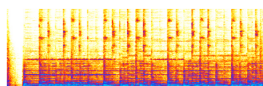


O'CONNELL STREET PRIMARY SCHOOL PARRAMATTA

ACOUSTIC ASSESSMENT OF CONSTRUCTION NOISE AND VIBRATION FOR PLANNING MODIFICATION

Issued

19 May 2017

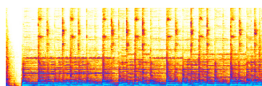


acoustic studio

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	O'Connell Street Primary School Parramatta		TZG-3028
Doc Title	Acoustic Assessment of Construction Noise and Vibration for Planning Modification		
Ref	20170519 TZG3028.0005.Rep.docx		
Date	19 May 2017		Revision: -
Author(s)	Jason Cameron & Hadi Khairuddin		
Circulation	Organisation	Location	Delivered Via
Jarrold Hughes	Tonkin Zulaikha Greer	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.....	4
2	Project Overview	5
2.1	Description of the proposal.....	5
2.2	Site details.....	7
3	Existing Noise Environment	9
3.1	General survey information	9
3.2	Long-term monitoring results.....	10
3.2.1	<i>Background and Ambient Noise.....</i>	<i>10</i>
3.3	Short-term monitoring results.....	11
4	Key Acoustic Considerations	13
5	Construction Airborne Noise Assessment.....	14
5.1	Relevant codes and standards.....	14
5.2	Criteria and limits.....	15
5.2.1	<i>Airborne noise</i>	<i>15</i>
5.3	Construction noise assessment	18
5.3.1	<i>Proposed Hours.....</i>	<i>18</i>
5.3.2	<i>Description of proposed works</i>	<i>18</i>
5.3.3	<i>Construction noise and vibration sources.....</i>	<i>19</i>
5.3.4	<i>Sensitive receivers</i>	<i>20</i>
5.3.5	<i>Methodology</i>	<i>21</i>
5.3.6	<i>Noise assessment results.....</i>	<i>22</i>
5.4	Control elements.....	24
5.4.1	<i>Additional noise control measures.....</i>	<i>25</i>
5.4.2	<i>Riverside Theatre.....</i>	<i>25</i>
5.5	Noise monitoring	26
5.6	Communication and complaints	26
5.7	Non-compliances	27
6	Construction Groundborne Noise & Vibration.....	28
7	Summary and Conclusions	29
	Appendix A : Noise Logger Data.....	30
	Location 2 – Background Noise Logger.....	30

1 Introduction

The Department of Education and Communities (DEC) proposes to facilitate acceleration of the construction phase of the O'Connell Street Primary School (OSPS) development through extended working hours and utilising hours outside of standard construction hours.

Acoustic Studio has been commissioned to carry out a construction noise and vibration impact assessment for proposed works conducted outside of standard construction hours, to accompany a State Significant Development Application (SSDA) modification for the proposal. We note that a previous construction noise and vibration assessment has been prepared by Acoustic Studio for activities undertaken within standard construction hours, as part of the OSPS Acoustic Assessment of Operation and Construction Noise and Vibration for Planning Application (Acoustic Studio, March 2016).

The objectives of this assessment are to:

- Identify noise sensitive receivers that will potentially be affected by the construction activities undertaken outside of standard construction hours.
- Review 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. Including:
 - NSW Industrial Noise Policy 2000
 - Interim Construction Noise Guideline 2009
 - Assessing Vibration: A Technical Guideline 2006
- Carry out a quantitative assessment to determine whether the relevant criteria can be achieved based on proposed construction methods. Where applicable, provide recommendations for any necessary acoustic control measures that will need to be incorporated into the development in order to ensure compliance with the assessment criteria.

This report presents the findings of the construction noise and vibration assessments. It includes measured environmental noise survey data and environmental noise limits based on the measured noise levels in the area. Compliance with these limits will ensure that any noise or vibration from construction will not impact negatively on the nearest existing receivers to the development.

2 Project Overview

2.1 Description of the proposal

The OSPS is currently within the construction phase of the project on a site in Parramatta bounded by O'Connell Street and Marsden Street (known as the Old Kings School site). The OSPS forms a key project in the planning strategy to meet projected increases in student enrolments and demand for additional teaching facilities in Parramatta into the future.

The OSPS development occupies a key heritage site overlooking the Parramatta River.

The proposal includes the fit out and refurbishment of existing buildings plus a new hall to provide five key building areas including:

- Building A and B – Admin, Resource Centre, Home Bases / Classrooms
- Building C and D – Home Bases / Classrooms
- Building H – New Hall and Covered Outdoor Learning Area

The proposal is shown in Figure 1 and Figure 2.

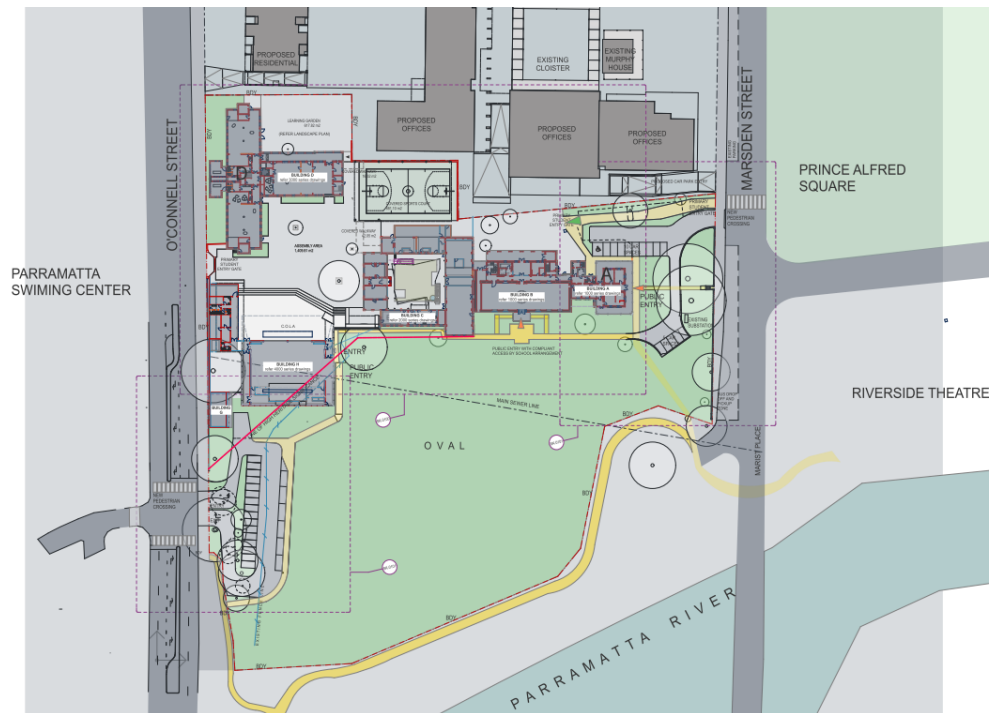


Figure 1: Site Plan

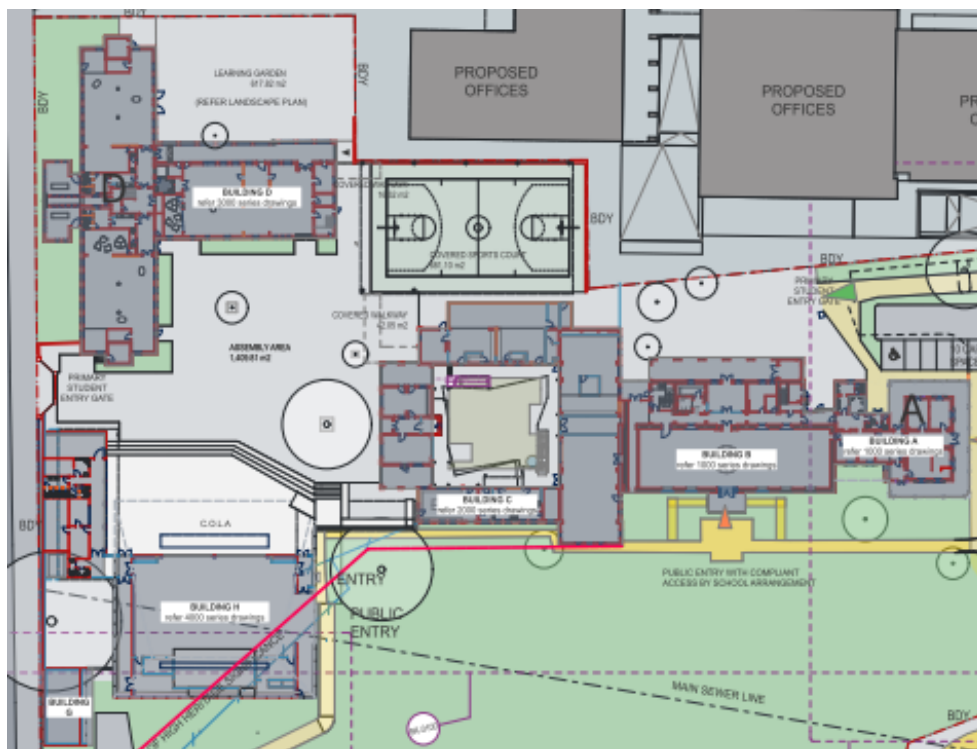


Figure 2: O'Connell Street Primary School – New and Refurbished Buildings

2.2 Site details

The site is located within an urban environment on the outskirts of Parramatta Central Business District, characterised by medium to high levels of activity throughout the day and decreasing noise levels in the evening and night.

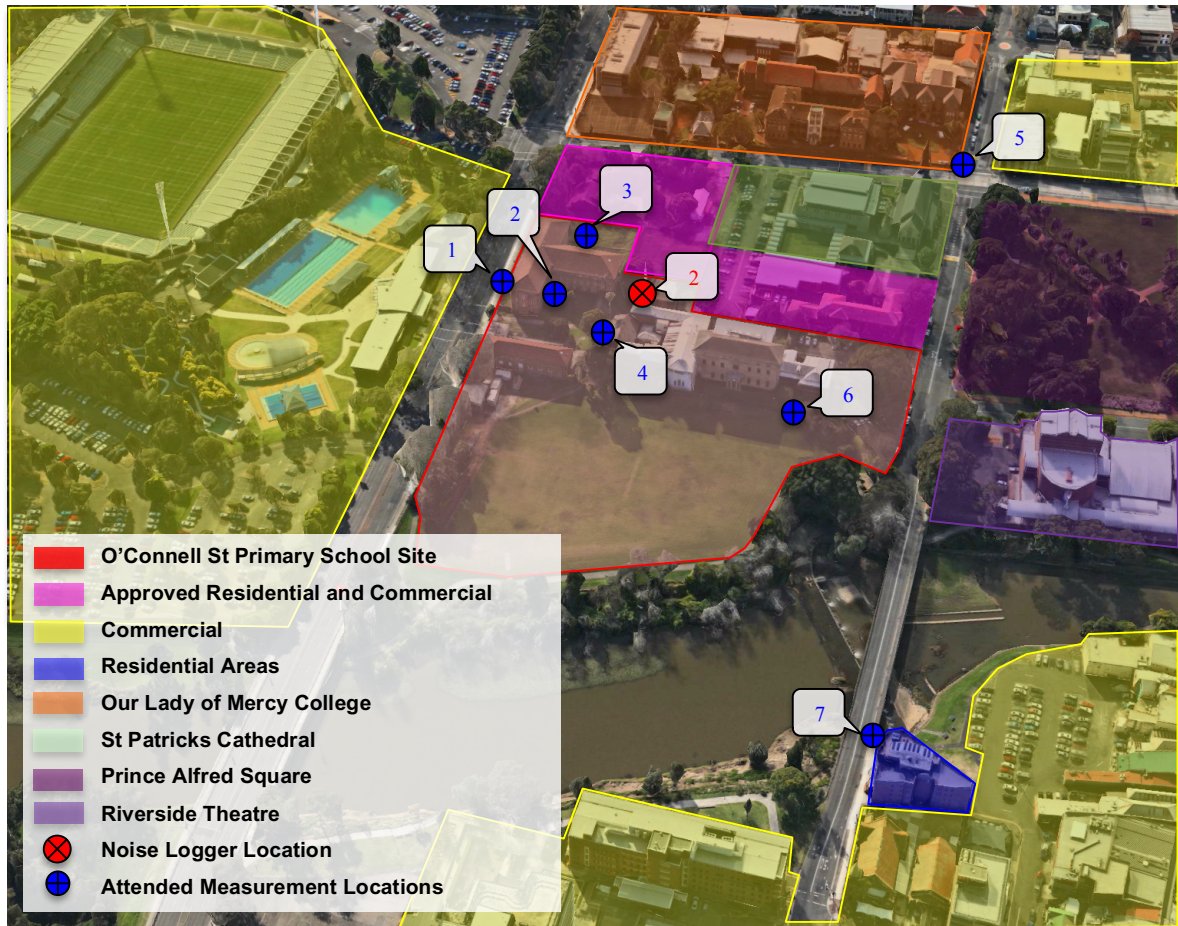


Figure 3: Proposed O'Connell Street Primary School Site in relation to noise-sensitive receivers.

Existing neighbouring buildings that surround the site are as follows:

- Pirtek Stadium and Parramatta Swimming Centre to the west across O'Connell Street. This is currently a construction site.
- Our Lady of Mercy College across Victoria Road to the North
- St Patricks Cathedral adjacent to the North East
- Commercial properties across the intersection of Victoria Road and Marist Place to the North East
- Prince Alfred Square (park area) and the Riverside Theatre to the East across Marist Place.
- Residential to the South East across Parramatta River
- Commercial to the south and southeast across Parramatta River

It is noted that new residential and commercial developments have been approved to the north of the site, however will not be occupied during the construction phase of the OSPS project.

3 Existing Noise Environment

3.1 General survey information

A survey of the existing noise environment around the O'Connell Street site was undertaken by Acoustic Studio as part of the OSPS Acoustic Assessment of Operation and Construction Noise and Vibration for Planning Application (Acoustic Studio, March 2016).

The survey was conducted with one unattended noise monitor used to continuously record the noise levels on the site. Long term noise monitoring was carried out from Monday 16th November to Monday 23rd November 2015 to establish the typical range of ambient noise levels of the proposed site and surrounds.

Long term noise monitoring was carried out with the following noise logger:

- Logger 2: Rion NL-42EX 521657.

The logger recorded L_{A1} , L_{A10} , L_{A90} , and L_{Aeq} noise parameters at 15-minute intervals continuously for the 7-day measurement period. The calibration of the logger was checked before and after use and no variation was noted.

Operator attended short-term monitoring was also carried out on Monday 16th and Monday 23rd November 2015 in order to supplement the long-term outdoor data across the site and at key surrounding receivers.

Short-term measurements were made with a Brüel & Kjær Hand-held Analyser Type 2250 (Serial Numbers 2446899 and 2832406). The calibration of the analyser was checked before and after the survey and no variation in level occurred.

A windshield was used to protect the microphone of both the logger and the analyser. Weather conditions were calm and dry during the attended noise survey.

Anthony Cano and Saiham Siraj of Acoustic Studio Pty Ltd carried out the surveys.

The long and short-term noise monitoring locations are shown in Figure 3.

3.2 Long-term monitoring results

A logger was installed within the proposed development site at the following location:

- Logger 2 – at the centre of the proposed development site to capture existing ambient and **background noise** levels at the site.

The logger position was chosen as it represented a secure place to leave the noise logger unattended whilst obtaining representative background and ambient noise levels at the nearest noise sensitive receivers. The long-term noise monitoring location is shown in Figure 3.

The detailed results of the long term noise monitoring at both logger locations are shown graphically in Appendix A.

Weather patterns were monitored during the survey period and were typically calm and dry during the unattended noise survey.

3.2.1 Background and Ambient Noise

The logged data shows the background and ambient noise levels representative of the area. The recorded background noise levels have been used to establish a limiting criteria for noise emitted from the site.

The background sound level is defined as the sound level exceeded 90% of the time, and is designated as the L_{90} . The ambient noise level impacting on the buildings is referred to as the equivalent continuous sound level (L_{eq}). This parameter is commonly used to describe a time varying noise such as traffic noise.

The background sound levels have been established in general accordance with the methodology described in the NSW INP, i.e. the 10th percentile background sound level for each period for each day of the ambient noise survey. The median of these levels is then presented as the background sound level for each assessment period. These background noise levels are shown in Table 1 below together with the L_{Aeq} ambient noise levels measured for each period.

In accordance with the INP, any data likely to be affected by rain, wind or other extraneous noises has been excluded from the calculations.

Location	Background Noise Levels (RBL), dB(A)			Leq Ambient Noise Levels, dB(A)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Logger 2 Centre of Development Site	47	46	37	53	54	50

Table 1: Long-term background and ambient noise levels

From observations during our site visit, it is noted that both ambient and background noise levels around the proposed development site is generally dominated by traffic noise around the site.

3.3 Short-term monitoring results

Seven (7) short-term noise monitoring locations were chosen as representative of the site and surrounds as follows:

- **Location 1** on the footpath in front of the existing Building D fronting O’Connell Street
- **Location 2** in front of the existing Building C with a direct line of site to O’Connell Street.
- **Location 3** at the rear of Building D to capture indirect traffic noise levels at the rear of the building plus background and ambient noise levels at the site.
- **Location 4** to the north of Building D to capture existing background and ambient noise.
- **Location 5** at the intersection of Victoria Road and Marist Place to the North East to capture background and ambient noise levels at the nearest school and commercial receivers.
- **Location 6** at the southern boundary of the site fronting Parramatta River.
- **Location 7** at the nearest residential noise receiver.

A summary of the measured values of the short-term background and ambient noise monitoring around the existing site are shown in Table 2.

Location	Time	Descriptor	Measured sound level, dB re 20 µPa									
			Overall dB(A)	Octave band centre frequency ¹ , Hz								
				31.5	63	125	250	500	1k	2k	4k	8k
1 (O'Connell Street)	16/11/15 11:50am	Leq 15 min	73	71	79	72	69	69	71	66	58	51
		L90 15 min	63	62	61	57	57	55	61	55	42	30
	23/11/15 14:15pm	Leq 15 min	72	70	75	70	67	66	69	64	55	47
		L90 15 min	61	60	60	57	56	55	58	53	43	34
2	16/11/15 11:30 am	Leq 15 min	56	59	63	64	56	50	52	47	38	37
		L90 15 min	50	56	57	53	50	44	46	41	32	23
	23/11/15 14:31pm	Leq 15 min	55	61	65	58	53	50	52	47	40	32
		L90 15 min	51	57	58	53	50	47	48	43	35	25
3	23/11/15 14:47pm	Leq 15 min	55	61	63	59	53	51	51	46	39	31
		L90 15 min	51	58	58	54	50	48	48	43	33	22
4	23/11/15 15:02pm	Leq 15 min	54	64	65	62	52	49	49	44	38	30
		L90 15 min	48	59	58	52	45	44	44	40	33	24
5	23/11/15 16:05pm	Leq 15 min	69	72	75	72	67	64	65	60	53	46
		L90 15 min	58	66	66	62	58	55	54	50	44	35
6	23/11/15 13:39pm	Leq 15 min	58	64	67	61	57	56	54	49	43	32
		L90 15 min	55	60	62	57	53	52	51	47	39	27
7	23/11/15 13:15pm	Leq 15 min	67	70	68	66	63	62	64	60	52	44
		L90 15 min	55	61	61	58	54	52	50	47	42	33

Table 2: Short-term traffic, background and ambient noise levels – Day time survey

4 Key Acoustic Considerations

The following acoustic issues are to be addressed as part of the construction noise and vibration impact assessment for the OSPS:

The impact of noise and vibration generated during the construction stage of the project on surrounding noise sensitive premises.

The development will contribute noise and vibration to the surrounding environment during outside of standard construction hours. Typically, this will result from intermittent noise from construction equipment and plant commonly used on construction sites.

Design noise and vibration limits have been set for the project and construction noise impacts have been anticipated from standard construction procedures.

The construction noise and expected impacts are reported in Section 5 of this report.

Construction groundborne noise and vibration impacts are reported in Section 6 of this report.

5 Construction Airborne Noise Assessment

The following provides a construction noise assessment of the proposed out of hours (OOH) construction activities and the associated construction methodology.

5.1 Relevant codes and standards

In preparing this construction noise and vibration assessment, the following legislation, codes and standards have been found to be relevant for the OSPS:

- NSW Department of Environment and Climate Change “Interim Construction Noise Guideline”, 2009.
- NSW Department of Environment and Conservation (DEC) “Assessing Vibration: A Technical Guideline”, 2006
- Australian Standard “AS 2436 : Guide to Noise Control on Construction, Maintenance & Demolition Sites”, 1981
- Australian Standard “AS 1055 : Acoustics – Description and Measurement of Environment Noise”, 1997
- Australian Standard “AS 2670.2 : Evaluation of human exposure to whole-body vibration – Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)”, 1990
- British Standards Institution “BS 6472 – Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)”, 1992
- German Institution for Standardisation “DIN 4150.3 : Structural vibration – Effects of vibration on structures”, 1999
- Protection of the Environment Operations Act 1997

5.2 Criteria and limits

5.2.1 Airborne noise

OEH Interim Construction Noise Guideline (OEH ICNG)

The relevant guideline applied for the assessment of construction noise is the Department of Environment and Climate Change (DECC) NSW, “*Interim Construction Noise Guideline (ICNG), 2009*”. This guideline provides construction noise criteria for Residential, Commercial and Industrial noise receivers as follows.

Residential Receivers

Section 4 of the ICNG provides recommendations for OOH construction activities and suggests construction noise management levels that aim to minimise the likelihood of annoyance caused to noise sensitive receivers. These consider both airborne and ground borne noise level impacts.

Table 3 below outlines the methodology for determining construction noise criteria at nearby residential receivers surrounding the development site based on existing background noise levels.

Time of Day	Management level L_{Aeq} (15 min)	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected $RBL^1 + 10 \text{ dB}$	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> Where the predicted or measured L_{Aeq} (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ol style="list-style-type: none"> Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours:	Noise affected $RBL + 5 \text{ dB}$	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 [of the ICNG].

Table 3: Residential construction noise criteria for airborne noise (from the ICNG) – the grey shaded area indicates the time period in which the proposed OOH works would be undertaken

¹ The RBL is the overall single figure background level representing each assessment period (day/evening/night) over the whole assessment period. This is the level used for assessment purposes and is further described in the Environmental Protection Authority (EPA) “NSW Industrial Noise Policy, 2000”

Based on the requirements detailed in Table 3 above and the measured data of existing conditions at the site (Section 3), the RBL has been calculated over the OOH periods and the corresponding project specific noise criteria levels for residential airborne noise have been determined. These are detailed in Table 4 below. The day/evening/night OOH periods within which construction works are proposed to be undertaken are shaded in Table 4. The actual proposed construction hours are provided in Section 5.3.1.

Location	OOH Period	Rating Background Level RBL, dB(A)	Criteria $L_{eq}(15\text{ min}), \text{dB(A)}$ (RBL + 5)
Residential Receivers	Monday to Friday OOH	6pm to 10pm	51
		10pm to 7am	42
	Saturday OOH	1pm to 6pm	54
		6pm to 10pm	51
		10pm to 8am	39
	Sunday / Public Hol. OOH	8am to 6pm	50
		6pm to 10pm	49
		10pm to 8am	40

Table 4: Project specific residential noise criteria for airborne noise– the grey shaded areas indicates the proposed OOH time period in which works would be undertaken

Other Sensitive Land Uses

OEH's "Interim Construction Noise Guideline" suggests construction noise management levels for other sensitive land uses surrounding construction sites. They are as follows:

- Offices, retail outlets : $L_{Aeq,15min}$ 70dBA (external)
- Classrooms : $L_{Aeq,15min}$ 45dBA (internal)
- Places of Worship : $L_{Aeq,15min}$ 45dBA (internal)
- Passive recreation areas : $L_{Aeq,15min}$ 60dBA (external)

Where reference is made to an internal noise level, an external noise level 10 dB above the internal noise levels are applied for the purposes of this assessment, which should achieve the internal noise level where a window is adequately opened to provide natural ventilation. The NSW Industrial Noise Policy supports this methodology.

5.3 Construction noise assessment

5.3.1 Proposed Hours

Proposed OOH periods for the project are as follows:

- 6:00pm to 10:00pm Monday to Friday
- 7:30am to 8:00am and 3:30pm to 5:00pm Saturday
- 8:00am to 5:00pm Sunday

5.3.2 Description of proposed works

Based on the proposed OOH construction works and timing provided by the Project Manager, it is anticipated that the key construction activities to occur outside of standard construction hours are as follows:

Proposed OOH period	Activities	Typical Plant
Saturday 7:30am to 8:00am and 3:30pm to 5:00pm Sunday 8:00am to 5:00pm	Internal refurbishment	Angle grinder / jackhammers / hand tools / drills
	Deliveries	Delivery trucks / Hiab trucks / mobile cranes
	Ground excavation	Excavator with bucket and hammer / bobcats / tip trucks / bin lift trucks
	Decontamination Activities	Hand tools
	Construction of new hall and covered structures	Mobile cranes / hand tools / circular saw / cement mixer / drill
	In – Ground Concrete Pours for courts and other areas	Concrete trucks / concrete vibrator / concrete pumps
Monday to Friday 6:00pm to 8:00pm	External works (Landscaping and footpaths)	Demo saw / excavator / hand tools / drills / angle grinders / hammer drill / mobile crane / concrete truck / concrete vibrator
	Low noise activities	Powered hand tools and battery tools only
Monday to Friday 8:00pm to 10:00pm	Internal refurbishment	No noise generating tools or equipment

Note: Items shaded in grey are works to be carried out internally within the building

Table 5: Proposed OOH Construction Works

5.3.3 Construction noise and vibration sources

The key construction noise sources for the works occurring during OOH construction periods and the associated equipment noise levels are listed in Table 6 below. These values are based on Acoustic Studio's database plus Australian and International Standards.

Equipment Type	Item	Typical Noise Level
		L _{A10,15min} SWL
Heavy Vehicles	Tipper Truck	114
	Bin Lift Truck	114
	Hiab Truck	116
	Delivery trucks (semi-trailers, rigid trucks)	108
	Concrete Mixer trucks	112
Site Machinery	Mobile Crane	111
	Bobcat	113
	Excavator (with rock breaker / rock saw)	119
	Excavator (8 Tonne w/bucket)	108
	Concrete Vibrator	104
	Concrete pump	113
Hand Held Tools	Angle Grinder	104
	Drill	94
	Hammer Drill	107
	Jackhammer	113
	Hand Tools (Electric)	99
	Circular saw	115
	Demo Saw	122

Table 6: Anticipated airborne noise levels for construction noise equipment / plant

5.3.4 Sensitive receivers

Nearest sensitive receivers to the OSPS site that will be potentially affected by noise associated with proposed construction are shown in Table 7.

Receiver	Location	Approximate Distance from construction site (closest point)
Residential	South East	200m
Residential ²	North East	150m
Our Lady of Mercy College	North	80m
Prince Alfred Square	East	40m
Riverside Theatre	East	70m
Commercial ²	North East	150m
St Patricks Cathedral	North East	25m

Table 7: Noise sensitive receivers and approximate distance (closest point) to Project site

² It is understood that the approved residential and commercial developments to the north will not be occupied during the construction phase of the OSPS project.

5.3.5 Methodology

An assessment of the likely noise impacts of the proposed OOH activities on the most-affected receivers surrounding the site has been carried out.

The assessment has considered the following:

- Typical construction activities considered in the noise impact assessment are as detailed in Table 5.
- Project specific criteria at each sensitive receiver location as outlined in Section 5.2.
- Noise level predictions are calculated using the noise data provided in Table 6.
- Noise level predictions consider:
 - Distance attenuation
 - Building attenuation (for internal works)
 - Ground and building reflections
- L_{Aeq} noise levels are predicted for the operations of the nearest construction area on the site to each sensitive residential receiver location.
- The predictions consider a range from individual tasks and associated equipment through to the cumulative noise contribution from all key activities and corresponding equipment, with plant running simultaneously for each phase and main task.
- The predictions assume continuous operation of equipment / plant over the 15-minute assessment period.
- For the purposes of this assessment, predictions have been undertaken for worst-case external and internal activities to be carried out at the site.

5.3.6 Noise assessment results

The following section presents the results of the construction noise assessment carried out for external and internal OOH construction works scheduled for the project.

This construction noise assessment determines the potential noise impact of activities and associated plant and equipment at the most affected receivers.

Tables 8 and 9 below present the predicted construction noise levels at the nearest residential and non-residential receivers, with comparison against the relevant criteria.

Location and Construction Activity	Predicted equipment noise level, in dBLA _{10,15min}			
	Monday to Friday 6:00pm to 10:00pm	Saturday 7:30am to 8:00am	Saturday 3:30pm to 5:00pm	Sunday 8:00am to 5:00pm
	Criteria L _{eq} (15 min) dBA			
	51	39	54	50
Internal refurbishment	- ³	28 to 49	28 to 49	28 to 49
Deliveries	-	51 to 63	51 to 63	51 to 63
Ground Excavation	-	51 to 65	51 to 65	51 to 65
Decontamination Activities	-	43 to 48	43 to 48	43 to 48
Construction of new hall and covered structures	-	37 to 58	37 to 58	37 to 58
In-ground concrete pours for courts and other areas	-	50 to 59	50 to 59	50 to 59
External walls	-	50 to 66	50 to 66	50 to 66
Low noise activities	40 to 49	-	-	-
Internal refurbishment ⁴	✓ ⁵	-	-	-

Table 8: Predicted equipment/plant noise levels at nearest residential receiver location – Levels predicted to exceed the worst case criteria are in **red**

³ Activities not proposed for time period

⁴ Refers to internal refurbishment works with no noise generating tools or equipment as per Table 5

⁵ Activities inaudible at the receiver

Location and Construction Activity	Predicted equipment noise level, in dBL _{A10,15min}				
	Our Lady of Mercy College	Prince Alfred Square	Riverside Theatre	Commercial	St Patricks Cathedral
	Criteria L _{eq} (15 min) dBA				
	55 ⁶	60	60	70	55 ⁶
Internal refurbishment	N/A ⁷	42 to 63	37 to 58	31 to 51	51 to 71
Deliveries	N/A	65 to 77	60 to 72	54 to 65	69 to 81
Ground Excavation	N/A	65 to 79	60 to 74	54 to 68	69 to 83
Decontamination Activities	N/A	57 to 62	52 to 57	46 to 51	60 to 65
Construction of new hall and covered structures	N/A	51 to 72	46 to 67	40 to 60	55 to 76
In-ground concrete pours for courts and other areas	N/A	64 to 73	59 to 68	53 to 61	77 to 68
External walls	N/A	64 to 80	59 to 75	52 to 69	68 to 84
Low noise activities	N/A	51 to 60	46 to 55	40 to 48	55 to 64
Internal refurbishment ⁸	N/A	✓ ⁹	✓	✓	✓

Table 9: Predicted equipment/plant noise levels at nearest non-residential receiver locations – Levels predicted to exceed the worst case criteria are in **red**. Note: the non-residential criteria above remains the same, irrespective of time period.

Due to the sensitivity of undertaking works outside of standard construction hours, it is likely that unrestricted construction activities will, at times, exceed the stated criteria at the nearest and potentially worst affected receivers. These times are indicated by **red** values in Tables 8 and 9.

⁶ An external noise level 10 dB above the internal noise levels is applied assuming windows are adequately opened to provide natural ventilation. The NSW Industrial Noise Policy supports this methodology.

⁷ Not applicable as receiver is not in use during proposed OOH periods

⁸ Refers to internal refurbishment works with no noise generating tools or equipment as per Table 5

⁹ Activities inaudible at the receiver

For each of these activities and assuming that, in fact, these activities are found to exceed the noise criteria, then the noise control measures Section 5.4 shall be considered and implemented wherever reasonable and feasible. In addition, the construction best practices presented in Section 5.4.1 shall be considered to minimise the noise impacts on the neighbourhood.

5.4 Control elements

As a general rule, prevention should be applied as universal work practice at any time of day, but especially for the occasional construction works to be undertaken at critical times outside normal daytime/weekday periods.

It is noted that the reduction of noise at the source and the control of the transmission path between the construction site and the receiver(s) are the preferred options for noise minimisation. Providing treatments at the affected residences or other sensitive land uses should only be considered as a last resort. Construction noise shall be managed by implementing the strategies listed below:

- Plant and equipment
 - Use quieter methods.
 - Use quieter equipment.
 - Operate plant in a quiet and effective manner.
 - Where appropriate, limit the operating noise of equipment.
 - Maintain equipment regularly.
 - Where appropriate, obtain acoustic test certificates for equipment.
- On site noise management
 - Strategically locate equipment and plant.
 - Avoid the use of reversing alarms or provide for alternative systems.
 - Maximise shielding in the form of existing structures or temporary barriers.
 - Schedule the construction of barriers and structures so they can be used as early as possible.
- Consultation, notification and complaints handling
 - Provide information to neighbours before and during construction.
 - 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.
- Keep truck drivers informed of designated routes, parking locations and delivery hours.

5.4.1 Additional noise control measures

If, during construction, an item of equipment exceeds either the noise criteria at any location or the equipment noise level limits, the following noise control measures, together with construction best practices presented in Section 5.4 shall be considered to minimise the noise impacts on the neighbourhood.

- Schedule noisy activities to occur outside of the most sensitive times of the day for each nominated receiver. For example, residential receivers are likely to be more sensitive to noise before 9 am than the commercial receivers.
- Consider implementing equipment-specific screening or other noise control measures recommended in Appendix E of AS2436.
- Limit the number of trucks on site at the commencement of site activities to the minimum required by the loading facilities on site.
- When loading trucks, adopt best practice noise management strategies to avoid materials being dropped from height into dump trucks.
- Avoid unnecessary idling of trucks and equipment.
- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc.) not specifically identified in this plan incorporates silencing/shielding equipment as required to meet the noise criteria.

Implementation of all reasonable and feasible mitigation measures for all internal and underground works will ensure that any adverse noise impacts to surrounding residential, commercial and recreational receivers are minimised when noise goals cannot be met due to safety or space constraints.

5.4.2 Riverside Theatre

It is understood that specific concern has been raised by the Riverside Theatre in relation to noise impacts associated with proposed OOH construction activities, particularly on Saturdays and Sundays. The Riverside Theatre has identified sensitive time periods during weekend matinee performances between the hours of 11am and 2pm. Weeknights after 7.30pm are also identified as sensitive time periods – but this coincides with proposed low noise construction works.

In addition to the standard consultation and notification measures described in Section 5.4, it is recommended that a specific communications protocol is established with the Riverside Theatre as a means to identify upcoming sensitive events / time periods (e.g. weekend matinee performances). The Contractor can then plan OOH works in coordination with the Riverside Theatre and, where possible, schedule activities that are predicted to exceed the relevant criteria (**red** values presented in Table 9) for hours that do not coincide with sensitive events / time periods as identified by the Riverside Theatre.

It is noted that, while the worst case scenario impact associated with the 'Deliveries' activity is shown to exceed the relevant criteria (refer to Table 9), noise emissions from construction trucks are likely to be consistent with the existing noise environment characterised by regular bus and general traffic noise. Therefore, 'Deliveries' activities are unlikely to result in additional / increased noise impacts to surrounding receivers, including the Riverside Theatre.

5.5 Noise monitoring

The Contractor should consider implementing environmental noise monitoring at the locations described below, particularly for OOH activities.

- The boundary of the construction site at the closest receiver (St Patricks Cathedral)

An allowance of 1.5 days per week, at least, should be dedicated to monitoring of noise for the first four weeks of OOH works. Further monitoring should be reviewed after this time or sooner should it be deemed necessary by the Acoustic Consultant and the Project Manager. This should take place mainly at the above locations although other locations and plant and equipment monitoring should take place as and when necessary.

The Contractor should prepare a noise monitoring report each month of OOH works for review by the Project Manager. The reports should summarise and interpret the results of the noise monitoring carried out during the past month.

5.6 Communication and complaints

The Contractor should establish a communications register for recording incoming complaints. The registration of a particular item will remain open until the complaint has been appropriately dealt with.

In addition, the following procedures are an example of the procedures that should be specifically adopted for complaints relating to noise.

Upon receipt of a complaint The Contractor should:

- 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 occurring outside normal working hours, the activity should 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 should then cease.

Any activity which is directed to cease due to excessive noise should not recommence until the Project Manager is satisfied that the noise and vibration limits requirements can be met and has given permission to recommence the activity.

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

The Project Manager should provide a report on the incident to the relevant stakeholders.

The Contractor should provide a 24-hour telephone contact number and this number should be prominently displayed on the site.

5.7 Non-compliances

Non-compliance reports can be used as appropriate to deal with failures to meet the construction noise management and control requirements.

6 Construction Groundborne Noise & Vibration

Construction groundborne noise and vibration criteria was established, and impacts assessed, as part of the OSPS Acoustic Assessment of Operation and Construction Noise and Vibration for Planning Application (Acoustic Studio, March 2016).

Groundborne noise and vibration impacts associated with the proposed OOH activities will be consistent with the previously assessed works. Therefore, it is anticipated that OOH construction works will result in no adverse impact at surrounding receivers.

Potential sources of vibration and groundborne noise during construction works include:

- Demolition and excavation plant including rock-breakers and jack hammers
- Installation of structure
- Grinding, cutting and drilling of existing building structures

Vibration and groundborne noise impacts are likely to have been highest during the demolition and excavation works, when equipment such as rock breakers and jackhammers were used – it is understood that these works have largely been completed and only limited subsurface rock strata is anticipated for remaining excavation activities. Groundborne noise and vibration levels generated during these works were found to not exceed the criteria at the surrounding sensitive receivers. Indeed, the need to control vibration levels affecting existing heritage structures on site results in low levels of groundborne noise and vibration to surrounding sensitive receivers.

Notwithstanding the above, all practical means should be used to minimise impacts on the affected buildings and occupants from any activities generating significant levels of vibration on site.

The following considerations shall be taken into account:

- Modifications to construction equipment used.
- Modifications to methods of construction.
- Rescheduling of activities to less sensitive times.

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

For detailed construction groundborne noise and vibration assessment and recommendations, reference should be made to the OSPS Acoustic Assessment of Operation and Construction Noise and Vibration for Planning Application (Acoustic Studio, March 2016).

7 Summary and Conclusions

A construction noise and vibration assessment report has been produced for proposed OOH activities to facilitate the construction phase of the acceleration of the OSPS development.

A survey of the existing noise environment around the O'Connell Street site was undertaken by Acoustic Studio as part of the OSPS Acoustic Assessment of Operation and Construction Noise and Vibration for Planning Application (Acoustic Studio, March 2016).

Appropriate criteria for both construction noise and vibration have been established based on relevant guidelines and standards.

A summary of the outcomes and recommendations of this construction noise and vibration assessment are as follows:

- *Construction Airborne Noise*

Due to the sensitivity of undertaking works outside of standard construction hours, it is likely that unrestricted construction activities will, at times, exceed the stated criteria at the nearest and potentially worst affected receivers.

If, during construction works, an item of equipment exceeds the stated airborne noise criteria at any sensitive location, the additional noise control measures presented in Section 5.4.1 and 5.4.2, together with construction best practices presented in 5.4, shall be considered to minimise the noise impacts on the neighbourhood.

- *Construction Groundborne Noise & Vibration*

Groundborne noise and vibration impacts associated with the proposed OOH activities will be consistent with the previously assessed works.

Vibration and groundborne noise impacts are likely to have been highest during the demolition and excavation works (which have now been completed), when equipment such as rock breakers and jackhammers were used. Groundborne noise and vibration levels generated during these works were found to not exceed the criteria at the surrounding sensitive receivers. Indeed, the need to control vibration levels affecting existing heritage structures on site results in low levels of groundborne noise and vibration to surrounding sensitive receivers.

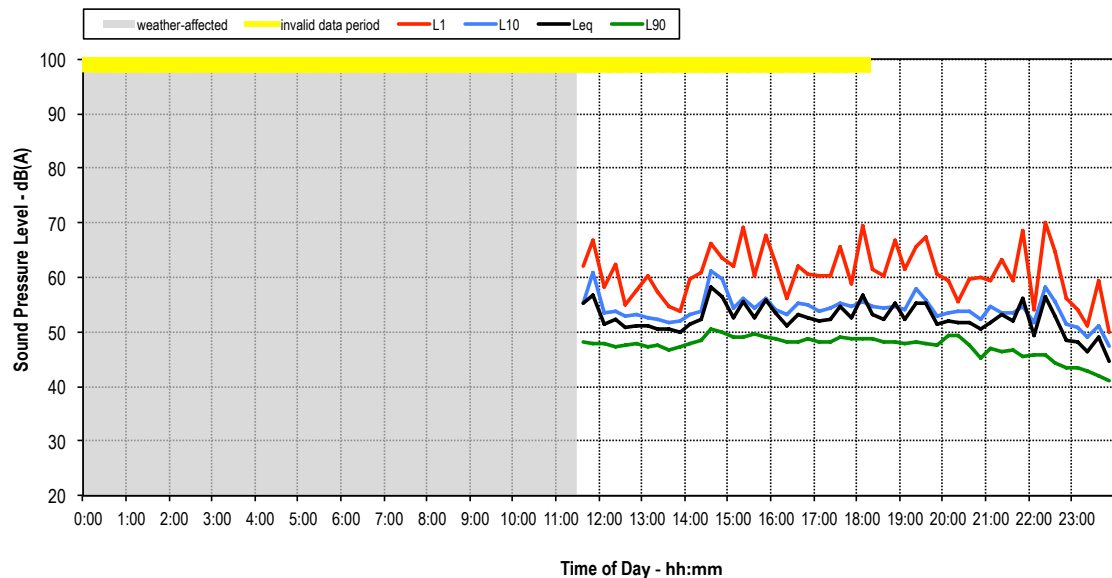
Therefore, it is anticipated that OOH construction works will result in no adverse impact at surrounding receivers.

Notwithstanding the above, all practical means should be used to minimise impacts on the affected buildings and occupants from any activities generating significant levels of vibration on site.

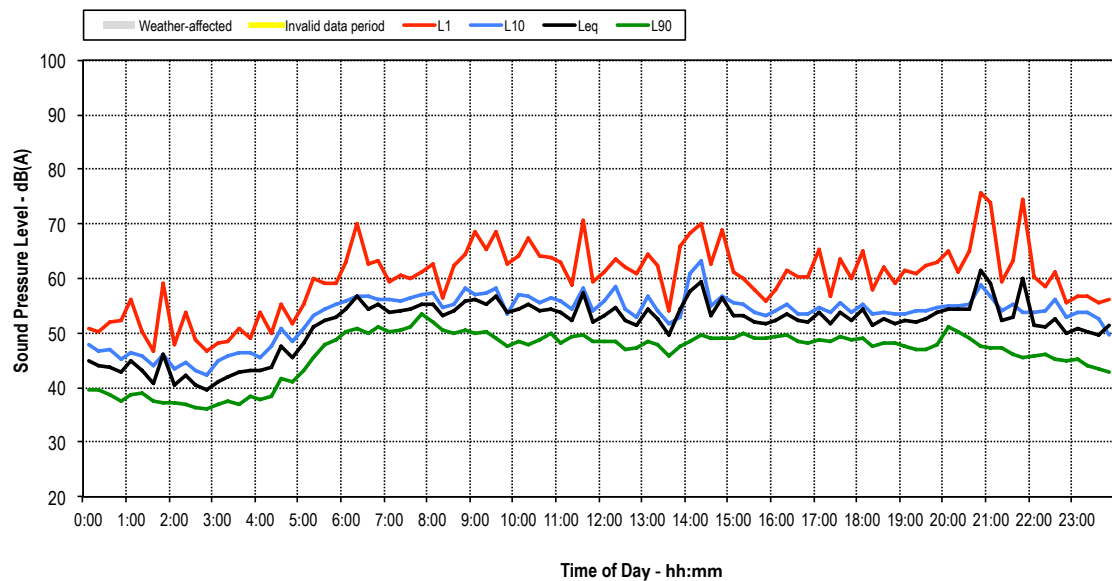
Appendix A : Noise Logger Data

Location 2 – Background Noise Logger

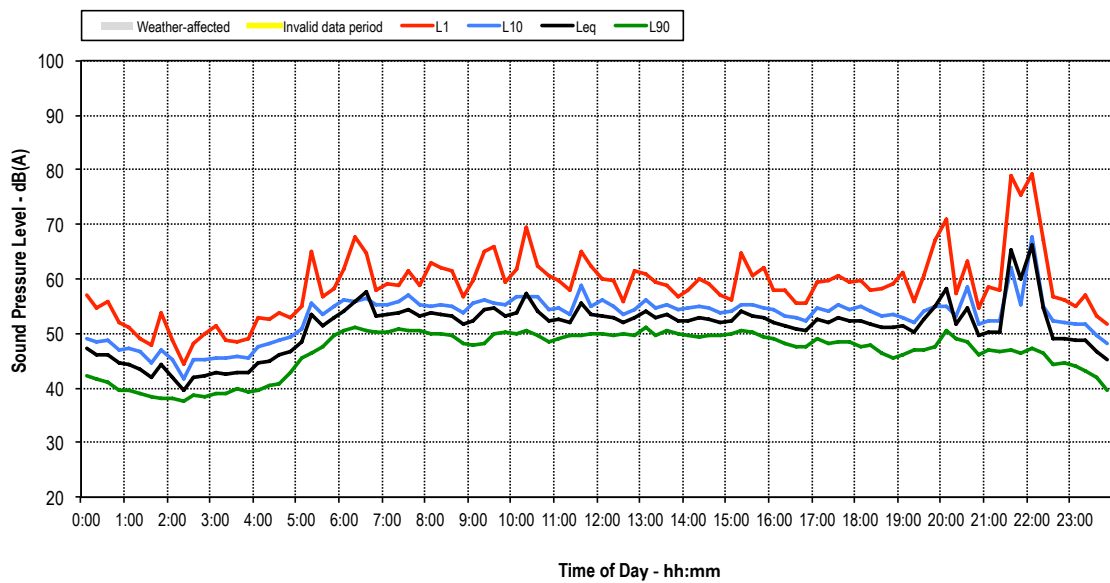
OSPS - Location 2 - Monday 16 November 2015



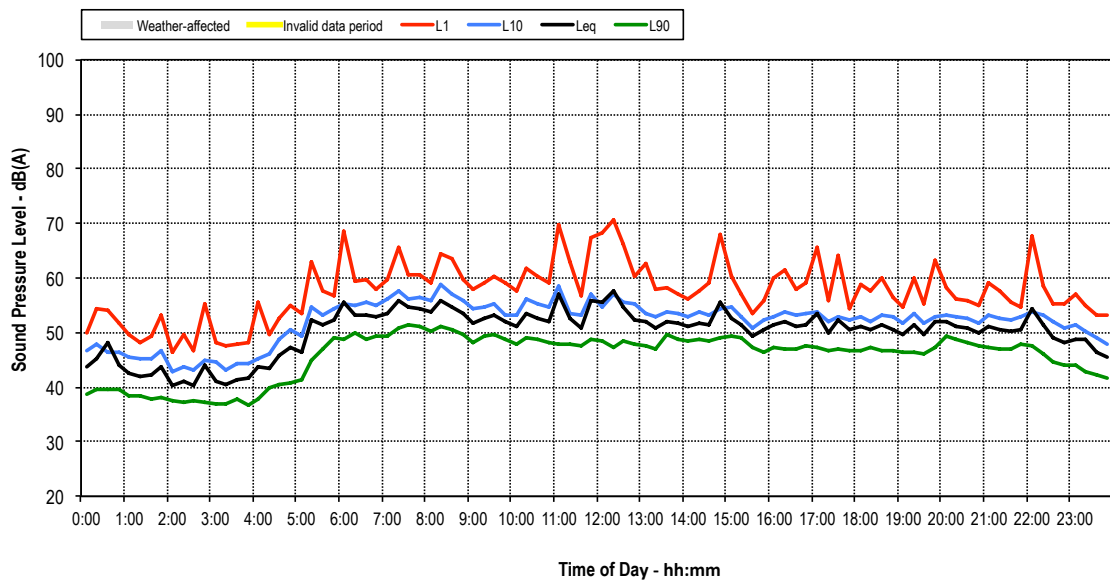
OSPS - Location 2 - Tuesday 17 November 2015



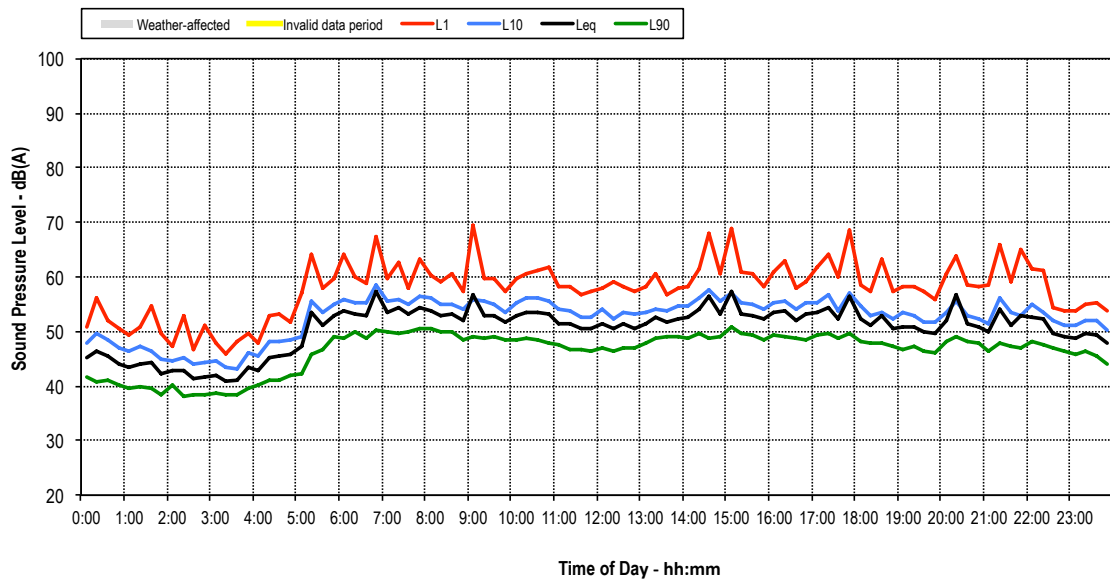
OSPS - Location 2 - Wednesday 18 November 2015



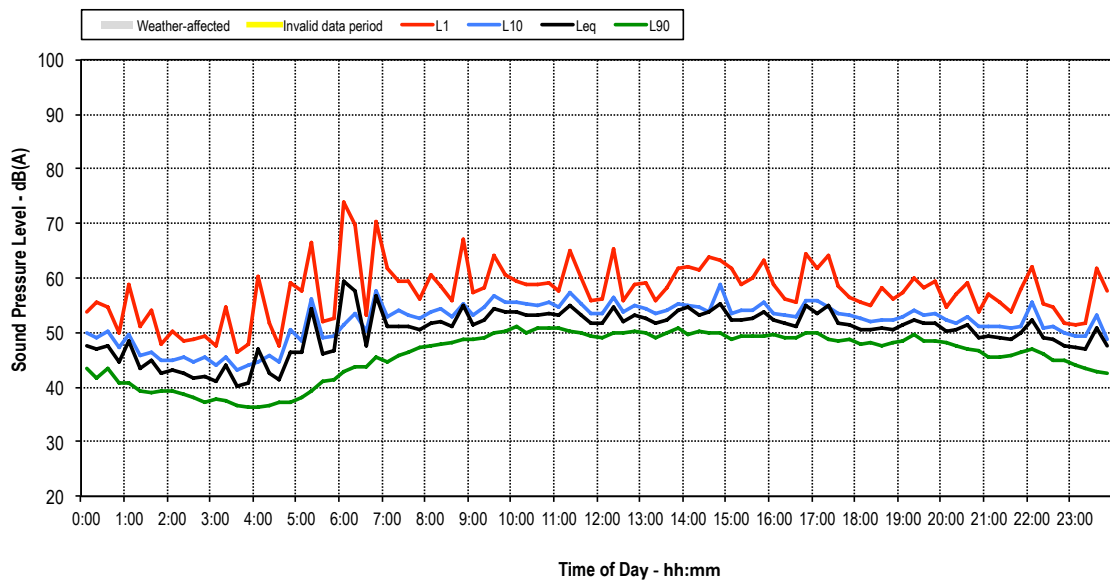
OSPS - Location 2 - Thursday 19 November 2015



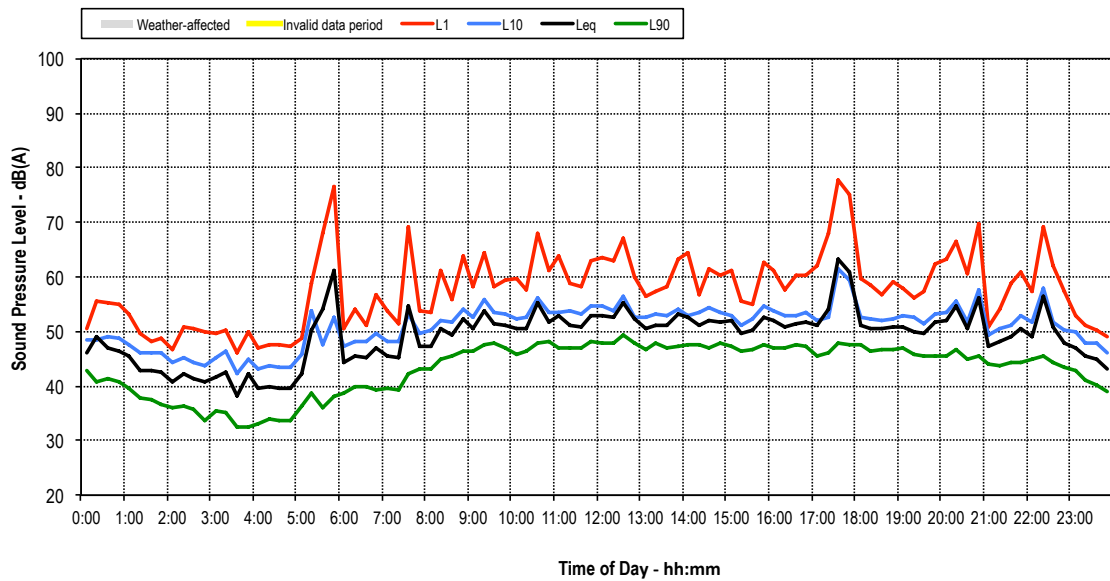
OSPS - Location 2 - Friday 20 November 2015



OSPS - Location 2 - Saturday 21 November 2015



OSPS - Location 2 - Sunday 22 November 2015



OSPS - Location 2 - Monday 23 November 2015

