88	81	76	69
		Predicted Level at receiver, L ₁₀	48	35	37	40	45	50	36	37	33	25
		Environmental Project Criteria, L ₁₀	54	59	60	55	53	52	49	44	36	27
		Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Existing Ambient, L _{eq}	55	69	66	59	55	53	50	45	37	25
		Quieter than or equal to existing ambient?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Predicted highest expected patron noise levels (L₁₀) at the nearest residential receiver due to proposed BSBLSC operations

The conservative patron noise predictions generally comply with LGNSW targets.

6.3.3 Sound System Noise from Internal & External Areas

Noise generated within the proposed BSBLSC building will include sound system noise from Public Address systems and music.

This acoustic assessment assumes that many of the speaker systems are either fully open to the environment or located internally with doors that are often left open.

Estimated levels for the sound system playing amplified music (internally) and amplified speech (externally) have been based on published source sound level data for amplified speech, pop music, and measurements by Acoustic Studio for a range of speech, pop and

rock music events / functions. These levels are conservative and would represent the “worst case” (noisiest) event.

Receiver	Source location and condition	Description	Sound pressure level, dB re 20 µPa									
			dB(A)	Octave band centre frequency, Hz								
				31.5	63	125	250	500	1k	2k	4k	8k
Residential, Campbell Parade	Internal Areas (with doors open)	Internal Total Reverberant Sound Level (amplified music), L ₁₀	100	95	100	100	95	95	95	90	90	80
		Maximum Predicted Level at receiver, L ₁₀	48	50	54	53	45	45	44	39	35	22
		Environmental Project Criteria, L ₁₀	54	59	60	55	53	52	49	44	36	27
		Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Existing Ambient, L _{eq}	55	69	66	59	55	53	50	45	37	25
		Quieter than or equal to existing ambient?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	External Areas	External Sound Level (amplified speech)*, L ₁₀	90	72	74	78	84	89	86	79	74	67
		Maximum Predicted Level at receiver, L ₁₀	46	33	35	38	43	48	34	35	31	23
		Environmental Project Criteria, L ₁₀	54	59	60	55	53	52	49	44	36	27
		Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Existing Ambient, L _{eq}	55	69	66	59	55	53	50	45	37	25
		Quieter than or equal to existing ambient?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No

Table 10: Allowable sound levels (L₁₀) sound systems at the BSBLSC, to meet environmental noise criteria at residential receiver locations

* The sound level for the external areas sound system noise shall apply at the perimeter of the BSBLSC. Actual levels within the external areas may vary depending on speaker installation and location. Background music on balcony will be at least 10 dB below 100 dBA.

Table 10 indicates that the BSBLSC operations will comply with the LGNSW criteria at all octave bands.

The internal areas noise emissions prediction assumes that the internal areas doors are open. With doors closed, the predicted noise level at the nearest residential receiver will be at least 20 dB below the levels presented in Table 10. This will also achieve full compliance with the applicable noise criteria.

The maximum allowable sound pressure level for the external areas sound system (for amplified speech) applies at the entry of the external areas which is nearest to noise-sensitive receivers (i.e. the eastern-side). The maximum allowable sound levels in the external areas will be determined by the sound system installation factors such as location, orientation and directivity of loudspeakers.

6.3.4 Sleep disturbance from patrons and sound systems

The NPI describes two methods for assessing the risk of Sleep Disturbance:

- Event $L_{Aeq,15min}$ 40 dB(A) or Night Time RBL+ 5 dB, whichever is the greater, and/or
- Event L_{AFmax} 52 dB(A) or Night Time RBL + 15 dB, whichever is the greater.

The patron and sound system noise predictions presented in Tables 9 and 10 show that overall $L_{A10,15min}$ levels are predicted to be no greater than RBL + 5dB.

The $L_{A10,15min}$ is the highest 10% of the noise levels measured over a 15-minute period and is generally expected to be approximately 3-5dB higher than the sound energy average $L_{Aeq,15min}$ for the same sounds measured over the same period. Therefore, compliance with the first Sleep Disturbance condition is met.

The $L_{A10,15min}$ is typically 5 to 10 dB below the $L_{Amax,15min}$ for the same sounds measured over the same period. Therefore, the $L_{Amax,15min}$ is expected to be no more than RBL + 10 to 15 dB, which meets the second Sleep Disturbance screening level.

If the sound system noise from the internal and external areas are controlled to meet the allowable sound levels presented in Table 10, and patron numbers are restricted as per the terms of the venue hire agreements, noise is considered unlikely to cause sleep disturbance.

6.3.5 Cumulative noise from all BSBLSC venues

It is noted that noise predictions for patron and sound system noise presented in Tables 9 and 10 are based on background noise criteria for the worst-case scenario (lowest measured existing background noise level), and the source noise levels are also assumed to be a worst-case scenario (i.e. noisiest likely in the building, with internal area doors open and with the largest capacity).

When more than one space is operating concurrently, the cumulative noise levels from all spaces is not expected to exceed the “worst case” noise level from the internal or external areas.

With any parallel hire event(s), the operational noise level is unlikely to increase. This depends, of course, on the nature of the activity. For a music-based activity, where the music sound level is the dominant operational noise source, the operational noise level is unlikely to be higher than that predicted during the amplified music event in the Function Room. Indeed, many events and functions would generate lower noise levels for different reasons, such as:

- Where the music would be set 5-10 dB lower than the “worst-case” assumption, to be comfortable for a smaller group of people.
- Where the music genre is different, such as jazz or pop with less bass content.
- Where concurrent events are being held at BSBLSC and sound level restrictions apply to control noise transfer to other spaces within the building.
- Where music is not a significant aspect of the event, such as for yoga classes, parents’ groups, community meetings, and so on.

Amplified music for events such as this can vary from 80 dBL_{A10,15min} up to 95 to 100 dBL_{A10,15min}, depending on the music genre.

In addition to the potential for noise from internal and external areas affecting residential receivers, further consideration of noise impacts on noise-sensitive spaces within the BSBLSC building will be required during detailed design.

In most cases the sound system noise levels will be limited to below the “worst-case” sound levels presented in Table 10, to avoid impacts on other occupants in the BSBLSC building.

Current operational management practices, as outlined in the Plan of Management [1], will continue to be enforced after the redevelopment project is commissioned and the upgraded BSBLSC building is in use. These practices include restrictions to sound system and patron noise, closing doors and windows when requested, and turning off / down amplified music by midnight.

The sound system set up may incorporate directional speakers and volume limiters to ensure that noise transfer from the internally and externally located sound systems will not be intrusive in noise sensitive spaces in the proposed development, as well as for external receivers.

Upgraded room acoustic treatment in many of the spaces will reduce reverberant sound within the spaces, when compared with current conditions.

The assessment therefore predicts patron and sound system noise compliance for most operational scenarios. In addition, noise emissions will be no higher than currently experienced.

6.3.6 Discussion of sound system and patron noise from BSBLSC

Acoustic Studio has undertaken a noise impact assessment which considers the control of patron and sound system noise break-out to the neighbourhood.

The assessment is based on the current uses for the various areas of the building. This is on the understanding that the application does not propose a change of use but rather that it will preserve and enhance the existing range of community uses.

The proposal does also aim for an increased efficiency of use with a corresponding increase in building occupancy.

Therefore, the Acoustic Assessment identifies that the noise levels generated by the future uses will need to be managed to be consistent with the operational noise levels generated by current activities.

The noise impact assessment determines that with noise levels from current 'worst-case' activities the operational noise can meet the applicable environmental noise criteria, provided that sensible operational management principles continue to be implemented by BSBLSC staff.

Because the operations are not expected to change from current use of the BSBLSC, environmental noise levels will be no higher than those currently experienced.

6.4 Traffic Noise Compliance

6.4.1 Road traffic noise

A Traffic and Parking Assessment has been prepared by TTW Engineers and provided to Acoustic Studio for reference for the BSBLSC Project.

The Traffic and Parking Assessment states that the project will not result in any changes to road traffic or car park use. Therefore, there will be no change in road traffic noise associated with the operational phase of this project.

6.4.2 Carparking and loading area noise

No operational noise changes in the carpark or loading area, including waste removal, are expected and therefore the redevelopment project is not expected to result in any carpark or loading area noise impacts.

6.5 POEO Offensive Noise Assessment

We have assessed the potential for offensive noise in accordance with the checklist considerations outlined in the Noise Guideline for Local Council, and we make the following comments.

- The predicted noise levels (associated with noise emissions from the proposed development) at the nearest affected residential receiver boundaries are not loud in an absolute sense and are not loud relative to the background noise level, with higher ambient levels associated with the nearby Campbell Parade.
- Patron noise from the BSBLSC will meet applicable criteria. In general, there should be no specific tones that would make the sound particularly irritating, however bass noise from music may need to be managed as this can be associated with noise complaints. Noise from carparking use may be audible at times, however typical use will not change from current operations.
- The proposal will not result in noticeable changes to operation and the noise emissions would be considered typical for the current noise environment at and around the site.

With consideration of the predicted noise levels outlined in Section 6 that show compliance with the relevant objective criteria, and the comments above, the development is not expected to generate offensive noise during the proposed operating hours.

Based on the findings of the assessment, it is recommended as best practice that the following measures continue to be applied:

- Shift managers and BSBLSC staff are to be briefed on the need to manage the premises such that excessively noisy or rowdy patron activity is not tolerated.
- Consideration be given to the installation of signs reminding patrons of the need to restrict high noise levels.

6.6 Summary of Predicted Operational Noise Compliance

Table 11 summarises the BSBLSC activities associated with the current proposal, and demonstrates compliance with the applicable noise criteria for general operational noise.

Full compliance with applicable noise emissions criteria can be achieved. Furthermore, noise emissions will be no higher than those from the current BSBLSC.

Period		Mechanical plant, cleaning and maintenance		Sound systems / patrons
		Amenity L _{eq} (period), dBA	Intrusiveness, L _{eq} (15minute), dBA ≤ RBL + 5dB	LGNSW, L ₁₀ (15minute), dBA ≤ RBL + 5dB
Day (7am-6pm)	Criterion	55	59	59
	Complies ?	Yes		Yes
Evening (6pm-10pm)	Criterion	45	58	58
	Complies ?	Yes		Yes
Night (10pm-7am)	Criterion	40	54	54
	Complies ?	Yes		Yes

Table 11: Summary of compliance with project noise criteria at nearest residential receivers

7 Construction Noise and Vibration Criteria

7.1 Construction Noise and Vibration Considerations - Overview

This acoustic report presents a high level review of the potential impacts from construction noise and vibration on residential receivers, as work methods and plans are not yet developed. A full construction noise and vibration impact assessment and management plan will be prepared by the contractor once the structure and likely construction methods are developed further.

The impacts of noise and vibration generated during the demolition and construction stages of the BSBLSC Project on surrounding sensitive receivers are considered as part of this Construction Noise and Vibration Assessment.

The development will contribute noise and vibration emissions to the surrounding environment during demolition and construction stages. Typically, this will comprise continuous and intermittent noise and vibration from construction equipment and plant commonly used on construction sites, plus noise from loading / unloading of goods vehicles.

Construction noise associated with the project may include noise and vibration impacts as follows:

- Airborne noise. Proposed construction works will generate noise that will propagate through the air.
- Airborne noise generated by external construction activities plus some high-impact internal activities, such as internal demolition, is likely to impact on surrounding sensitive receivers.
- Ground-borne noise and vibration impacts. Demolition, excavation and piling works undertaken during these stages of the project have the potential to generate noise and vibration that propagates through the ground and building structural elements and is then radiated by vibrating walls and floor surfaces nearby sensitive receivers.
- Ground-borne noise is likely to mostly impact on the BSBLSC premises, but is likely to occur during the demolition, excavation and piling works of the project only.
- Structural damage. Vibration induced damage of buildings and structures are a common concern, but rare in practice.

7.2 Airborne Noise Management Levels (NML)

7.2.1 Airborne noise management levels for residential receivers

The EPA *Interim Construction Noise Guideline* (ICNG, 2009) defines standard construction hours during which the construction Noise Management Level (NML, $L_{Aeq,15min}$) is 10 dB above the applicable period background noise level. A strong justification is required for conducting works outside standard construction hours, and the NML during these periods is significantly lower.

The ICNG also defines “Highly Affected” levels for daytime works, above which point there may be a strong community reaction against the noise. Acoustic Studio has assumed Evening Highly Affected Levels equal to 10 dB below the Day-time Highly Affected Level. Night time Highly Affected Noise Levels are set to 5 dB below the Sleep Disturbance screening test level.

Table 12 summarises the applicable residential construction noise criteria for different time periods during the week.

Period	Monday to Friday	Saturday	Sunday / Public Holiday	Highly Affected Level
Day: Standard construction hours	65 (7am – 6pm)	64 (8am – 1pm)	-	75
Day: Out of hours	-	60 (1pm-6pm)	56 (7am-6pm)	75
Evening (6pm-10pm)	58	59	53	65
Night (10pm-7am)	50	56	53	60

Table 12: Construction noise criteria (overall levels, $L_{Aeq,15min}$) at nearest residential receivers

7.2.2 Airborne noise management levels for non-residential receivers

Construction noise impacts on non-residential receivers also need to be assessed.

The ICNG provides recommends construction noise management levels for non-residential noise sensitive receivers surrounding a construction site, which are as follows:

Occupancy	Management level L_{eq} (15 min)
Industrial premises	75 dB(A) - External
Offices, retail outlets	70 dB(A) - External
Classrooms at schools and other educational institutions	45 dB(A) - Internal / 55 dB(A) - External ⁴
Hospital wards and operating theatres	45 dB(A) - Internal / 70 dB(A) - External ⁵
Place of worship	45 dB(A) - Internal
Passive recreation areas	60 dB(A) - External
Active recreation areas	65 dB(A) - External

Table 13: Industrial, commercial, educational and hospital demolition noise criteria for airborne noise

Where receiver types are not defined, the ICNG refers to AS2107 maximum design noise levels as guidance for setting internal noise management levels. AS2107:2016 recommends a range of noise levels from continuous sources such as air conditioning. Acoustic Studio recommends an airborne construction noise management level inside Community Facilities (Bondi Pavilion) of 50 dBL_{Aeq(15min)}.

For pedestrian walkways, Acoustic Studio recommends applying a construction noise management level of 60-65 dBL_{Aeq(15minutes)}. This aligns with passive and active recreation area noise management levels.

⁴ Where internal noise levels are specified, the NSW INP assessment methodology states that in cases where the gaining of internal access for monitoring is difficult, then external noise levels 10 dB above internal noise levels apply assuming a window opened sufficiently to provide ventilation.

⁵ For hospitals, where windows are typically fixed (inoperable), it is assumed that the weakest building element (typically glazing) will provide a minimum of 25 dB(A) sound reduction. Therefore external levels are based on an internal noise level plus 25 dB.

7.3 Groundborne Noise Management Levels

The ICNG recommends ground-borne noise management levels at residences affected by nearby construction activities. Ground-borne or structure-borne noise is noise generated by vibration transmitted through the ground or structure and is re-radiated as audible airborne noise.

The ground-borne noise levels presented in Table 14 below are for evening and night-time periods only, as the objectives are to protect the amenity and sleep of occupants during the more sensitive time periods.

Time of Day	Management level L_{eq} (15 min)
Evening (6pm to 10pm)	40 dB(A) - Internal
Night (10pm to 7am)	35 dB(A) - Internal

Table 14: Residential construction noise criteria for ground-borne noise

Acoustic Studio considers that it is unlikely that ground- structure-borne noise will be audible above airborne noise for receivers across Campbell Parade from the BSBLSC site.

Furthermore, no Evening or Night time works are proposed. Therefore ground- or structure-borne noise has not been predicted and assessed in detail in this report.

7.4 Vibration Effects on Structures

Once the structural details for the works are developed, a construction methodology will be determined that will ensure no adverse effects on any sensitive structures and sites.

Typically the applicable vibration criteria for cosmetic damage to historic or heritage structures are taken from German Standard DIN 4150: Part 3-1999 *Structural Vibration Part 3: Effects of Vibration on Structures*. A short-term vibration velocity limit of 3 mm/s (<10 Hz) and 3-8 mm/s (10-50 Hz) is typically applied to historic or heritage buildings. Swiss Standard SN 640-312:1978 suggests slightly lower limits for steady state vibration. The duration of the works must be considered when determining the most relevant criteria.

Acoustic Studio recommends adopting German Standard DIN4150 criteria for heritage or historic structures as a preliminary vibration criterion. This should be the limiting criterion on site, unless a structural assessment is carried out prior to works commencing, and determines that the building is structurally sound. In that case, a higher vibration limit may be adopted.

Figure 5 below summarises vibration targets to protect buildings from cosmetic building damage. If vibration measurements are conducted in third octave bands (Hz), then the on-site limit curve shall apply. If vibration measuring equipment is only capable of measuring overall peak levels, then a peak particle velocity limit of 3 mm/s (rms) shall apply on site.

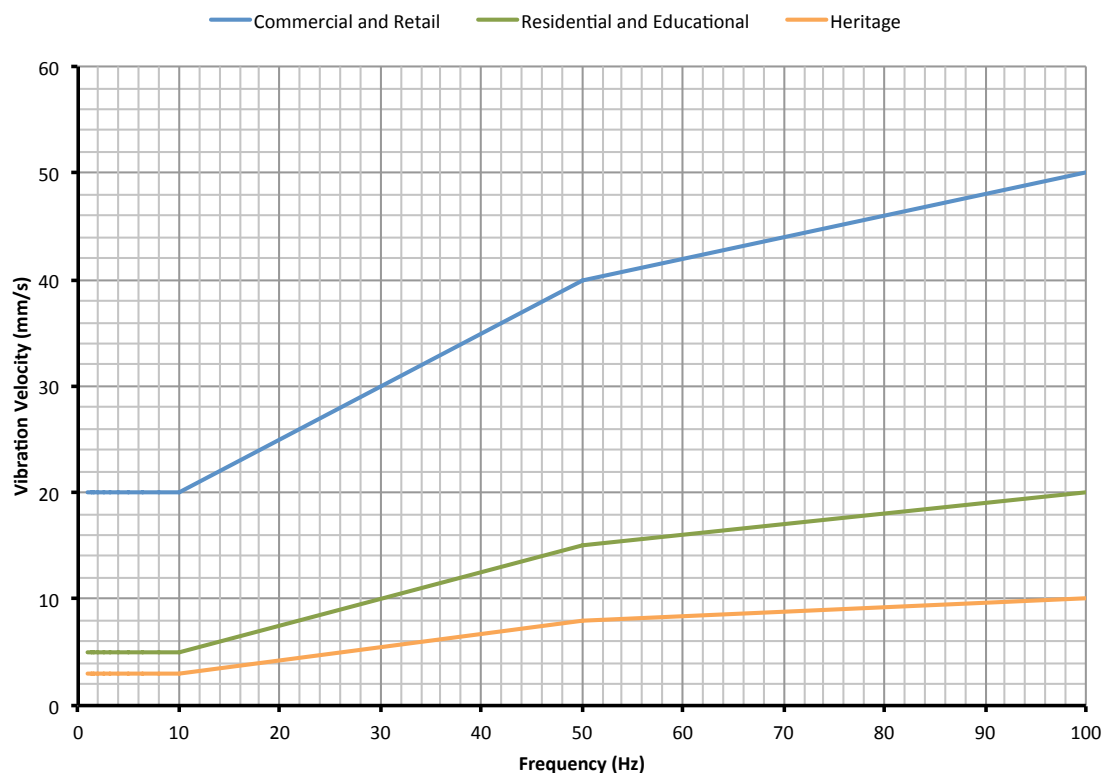


Figure 5: Vibration targets for protecting heritage and historic structures (“very sensitive”), and typical residential and commercial receivers.

7.5 Vibration Effects on Humans

The DEC guideline “*Assessing Vibration: a technical guideline, 2006*” provides suitable criteria that can be applied to the assessment of vibration and human comfort. The guideline makes reference to the British Standard BS 6472: 1992, which shares many similarities to the Australian Standards AS 2670.2: 1990.

The guideline provides vibration levels for which there is a low probability of comment or disturbance to building occupants. The criterion also considers the type of vibration being assessed, namely continuous, impulsive and intermittent vibration. Examples of these vibration types are provided in Table 15 below.

Continuous	Impulsive	Intermittent
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, e.g. occasional dropping of heavy equipment, occasional loading and unloading.	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

Table 15: Examples of vibration source types

The criteria for human exposure to continuous and impulsive vibration are detailed in Table 16 below. Vibration levels are assessed through the consideration of the summation of effects for vibration levels at frequencies from 1 to 80 Hz for all axes.

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Offices, schools, educational institutions	Day or night time	0.020	0.014	0.040	0.028
Workshops	Day or night time	0.04	0.029	0.080	0.058
Impulsive vibration					
Offices, schools, educational institutions	Day or night time	0.64	0.46	1.28	0.92
Workshops	Day or night time	0.64	0.46	1.28	0.92

Table 16: Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration (m/s²) 1-80 Hz

Note: Daytime is 7am-10pm and night time is 10pm to 7am.

Human exposure to intermittent vibration is assessed using the Vibration Dose Value (VDV). The VDV accumulates the vibration energy experienced over an extended period (daytime and night-time periods) from intermittent events. Table 17 sets out the acceptable VDV values for intermittent vibration.

Location	Daytime		Night-time	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Table 17: Acceptable vibration dose values for intermittent vibration (m/s^{1.75})

7.6 Vibration Effects on Sensitive Equipment

Neighbouring vibration receivers with sensitive equipment are likely to require a higher degree of vibration isolation than the values outlined in Tables 15, 16 and 17.

No receivers with such sensitive equipment were identified in the vicinity of the project site and so this has been excluded from the assessment at this time.

8 Construction noise assessment and recommendations

8.1 Construction Sequence

The BSBLSC conservation and upgrade proposal includes the following stages of upgrades and improvements to the existing premises:

- Site establishment
- Main works
- Landscaping

The main stages of work have been broken up in terms of the following “noise scenarios”. A scenario is a work phase, characterised by the type of plant and equipment used, concurrent activities, location of works, and timing of works.

The works phases shown below are indicative only. The Contractor is responsible for preparing a Works Plan and Schedule, including updated noise and vibration impact assessments for proposed methods and timing of each stage of work.

Noise Scenario / Activity Description	List of plant	Notes about subjective impact
A. Site preparation and set up, including site amenities	Generators Trucks Hammers Hand tools Circular Saw	High vibration: N Tones or impulses: Y - reversing alarms, low frequency noise from generators
B. Main Works: Demolition of existing buildings and structures, In-ground services	Excavators Concrete / demolition saws Hand tools Bobcats Delivery trucks Removal of building waste	High vibration: Y Tones or impulses: Y - reversing alarms, tonal saw
C. Main Works: Structure, Roofing and Cladding	Mobile cranes Hand tools Concrete trucks Concrete pumps Concrete pencil vibrator Concrete mixer Circular saw Hammer drill	High vibration: N Tones or impulses: Y - reversing / vertical movement alarms, impulsive / tonal drill & saw

Noise Scenario / Activity Description	List of plant	Notes about subjective impact
D. Main Works: Roofing and Cladding, Services	Hammer drill Mobile cranes Hand tools Circular / demolition saw Concrete mixer Grinder	High vibration: N Tones or impulses: Y - reversing / vertical movement alarms, impulsive / tonal drill & saw
E. Landscaping	Truck Crane Diggers, excavators Hand tools	High vibration: Y – digger / excavator Tones or impulses: Y - reversing alarms

Table 17: Indicative work phases and subjective impact considerations

8.2 Hours of work

The hours of work affect community noise impacts. This is due to the fluctuations of ambient noise through the day, and the type of activities typically conducted by the community during Day, Evening and Night.

Standard construction hours defined in the *Interim Construction Noise Guidelines* (7am – 6pm, Monday to Friday, and 8am – 1pm, Saturday) are considered the least sensitive times of day.

The proposed works hours for this project are:

- Weekdays 7am to 6pm (Standard construction hours)
- Saturdays 8am to 1pm (Standard construction hours to 1pm).

Works will not be carried out on:

- Saturdays and Sunday that form part of a public holiday weekend
- Sundays and Public Holidays.

Construction vehicles may enter the work site during the following hours:

- Weekdays 6am to 6pm
- Saturdays 8am to 1pm.

It is noted that for the purposes of road traffic noise assessments, the hours before 7am are considered to be “night time” and are typically considered to be times when residential receivers are more sensitive to road traffic noise. For the purposes of construction noise assessments, the hours before 8am are considered to be more noise-sensitive.

The Contractor’s Construction Noise and Vibration Management Plan must state the hours of work, and any deviations to the schedule must be assessed and approved prior to commencing the altered works schedule.

9 Construction Noise Assessment Considerations

9.1 Noise and Vibration Sources

Potential noise sources during the construction stage are identified in Table 18. Typical airborne noise levels associated with each noise source have been taken from AS 2436-2010.

For the detailed assessment (undertaken once the construction methodology and proposed equipment are confirmed), Acoustic Studio recommends a conservative approach be taken, which applies the levels provided in the standard as $L_{eq,T}$ noise sound power levels.

The ICNG imposes a 5 dB penalty for sources with a tonal noise content, or associated with high vibration levels. A 5 dB penalty is also applied to vehicles with tonal reversing alarms. Non-tonal or broadband reversing alarms do not attract this 5 dB penalty. The 5 dB penalty is added to the predicted construction noise level at the receiver boundary. These activities have been identified in Table 18.

Table 18 also identifies potential sources of perceptible vibration. Vibration levels associated with plant typically depend on the material being worked on. For example jackhammers used on age-hardened concrete or hard rock will generate higher levels of vibration than the same jackhammers used on soft limestone or brick.

Noise Source / Plant	Sound Power Level, L _{eq,T} dB(A)	Sound Pressure Level, L _{eq,T} dB(A), at 10m
Dump Truck (tipping material)	117	89 (+5dB penalty – tonal reversing alarm)
Truck, Forklift (<i>vibration source</i>)	107	79 (+5dB penalty – tonal reversing alarm)
Tipper / Bin lift Truck	111	83 (+5dB penalty – tonal reversing alarm)
Hiab (mobile crane) truck	113	85 (+5dB penalty – tonal reversing alarm)
Bobcat / Forklift	110	82 (+5dB penalty – tonal reversing alarm)
Front end / Wheeled loader	111	83 (+5dB penalty – tonal reversing alarm)
Skidsteer loader (½ tonne) (<i>vibration source</i>)	104	76 (+5dB penalty – tonal reversing alarm)
Excavator with rock breaker (<i>vibration source</i>)	116	88 (+5dB penalty)
Excavator, 8T with bucket (<i>vibration source</i>)	105	77
Vibratory roller (<i>vibration source</i>)	108	80
Asphalt Paver (<i>vibration source</i>)	108	80
Asphalt Rotomill (scabbler)	111	83
Concrete Pump	110	82
Cement Mixer	109	81
Concrete Placing Boom	105	77
Concrete Vibrator	104	76
Jump Form	102	74
Generator, 4 stroke portable petrol	103	75
Generator, diesel	113	85
Air compressor	107	79
Compactor (<i>vibration source</i>)	113	85
Angle grinder	101	73
Concrete Saw, handheld	115	87 (+5dB penalty)
Demolition saw	119	91 (+5dB penalty)
Circular saw	112	84 (+5dB penalty)
Jack Hammer (<i>vibration source</i>)	121	93 (+5dB penalty)
Hammer / percussive drill (<i>vibration source</i>)	112	84 (+5dB penalty)
Rattle gun	113	85 (+5dB penalty)
Electric drill	91	63
Electric hand tools	102	74
Welder	105	77
Tower crane	105	77
Mobile crane	106	78

Table 18: Typical mid-point sound power and pressure levels of plant typical to proposed construction. These sound level values do not include the 5 dB penalty noted for some types of work. The 5 dB penalty is added to the predicted sound level at the receiver.

9.2 Methodology

The assessment should consider the noise impact from each category of major works as follows:

- Noise predictions at receiver boundaries carried out for each piece of equipment that may be used during major works.
- Each piece of equipment modelled as a point noise source.
- To provide a realistic worst case $L_{eq}(15min)$ prediction, most equipment should be assumed to be used continuously over the assessment period. However, for some intermittent activities such as saw cutting, it is recommended that the noise from this particular piece of equipment is not used continuously and be assessed to generate noise for 7.5 minutes out of a 15-minute assessment period.
- Predictions should only consider the distance attenuation between source and receiver, unless works are carried out behind existing structures which provide shielding.
- It should be assumed that works activities in various parts of the site may be carried out simultaneously.
- In accordance with the proposed work hours, noise predictions are to be compared with Standard work hours' noise management levels and also out of hours Daytime noise management levels for Saturday works between 1pm and 3pm.
- Vibration levels are difficult to predict without detailed material and structural information which affects the vibration at source (related to the material being worked on), and the vibration transmission through the receiving structure. Therefore vibration risks are to be assessed at a high level, based on measurements taken at other construction sites.
- It will be necessary to confirm vibration through monitoring early in the any works phase that involves high-vibration activities such as excavating, to re-assess whether levels are expected to exceed applicable criteria at heritage or historically significant structures.

It is likely that there will be times / situations when demolition and new-build works are likely to exceed stated criteria, particularly when works occur in the areas closer to sensitive receivers. This is particularly the case for receivers closest to the site, such as tenancies inside the Pavilion building.

For each of these activities, the noise control measures in Section 11 shall be considered and implemented wherever reasonable and feasible. In addition, the construction best practices presented below shall be considered to minimise the noise impacts on the neighbourhood.

- Local hoarding around the worksite is recommended for all external works. The primary reason is managing noise on the walkways. When works are moving around the site, including mobile cranes, jackhammers, and concrete saws, local “noise curtains” such as EchoBarrier will assist with reducing noise near the source.
- If generators are required for the site set-up, petrol generators should be used instead of diesel.
- Truck access should be limited to designated time periods and site access gates should be as far as possible from sensitive enclosures and well-used walkways. Vehicle pathways around the site should be arranged to minimise the need for reversing. Where reversing is necessary, the contractor should consider whether non-tonal reversing alarms are an acceptable safety alternative to tonal “beeper” alarms.
- Pedestrian pathways and access to passive recreation areas may need to be restricted to move pedestrians farther away from noisy work, particularly external work which may also pose safety risks.

10 Construction-related Road Traffic Noise

A Traffic and Parking Assessment has been prepared by TTW Engineers and provided to Acoustic Studio for reference for the BSBLSC Project.

Construction-related road traffic is a temporary noise source but one which requires assessment and management, particularly for heavy vehicles accessing the site.

Truck arrivals to and departures from site should be scheduled to occur outside the busiest traffic periods, but where possible should also avoid noise-sensitive night time periods.

The temporary additional traffic increase due to construction would be minimal, totalling less than 5% additional vehicles to the existing traffic. This would result in below a 0.5 $dBL_{Aeq(1hr)}$ increase; a 2 dB increase is considered to be noticeable.

However, it is also important to recognise that heavy vehicles associated with construction can generate maximum noise levels which are higher than general car traffic, and can lead to greater disturbance than cars.

Access routes should be limited to main roads and avoid local residential streets. Engine braking should be avoided, speed limits strictly observed, and heavy braking and accelerating avoided. These noise avoidance driver behaviours may need to be enforced through observation and monitoring, and all contractors and subcontractors are to be made aware of the need for noise-considerate driver behaviour when travelling to and from the work site.

11 Noise Management and Mitigation Measures

11.1 General Noise Control Elements

The noise and vibration objectives, management and mitigation measures in environmental assessment documentation are based on an initial design and construction methodology. It is expected that the works methodology and staging may be altered. Consequently, it may be necessary to update the assessment and associated noise management plan at several stages throughout the project.

As a general rule for best practices, prevention and elimination of noise would be applied as universal work practice during construction, especially when construction works are to be undertaken outside recommended standard hours.

Where elimination and prevention are not feasible options, the reduction of the noise at the source and the control of transmission path between the construction site and the receiver are the preferred options for noise minimisation through engineering and or administration controls.

Construction noise would be managed by implementing the strategies listed below:

- Plant and equipment
 - Use quieter work methods.
 - Use quieter equipment.
 - Use mobile noise curtains for external works with noisy hand-held tools
 - For noisy works, consider carrying out in continuous blocks not exceeding 3 hours each, with a minimum respite period of one hour between each block
 - Operate plant in a quiet and effective manner.
 - Plant used intermittently to be throttled down or shut down.
 - Use mains power supply where possible, rather than use generators.
 - Use one larger generator to power multiple plant items (ensuring safe cabling). Use petrol generators instead of diesel generators.
 - Switch off generators when not in use, particularly during out-of-hours work periods.
 - Maintain equipment regularly.
 - Where appropriate, obtain acoustic test certificates for equipment.
- On site noise management

- Strategically locate equipment and plant. Locate generators away from sensitive receivers.
- Avoid the use of reversing alarms through site layout to minimise reversing, or provide for alternative systems such as non-tonal reversing alarms.
- Maximise shielding in the form of existing structures or temporary barriers.
- Enclose the work site as far as possible from receivers, and use hoarding. Noise reductions of at least 10 dB are expected due to hoarding.
- Schedule the construction of barriers and structures so they can be used as early as possible.
- Consider signage at walkways affected by construction noise.
- Manage waste removal from the site to minimise noise impacts.
- Reduce noise from metal chutes and bins by placing damping material in the bin.
- Locate waste deposit bins as far as possible from sensitive receivers.
- Where possible, carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site.
- Delivery vehicles should be fitted with straps rather than chains for unloading, wherever possible.
- Keep windows closed during all internal works.
- Consultation, notification and complaints handling
 - Provide information to affected receivers before and during construction as required.
 - Maintain good communication between the community and project staff.
 - Have a documented complaints process and keep register of any complaints.
 - Give complaints a fair hearing and provide for a quick response.
 - Implement all feasible and reasonable measures to address the source of complaint.
- Work scheduling
 - Schedule activities to minimise noise impacts.
 - Ensure periods of respite are provided in the case of unavoidable maximum noise levels events.
 - Avoid simultaneous operation of noisy plant within discernible range of a sensitive receiver. Ensure noisy plant schedules are clear in Works Plan.
 - Keep truck drivers informed of designated routes, parking locations and delivery hours.
 - Schedule deliveries to planned construction hours only.
- Mandatory site rules of conduct

- Avoid the overuse of public address systems, radios or stereos outdoors.
- No swearing or unnecessary shouting.
- No unnecessary dropping of materials from height, throwing of metal items, and slamming of doors.
- No extended periods of engine idling.

11.2 Communication and Complaints

The following procedures are an example of the procedures that would be specifically adopted for complaints relating to noise.

Upon receipt of a complaint The Contractor would:

- Try to ascertain from the complaint which appliance is causing the problem i.e. inside or outside the site and in what position;
- Establish from the monitoring equipment if the allowable noise levels have been complied with;
- Establish if the appliance positioning has previously been highlighted as a problem area. If not and the noise levels are above the allowable limit, then the equipment and its position shall be noted;
- Move machinery if the allowable levels have been exceeded or take other acoustic remedial action.

If the activity is considered to be creating excessive noise (ie noticeably higher than expected from the activity), the activity would be immediately stopped. Where stopping the activity would create a safety issue the activity may be permitted to continue only as long as is necessary to make the area safe. The activity would then cease.

Any activity which is directed to cease due to excessive noise would not recommence until the Project Manager is satisfied that the requirements of the relevant criteria can be met and has given permission to recommence the activity.

The Site Supervisor would ensure that a report of any incident is provided to the Project Manager.

The Project Manager would provide a report on the incident to the relevant stakeholders. The Contractor would provide a 24-hour telephone contact number and this number would be prominently displayed on the site.

11.3 Timing of Works

If the detailed assessment of proposed construction activities indicates noise levels are likely to exceed the relevant criteria at receivers surrounding the site, the following noise control measures, together with best practices detailed in the previous sections, should be considered in order to minimise the noise impacts.

- Construction activities would typically occur during the prescribed standard hours (at the least sensitive times of the day).
- Where work must be carried out during noise sensitive periods, residents and commercial receivers would be informed and management principles would be in place to ensure a minimal amount of impact. This may include:
 - Do not use noise sensitive equipment likely to exceed the relevant criteria i.e rock-breakers, concrete cutters and sledgehammers.
 - Where possible limit construction works to those internal to buildings so as to contain the noise and minimise noise emissions externally.
 - Outside standard hours, only carry out activities at locations where compliance with the criteria (RBL+5) can be achieved.

11.4 Equipment and Plant Selection

This initial assessment will be based on typical noise sources defined in AS 2436-2010. The contractor should aim to choose the quietest pieces of equipment where feasible and reasonable. If the final equipment selection varies significantly from items specified in Section 9.1, it is recommended that an additional assessment be carried out for noise sources other than those included in this report and revisions made to the noise management plan where necessary.

From the results of the detailed assessment, it is likely that key pieces of equipment will dominate the overall noise contribution at the receiver position – most-likely including concrete saws, jackhammers and dump trucks.

Where possible alternative methods or selection of quieter equipment would be considered. Lessening the time in use and ensuring equipment is not used simultaneously will further reduce the noise impact at residents.

Where possible, reduce the number of noise sources/activities running simultaneously at the same location.

Limit the number of site vehicles such as dump trucks at any one time.

A screen or enclosure would be used when carrying out external building works that are predicted to exceed the noise management level at environmental receivers. Typically screens and enclosures constructed with plywood would be sufficient. Reference shall also be made to specific screening and enclosures detailed in Appendix F of AS 2436:2010.

11.5 Construction Vibration Assessment

11.5.1 Vibration sources and methodology

Potential sources of vibration and ground-borne noise during the Project works include:

- Demolition and excavation plant including rock-breaking and jackhammers.
- Grinding, cutting and drilling of existing building structures.

Vibration and ground-borne noise impacts are likely to be highest during the demolition and excavation stages of the project, when equipment such as rock breakers and jackhammers are used.

At this stage, we anticipate that construction works will result in no adverse vibration impacts at surrounding receivers.

When engaged, the Contractor shall carry out a preliminary vibration assessment at the commencement of operations for each vibration generating to determine whether the existence of significant vibration levels justifies a more detailed investigation.

11.5.2 Predicted vibration levels

The levels of vibration generated by the construction activities are site specific and depend upon the type of activity, the particular equipment used, and the proximity of the construction activity to the nearest occupied spaces within the affected properties.

When appointed the Contractor should carry out a review of vibration generated by these construction activities, and assess these against the criteria for human comfort and building damage provided in Sections 7.4 and 7.5.

A preliminary vibration survey on site will determine the actual vibration levels generated by each activity, and whether a means of vibration mitigation will be necessary for any equipment or processes on the site.

Given the nature of the works, the distance to the closest affected receivers plus the need to control vibration levels affecting the existing hotel building structure to avoid damage and disruption to the public and staff in the areas of the BSBLSC that remain open; we consider that vibration levels at the surrounding buildings are unlikely to exceed the applicable limits.

A detailed vibration assessment has not been carried out at this stage, as actual vibration levels experienced will be dependent upon

- Site characteristics.
- Specific construction equipment used.

It is recommended that, prior to the commencement of demolition and construction, a preliminary vibration survey is carried out on each key vibration generating activity / equipment.

A preliminary assessment would be carried out to determine whether the existence of significant vibration levels justifies a more detailed investigation, and where applicable establish site laws for the operation of key vibration generating equipment.

If the preliminary survey indicates that vibration levels might exceed the relevant criteria then vibration mitigation and management measures will need to be put in place to ensure vibration impacts are minimised as far possible.

A more detailed investigation would involve methods of constraining activities generating high vibration levels. A method of monitoring vibration levels could then be put in place. Vibration mitigation measures and a review of vibration criteria may then be necessary.

11.5.3 Vibration mitigation measures

Where vibration levels are found to exceed the relevant criteria, one or more of the following measures could be taken:

- Modifications to construction equipment used.
- Modifications to methods of construction.

If the measures given above cannot be implemented or have no effect on vibration levels or impact generated, a review of the vibration criteria would be undertaken and the vibration management strategy amended.

11.5.4 Vibration management approach

It is the contractor's responsibility to identify potential vibration generating sources in the proposed work methods.

The contractor shall refer to the demolition and landscaping plans to determine where rock cutting, excavation, or other vibration-generating activities are to occur. The contractor shall refer to the Structural Engineer's report and plans to identify structurally sensitive or historic or sensitive structures requiring protection from vibration.

The Contractor would carry out a review of vibration generated by construction activities. The levels of vibration generated will be site specific and will depend upon the type of activity, the particular equipment used, and the proximity of the construction activity to the nearest occupied spaces within the affected properties. The Contractor would carry out a preliminary vibration survey, which will determine whether a means of vibration mitigation will be necessary on the site.

11.5.5 Dilapidation survey

Vibration-intensive activities often warrant condition surveys and monitoring.

The Contractor would be required to conduct a dilapidation survey up to 50 m from the work site prior to high vibration works.

11.5.6 Vibration monitoring inside the BSBLSC Building

Preliminary vibration monitoring is to be carried out for each key vibration generating activity, i.e.:

- Concrete saw cutting
- Sledgehammer demolition
- Jackhammering
- Percussive / Hammer drilling
- Concrete and brick drilling
- Any other activities proposed by the contractor which is likely to generate perceptible vibration.

The purpose of the vibration monitoring is to assess the risk of potential structural damage to heritage structures within the premises.

These activities should also be monitored for the risk of cosmetic damage.

When considering the measured vibration impact associated with construction works, the following would be taken into account.

- The layout of the site, including the location of static sources of vibration.
- Techniques used in construction to minimise generated vibration levels.
- Hours of work with regard to the nature of operations in the affected receivers and the duration of the works.

Monitoring is also required in situations where there are changes in equipment and activities or work procedures that might affect existing vibration control measures. The monitoring procedure would be carried out with appropriate equipment so as to provide results that are readily comparable to the preliminary survey and relevant criteria provided in Section 7.4 and 7.5.

Pending the results of a vibration survey, a vibration monitoring system may be considered. The purpose of the system would be to assess the risk of potential structural damage to the BSBLSC and to nearby buildings of concern (including the Pavilion). This could be used for specific activities generating significant levels of vibration, in situations where there are changes in equipment and activities or work procedures that might affect existing vibration control measures. The monitoring procedure would be carried out with appropriate equipment so as to provide results that are readily comparable to the preliminary survey and relevant criteria.

11.5.7 Groundborne noise controls

Ground borne noise is not considered to be a risk for any residential receivers for this project.

Although unlikely, there may be instances when ground borne noise is audible and intrusive for commercial receivers within Bondi Pavilion, during some works. Mitigation options to deal with ground-borne noise may include consultation with affected receivers to determine the acceptable level of disruption and the provision of respite accommodation in some circumstances, not just restriction of work hours.

The level of mitigation of ground-borne noise would depend on the extent of impacts and also on the scale and duration of works.

Any restriction that the relevant authority (consent, determining or regulatory) may impose on the days when construction work is allowed should take into account whether the community:

- Has identified times of day when they are more sensitive to noise (i.e. Sundays or public holidays).
- Is preparing to accept a longer construction duration in exchange for days of respite.

11.6 Noise and Vibration Monitoring and Reporting

During any stage in construction that is expected to exceed the recommended noise management level by more than 10 dB even with mitigation measures in place, or where vibration generating plant is used within 20 m of heritage structures, the Contractor may implement environmental noise or vibration monitoring.

The location of monitors should represent the most affected receiver, such as the nearest residential receiver or Bondi Pavilion receivers in the case of noise monitoring, or at the nearest affected structure in the case of vibration monitoring.

Additional positions may also be selected or the monitor could be relocated at different stages of construction to correspond with the location construction activities progress to different locations within the development site.

It is recommended that noise monitoring be carried out for a minimum of 1 week during the period where the greatest impacts are expected, or for the duration of the noisy works (whichever is less). Monitoring results can be reviewed at the end of the week, however could be reviewed on more regular intervals depending on the type of work and level of noise expected. The requirement for further monitoring would be reviewed after this time or sooner if deemed necessary by the Acoustic Consultant and Project Manager.

11.7 Construction Noise and Vibration Compliance

This report establishes applicable noise criteria for the proposed works. Potential noise and vibration effects have been identified.

Works that will require careful noise and vibration management are likely to include concrete saws during demolition, rockbreaking, concrete pumps, and dumping spoil into trucks. This list is not exhaustive.

The contractor will need to prepare a detailed Construction Noise and Vibration Noise Management Plan for the works once the demolition and construction method is more progressed. This Plan will need to outline the proposed stages of work, plant and equipment to be used, and times of day during each week that construction is expected to occur. The Plan will need to demonstrate that all feasible and reasonable measures will be applied to meet the relevant Noise Management Levels.

All feasible and reasonable measures to meet the applicable Noise Management Levels will need to be identified and applied.

Any expected excess above the Highly Affected Level will require a detailed analysis of construction methods. Respite periods may be needed if high noise levels are expected for several days in a row. Community consultation is likely to be required.

Acoustic Studio recommends that works are conducted during standard construction hours where possible. However, Saturday afternoon out of hours works (1pm to 3pm) may pose an acceptable impact since the prevailing environmental noise is relatively high at this time.

Particular consideration of construction-related road traffic noise impacts is required. Construction vehicles would be restricted to Beach Road and Campbell Parade and drivers should be made aware of noise-mitigating driver behaviour.

Dilapidation surveys are recommended for nearby historic or heritage structures including the BSBLSC itself, in order to ensure that vibration-generating construction activities do not affect the structures.

12 Summary and Conclusions

A noise assessment has been carried out for the proposed BSBLSC redevelopment project at Bondi Beach.

External noise emissions associated with the operation of the proposed upgraded BSBLSC have been assessed. The assessment has adopted methodology from relevant guidelines to assess particular noise sources and expected worst-case impacts as follows:

- External mechanical plant and maintenance noise emissions – NSW Noise Policy for Industry (NPI) overall A-weighted noise criteria.
- Noise emissions from patrons and sound systems – Liquor and Gaming NSW (LGNSW) octave band noise criteria (7am to midnight).

Short-term and week-long ambient noise monitoring has been carried out to establish the existing background noise levels of the neighbourhood, and to establish typical octave band frequency spectra of the existing background noise levels at the residential boundaries of the nearest affected residential premises.

Source noise levels and spectra for the BSBLSC patrons have been based on patron noise measured by Acoustic Studio and acoustic literature on male and female voices.

The noise impacts have been predicted at the most sensitive boundary positions, taking into account distance attenuation, building and ground reflections, directivity and, where applicable, shielding by existing buildings / structures. These calculations show that all the relevant criteria (LGNSW and NSW NPI) for patron and sound system noise emissions can be met.

Also, the noise emission levels are expected to be no higher than is currently experienced from BSBLSC events.

Operational noise management will continue to be implemented on site, as per Plan of Management [1].

A general operational environmental noise assessment has been carried out for mechanical plant and cleaning and maintenance activities. These noise sources are likely to be effectively controlled through:

- Appropriate design and location of the mechanical plant system during the detailed design stage: responsibility of the architect, builder and mechanical and acoustic consultants; and
- Management controls for the timing of cleaning and maintenance activities, and for closing doors if required for cleaning the inside of the enclosures.

The potential for Sleep Disturbance to nearby residents, from patrons and sound systems, has been assessed. Compliance with Sleep Awakening and Sleep Disturbance Levels is predicted for activities on site.

A high level construction environmental noise assessment has been carried out, based on assumptions about the type of equipment that would be used on site. These noise sources are likely to be effectively controlled through:

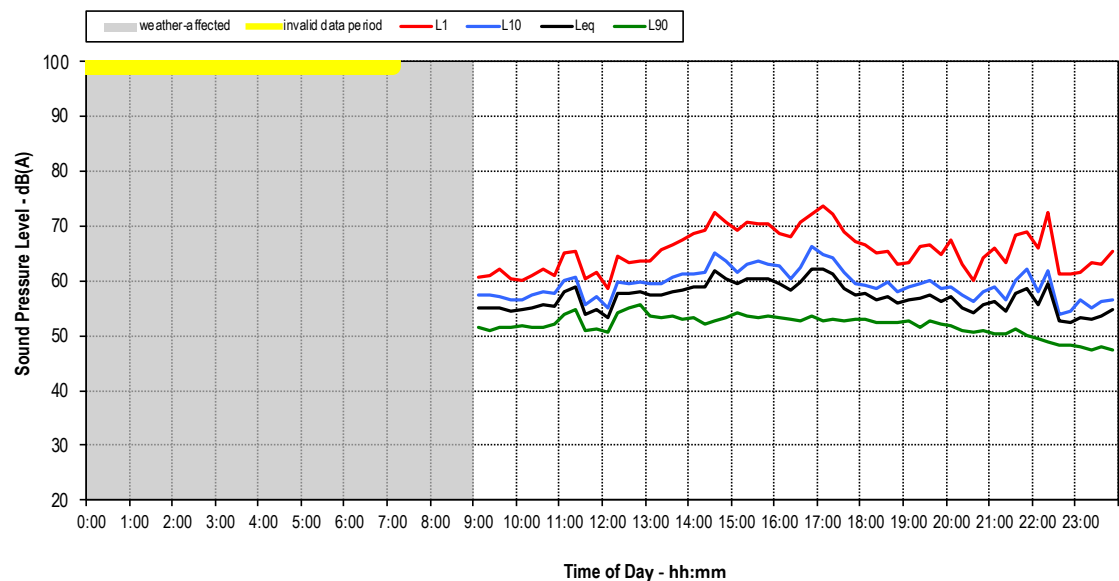
- Hoarding around the work site, and local enclosures of noisy plant or activities;
- Selection of quieter plant, including a commitment to use petrol rather than diesel generators if generators are required;
- Selection of quieter methods where possible and appropriate, particularly for piling;
- Selection of low vibration work methods where possible and appropriate;
- Vibration monitoring and management controls for historic or heritage structures.

Provided the recommendations detailed in this report are correctly implemented, it is anticipated that the BSBLSC Project construction and operations will have no adverse noise impact at the nearest residential and commercial receivers.

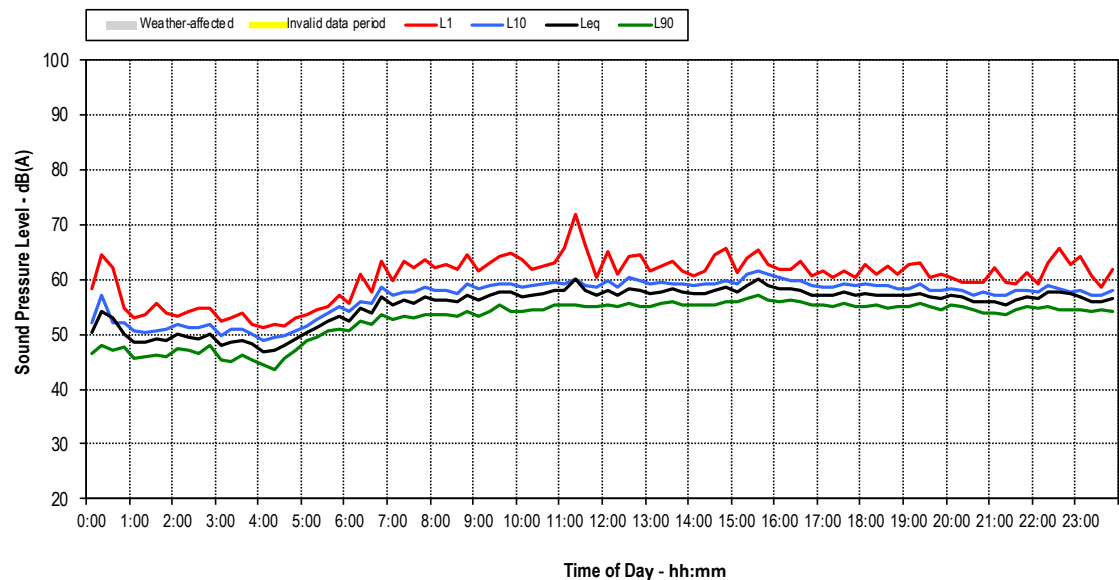
APPENDIX

Noise logger graphs

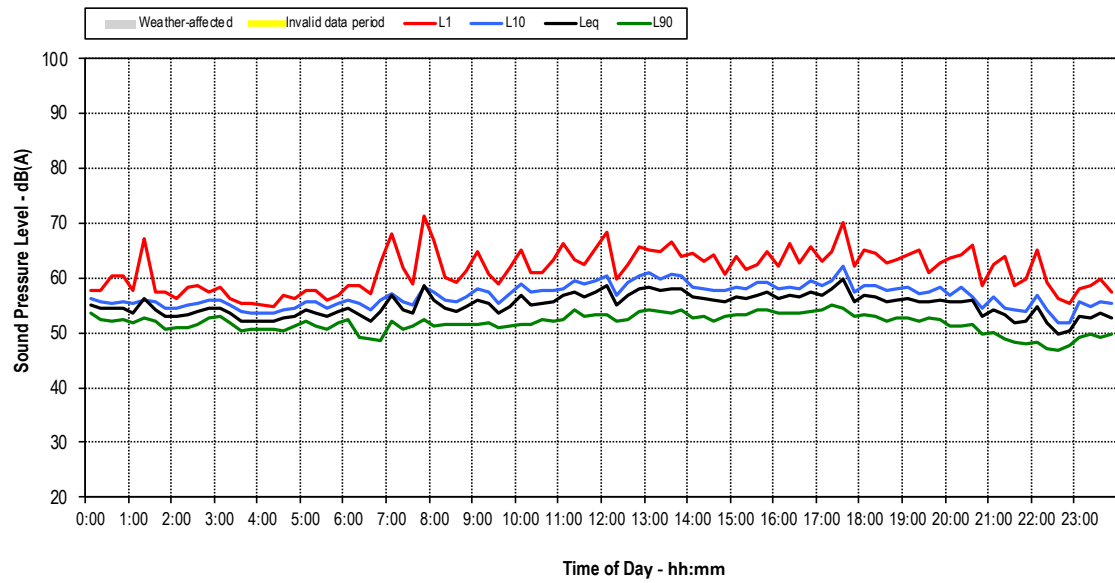
1 Beach Road, Bondi - Friday 08 March 2019



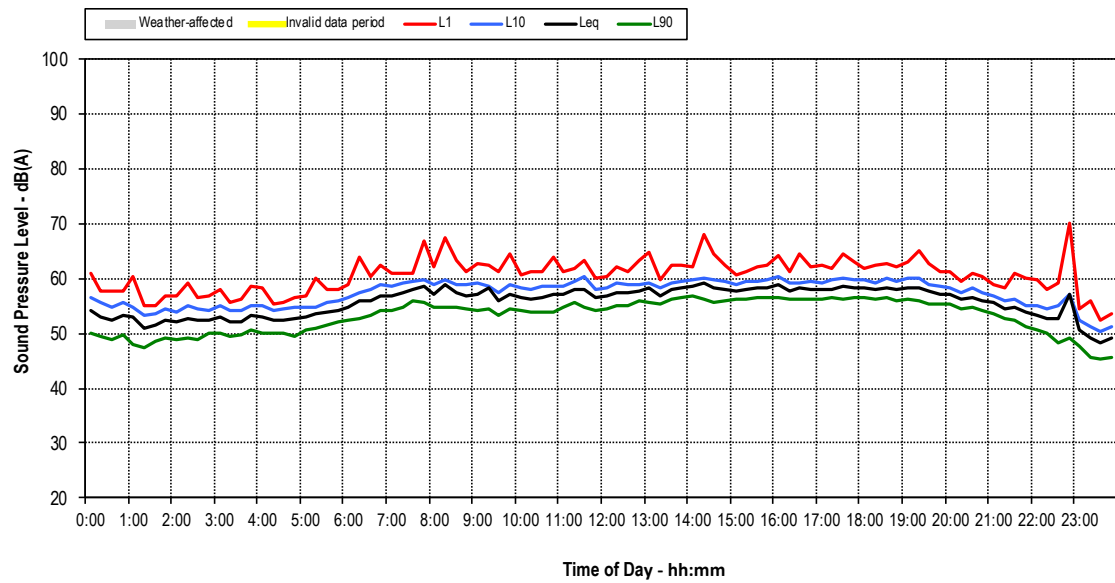
1 Beach Road, Bondi - Saturday 09 March 2019



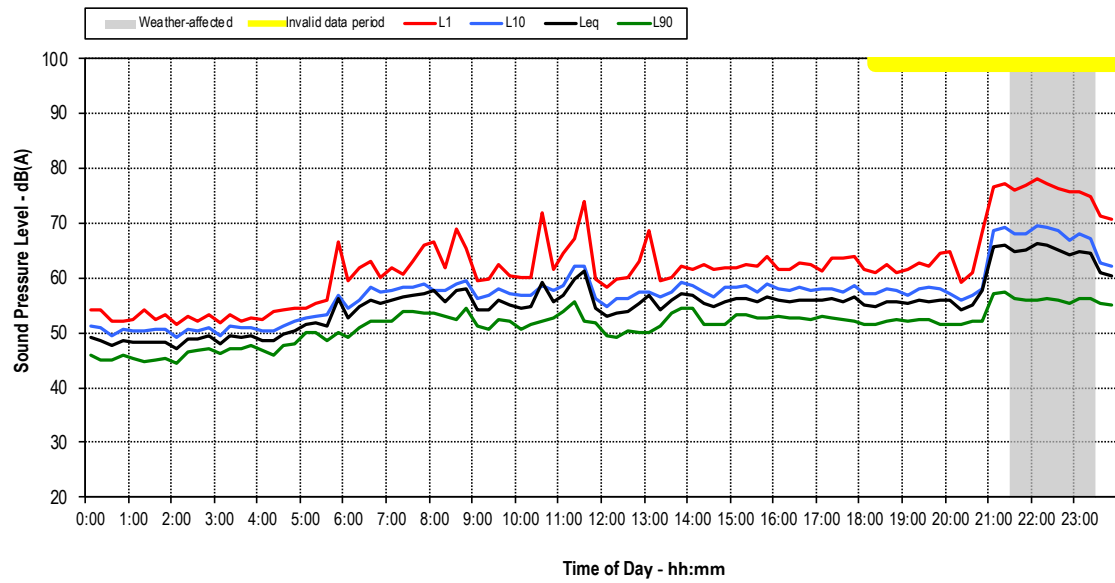
1 Beach Road, Bondi - Sunday 10 March 2019



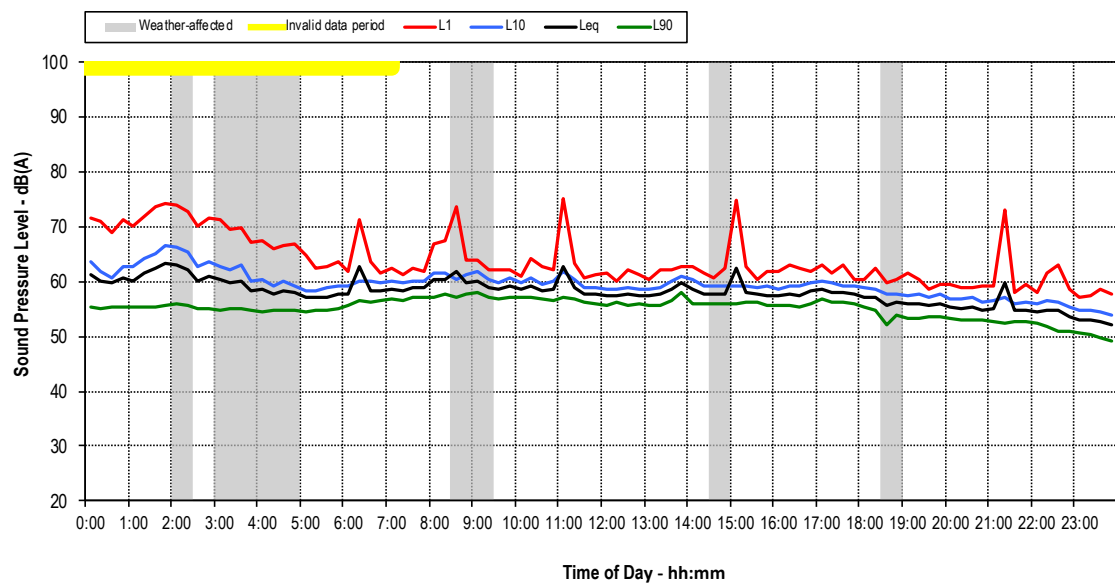
1 Beach Road, Bondi - Monday 11 March 2019



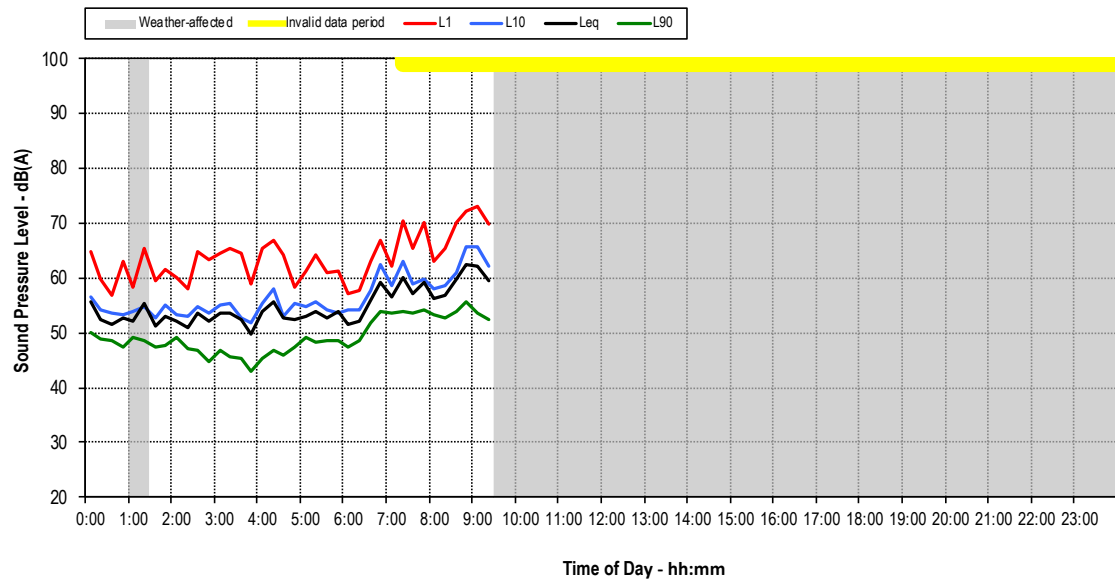
1 Beach Road, Bondi - Tuesday 12 March 2019



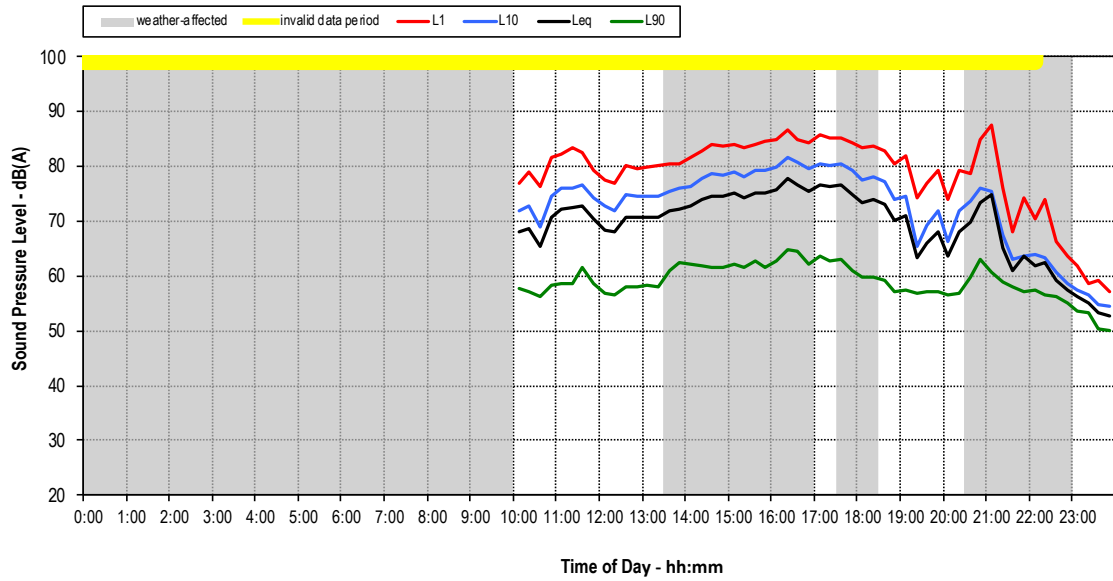
1 Beach Road, Bondi - Wednesday 13 March 2019



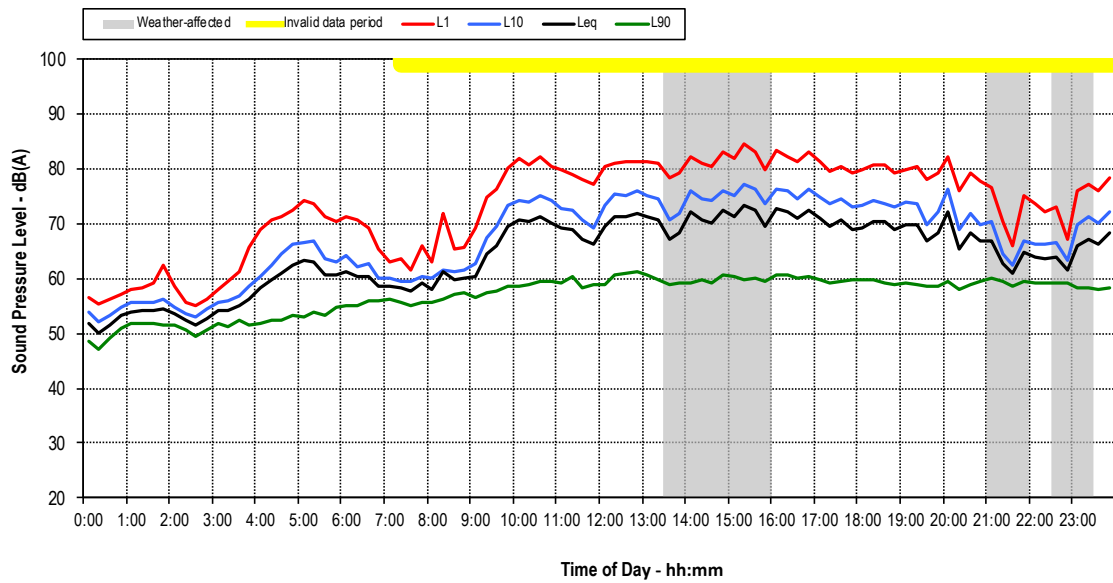
1 Beach Road, Bondi - Thursday 14 March 2019



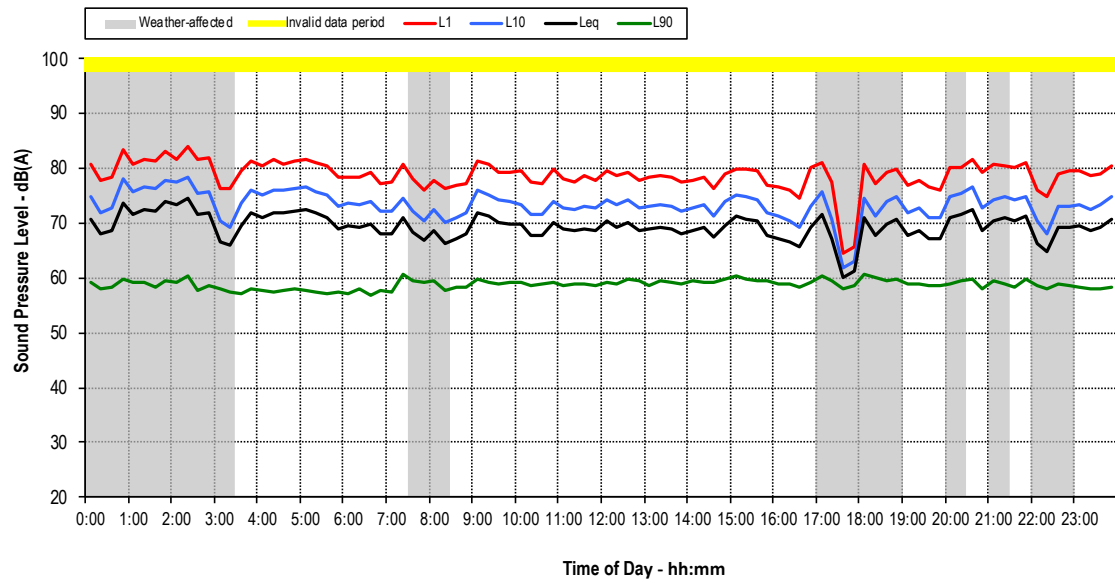
1 Beach Road, Bondi - Thursday 14 March 2019



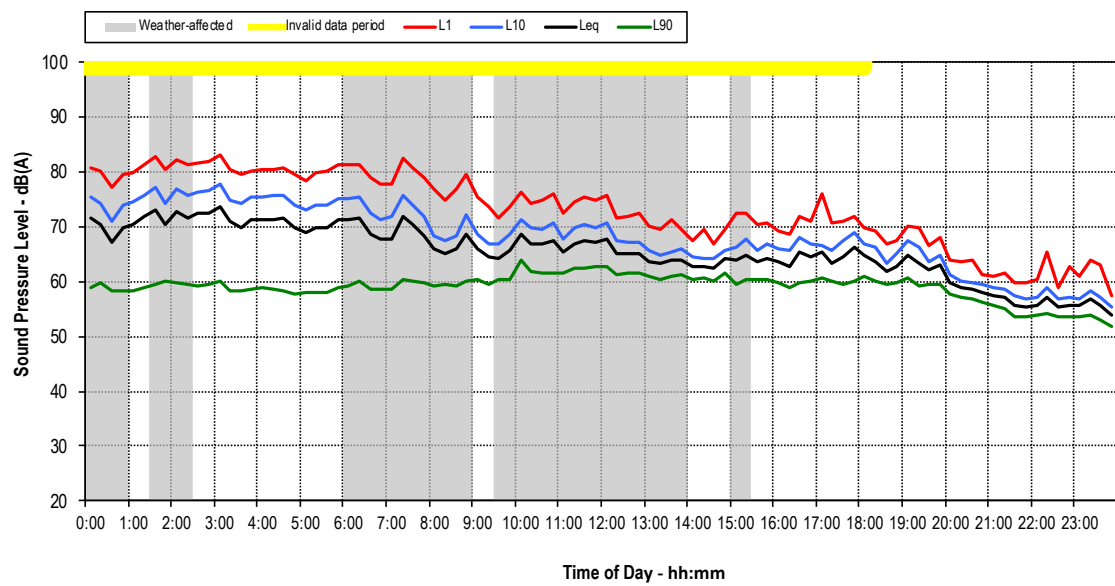
1 Beach Road, Bondi - Friday 15 March 2019



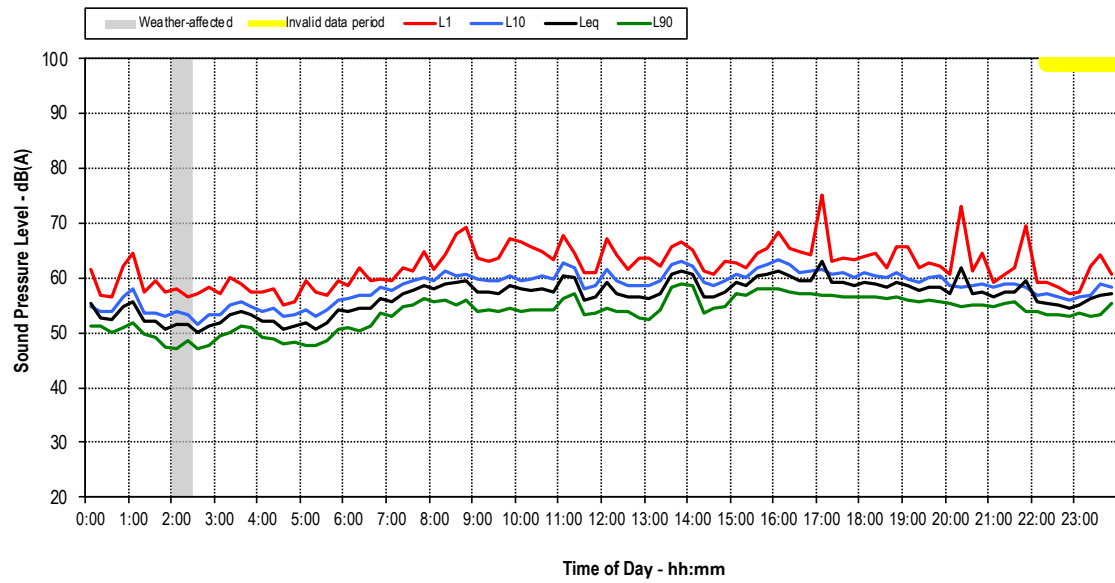
1 Beach Road, Bondi - Saturday 16 March 2019



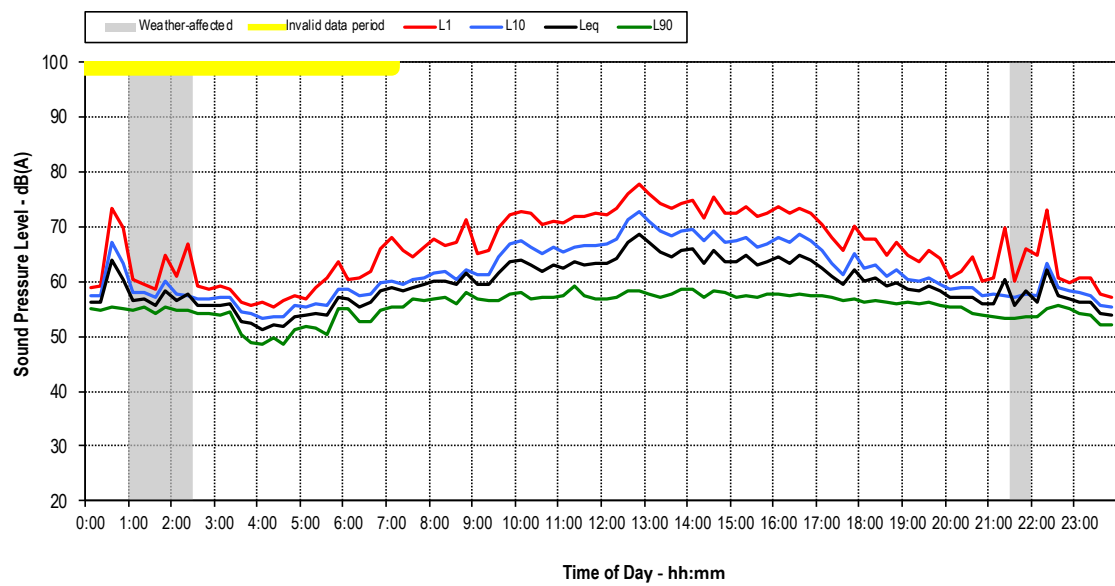
1 Beach Road, Bondi - Sunday 17 March 2019



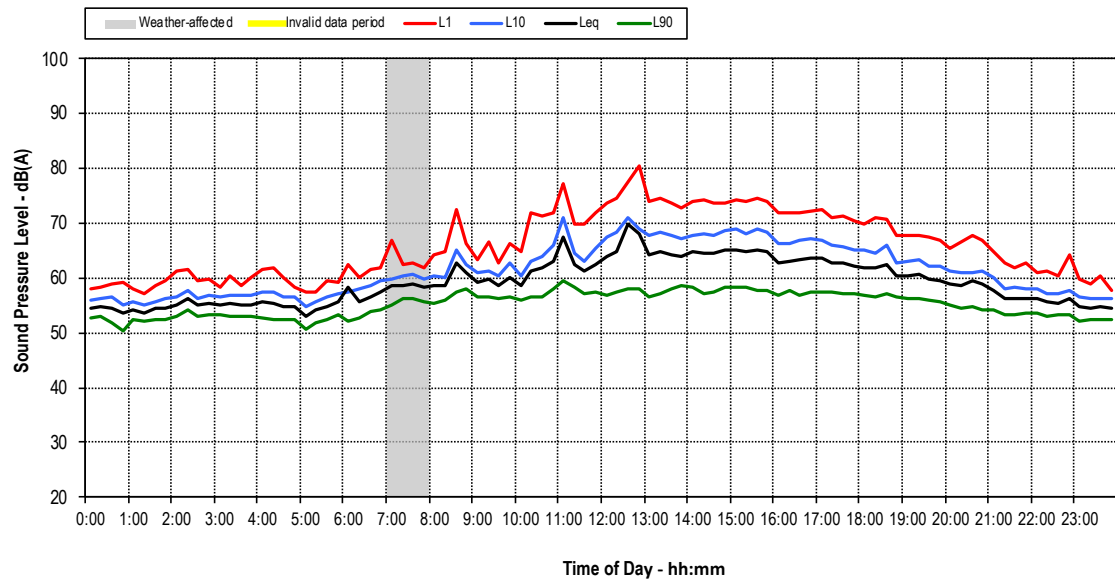
1 Beach Road, Bondi - Monday 18 March 2019



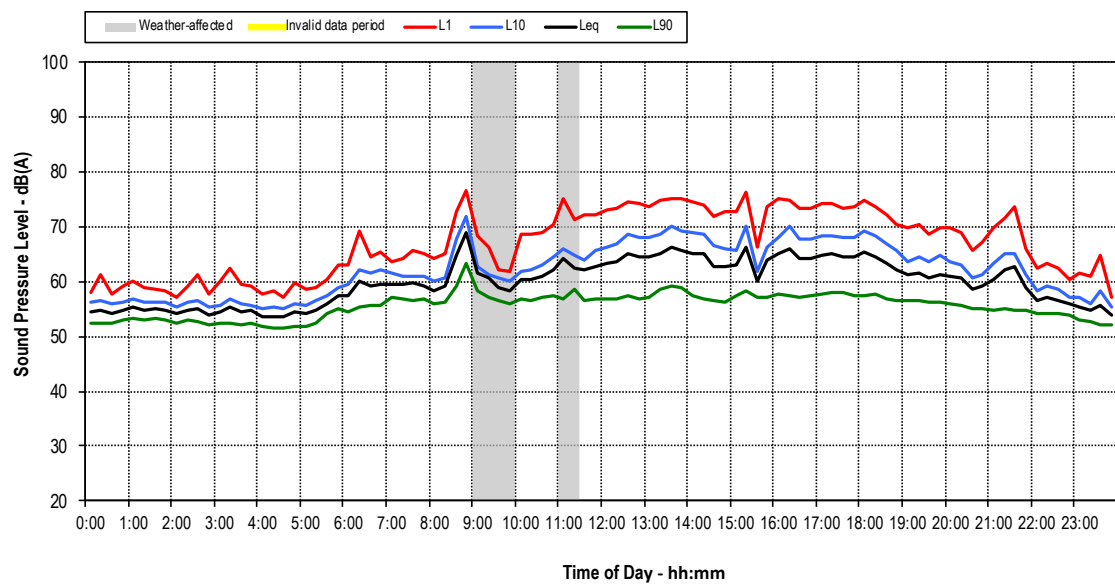
1 Beach Road, Bondi - Tuesday 19 March 2019



1 Beach Road, Bondi - Wednesday 20 March 2019



1 Beach Road, Bondi - Thursday 21 March 2019



1 Beach Road, Bondi - Friday 22 March 2019

