WILKINSON MURRAY

MEMORANDUM

DATE: **20 December 2020**

FROM: **John Wassermann**

TO: **Mitch Alexander Bloompark Consulting Pty Ltd**

SUBJECT: **Scientia Project - Monte Sant' Angelo Mercy College**
Acoustic Addendum Report - Sydney Metro Acoustic Conditions B7, B8 and B9

INTRODUCTION

Wilkinson Murray Pty Limited conducted an acoustic assessment (*DA Acoustic Report Revision E*; dated April 2020 and addendum dated 23 July 2020) to support the Environmental Impact Statement (EIS) of the State Significate Development (SSD) 10393 for a new Sports and Science Building at Monte Sant' Angelo Mercy College, North Sydney (Monte).

The SSD was granted consent in October 2020 subject to recommended conditions.

The development consent included acoustic conditions B7, B8 and B9 regarding additional noise and vibration impacts that are required to be conducted prior to the construction certificate. This report is an addendum to the previous reports addressing the items in conditions B7, B8 and B9.

The conditions B7, B8 and B9 are reproduced below:

#		Condition	Where in the report the condition is responded to.
B7		Prior to the issue of the construction certificate, the *DA Acoustic Report Revision E*; dated April 2020 and addendum dated 23 July 2020 prepared by Wilkinson Murray must be amended to include:	
	a)	an assessment against the relevant provisions of State Environmental Planning Policy (Infrastructure) 2007, as the property adjoins a future rail corridor;	See "Noise Criteria" Section.
	b)	an assessment of the impact levels of the proposal on Sydney Metro infrastructure addressing the requirements of the Sydney Metro Underground Corridor Protection Guidelines (available on www.sydneymetro.info);	See "Noise Criteria" Section.
	c)	the details of compliance with of the building in accordance with *Development Near Rail Corridors and Busy Roads - Interim Guidelines (Department of Planning 2008)* and the Sydney Metro At Grade Elevated Sections Corridor Protection Guidelines (available at www.sydneymetro.info);	See "Calculations of Groundborne Rail Noise within the School" Section.

#		Condition	Where in the report the condition is responded to.
	d)	demonstration that the development can be designed and constructed to avoid any damage or other interference due to air-borne noise, ground-born noise and vibration effects due to the rail corridor, during the rail construction and future operation;	See "Calculations of Groundborne Rail Noise within the School" Section.
	e)	any impacts of vibrations due to the adjoining rail corridor in accordance with Development Near Rail Corridors and Busy Roads - Interim Guidelines (Department of Planning 2008);	See "Calculations of Groundborne Rail Noise within the School" Section. Predicted vibration levels comply with criteria recommended in the Sydney Metro – Technical Services Sydney Metro Underground Corridor Protection Technical Guidelines and Development Near Rail Corridors and Busy Roads - Interim Guidelines (Department of Planning 2008).
	f)	acoustic treatments that would ensure that the recommended internal noise levels within the learning areas of the proposed building are achieved; and	Ground borne noise and vibration from the Metro complies with with criteria recommended in Development Near Rail Corridors and Busy Roads - Interim Guidelines (Department of Planning 2008). No additional acoustic treatment is quired.
	g)	any additional treatment to ensure that the noise and vibration impacts due to the rail corridor are appropriately mitigated.	
B8		The construction certificate plans must demonstrate that the recommended measures in *DA Acoustic Report Revision E*; dated April 2020 and addendum dated 23 July 2020 prepared by Wilkinson Murray, as revised by condition B7, have been incorporated in the design of the building to prevent noise and vibration intrusion into the development due to the adjoining rail corridor.	No additional acoustic treatment is required therefore DA drawings remain the relevant documents.
B9		A suitably qualified Acoustic Consultant must certify that the construction certificate plans comply with condition B7. A copy of this certification must be submitted to the Certifier for their information.	See "About the Author" Section

BACKGROUND

Sydney Metro is currently being constructed between Chatswood to Sydenham. New stations will be delivered at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo along with new underground platforms at Central Station.

Monte is located in the North Sydney Council local government area (LGA). It is directly to the north of the North Sydney CBD, which is the major commercial centre of North Sydney.

Monte is located approximately 3.5km north of the Sydney CBD, 500 metres north of North Sydney Railway Station. Victoria Cross Metro Station is currently under construction diagonally opposite the school at the south-eastern corner of Miller Street and Berry Street, as well as an entrance to the north-east on the corner of McLaren Street. Miller Street runs along the eastern boundary of the Site.

The proposed works for the project comprise the following:

- Demolition of two existing sports courts and associated undercroft staff carpark. The demolition works will include demolition of all structures between the main 'circular-drive' driveway entry from Miller Street, and the McQuoin Hall/Aquatic Centre at the corner of Miller and Berry Streets.
- Construction of a new four-storey sports and science building with a basement staff carpark, partially underground dual sports court facility, three levels of new teaching spaces (innovation / science labs) and a rooftop sports court.
- Landscaping works surrounding the new sports and science building.

A plan of the new Sports and Science Building at Monte with respect to the rail alignment is shown in Figure 1. Victoria Cross Station is adjacent to the site. Figures 2 and 3 show cross sections of the tunnel and the proposed building. It can be seen from Figure 2 and Figure 3, that the proposed building intrudes into the 2nd Reserve of the Metro tunnel reserve but not the 1st Reserve.

It should be noted that the distance from the track to the closest point of the school is approximately 34 metres and the distance from the tunnel to the closest point of the school construction is approximately 21 metres.

NOISE CRITERIA

In the case of existing rail corridors, the Infrastructure SEPP refers to the Development near rail corridors and busy roads – interim guideline which must be taken into account where development is proposed in, or adjacent to, specific railway corridors.

The guideline relates to SEPP rail clauses 85, 86 and 87.

Clause 87 of the Infrastructure SEPP applies to dwelling house, church, hospital, school or childcare centre on land that is in or immediately adjacent to a rail corridor that the consent authority considers is likely to be adversely affected by rail noise and vibration.

Development Near Rail Corridors and Busy Roads – Interim Guideline (DoP, 2008) supports specific rail and road provisions of the State Environmental Planning Policy (Infrastructure). The guideline recommends where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present. In such cases, schools should be designed so that the 95th percentile of train pass-bys complies with a ground-borne L_{Amax} noise limit of 40dBA (daytime) measured using the "slow" response time setting on a sound level meter.

Additionally, the guideline recommends that vibration levels such as those from the intermittent vibration emitted by trains should comply with the criteria in Assessing Vibration: a technical guideline (DECC 2006).

For schools, the recommended level is 0.4 as an acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$).

Figure 1 Site Location

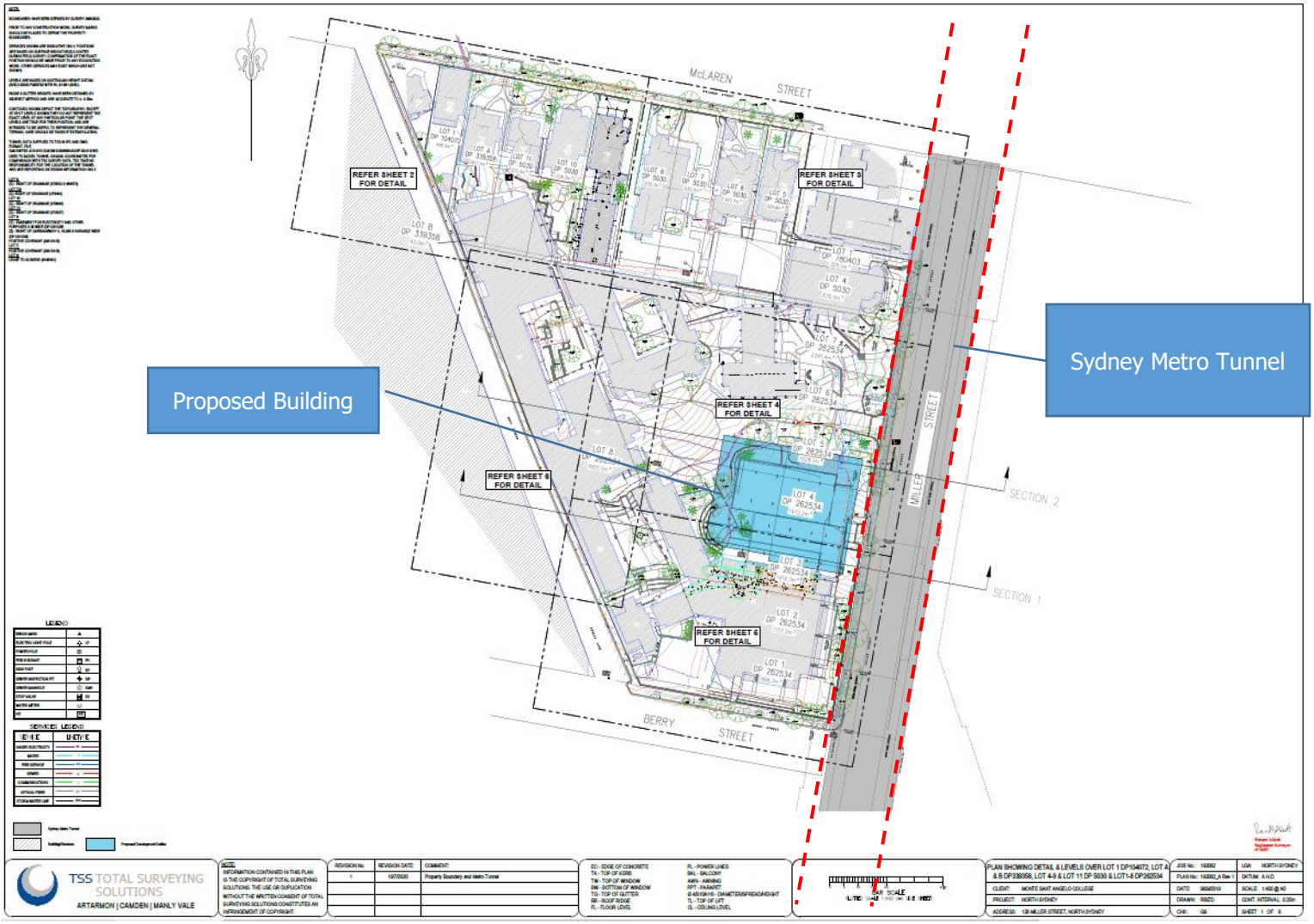


Figure 2 Cross Section 1 – Northern

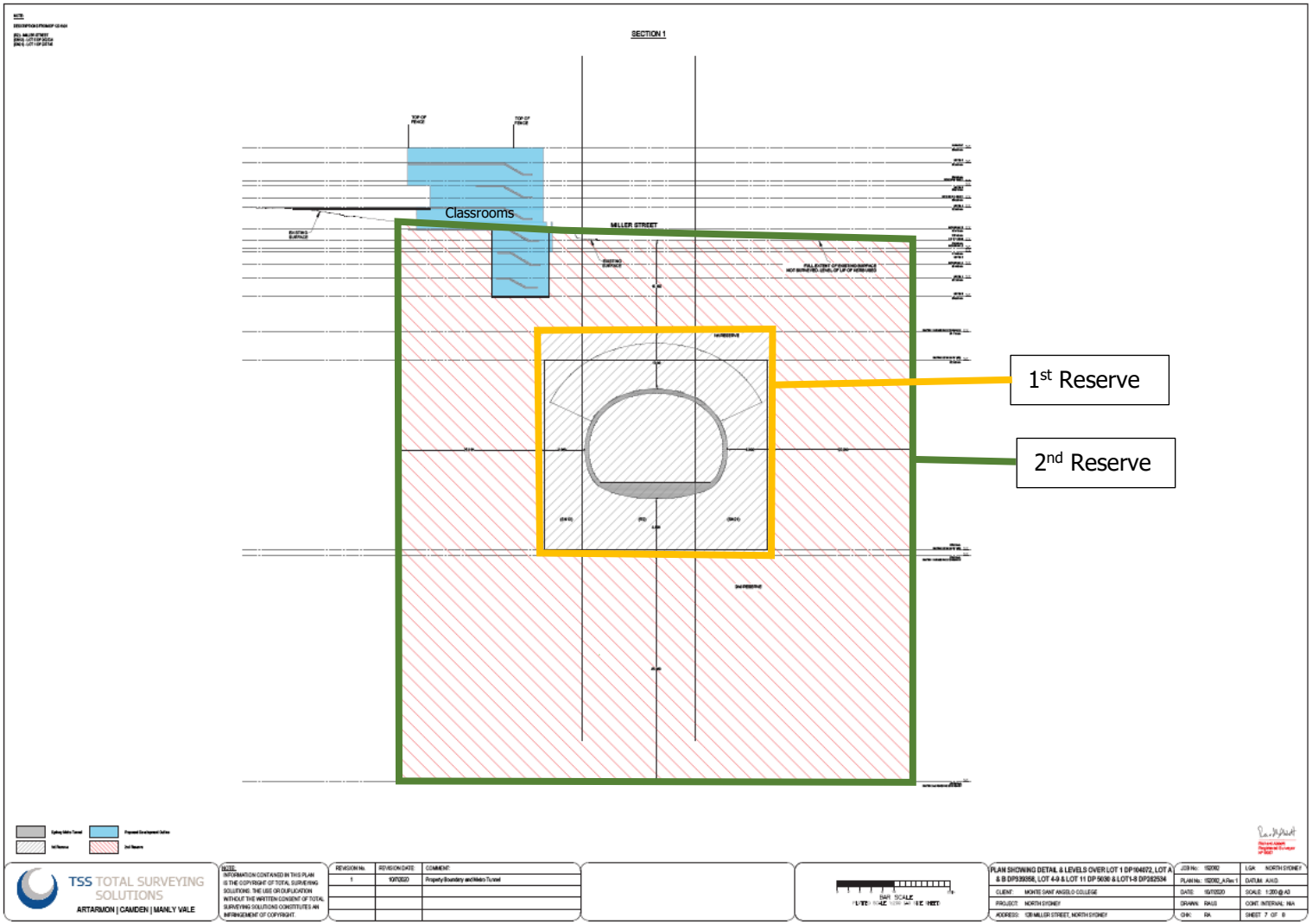
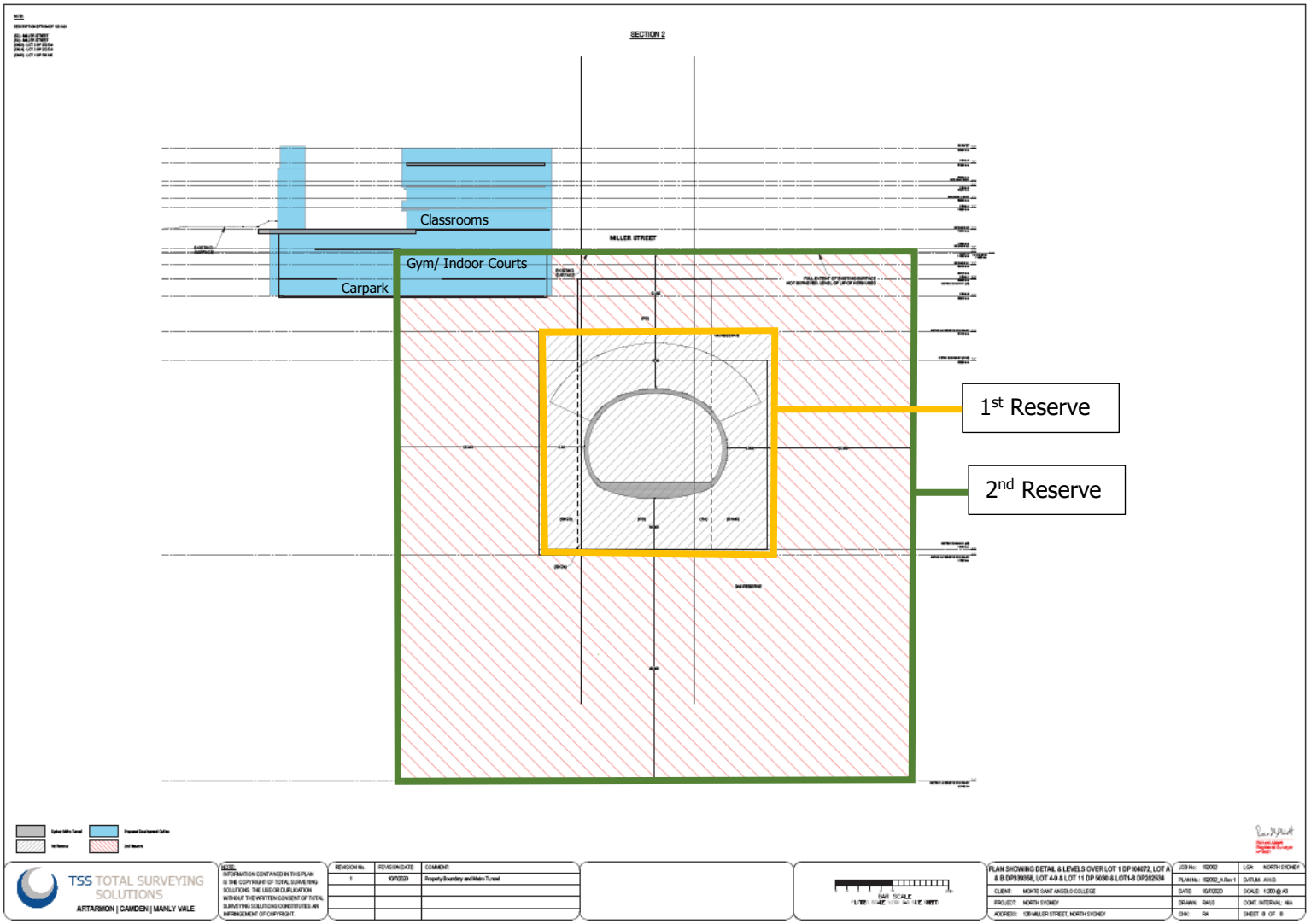


Figure 3 Cross Section 2 - Southern



The effects of noise and vibration on existing Metro infrastructure must be considered as part of the design and construction of developments. The construction of the development must be carried out such that the effects of noise and vibration on nearby metro structures and facilities are minimised. Sydney Metro – Technical Services Sydney Metro Underground Corridor Protection Technical Guidelines (Document No: NWRLSRT-PBA-SRT-TU-REP-000008) provide performance criteria for maximum peak particle velocity (PPV), namely:

- 15 mm/s for tunnel and cavern cast insitu concrete linings that are in good condition.
- 20 mm/s at the running tunnels supported using a precast concrete segment lining.

Sydney Metro recommend that if the vibration levels exceed tolerable limits, then the developer must modify the construction methodology in such a way that the vibration limits are satisfied.

CALCULATIONS OF GROUNDBORNE RAIL NOISE WITHIN THE SCHOOL

A computer model of the alignment, predicting the vibration and regenerated noise levels for the proposed school building near the rail alignment.

Modelling inputs included:

- Floating slab track (FST) will be installed in the station near the school;
- 34m slant distance from the track to the building;
- Train length 60m at 5 minute headway;
- The train speed will not exceed 30km/h in the station in the vicinity of the school;
- Train force density levels (FDL) taken from typical metro train SP1900;
- The tunnel coupling loss is taken as zero in rock;
- The building coupling loss is taken as zero in rock;
- Local ground properties.

With the modelling inputs listed above, it is expected that the regenerated rail noise in the ground floor classrooms would be less than 15dBA, significantly below the 40dBA criterion and is likely not going to be audible.

The vibration levels were calculated to be 0.02 vibration dose values ($m/s^{1.75}$) in the ground floor classrooms, significantly below the 0.4 VDV criterion and is likely not to be perceptible.

Noise from train passbys from the Metro rail line are well below the criteria from the Development Near Rail Corridors and Busy Roads – Interim Guideline (DoP, 2008) for both groundborne noise and vibration. As such, no additional noise mitigation is required to be incorporated in the school design.

CONSTRUCTION VIBRATION ASSESSMENT

The highest potential vibration levels from construction on the Metro tunnel will occur when construction equipment is located on the eastern side of the site near the eastern boundary on Miller Street.

Operation of rock hydraulic hammers, rock saws, rippers, etc generate ground vibration that has the potential to be transmitted to the nearby Metro tunnel. Table 1 sets out the typical ground vibration levels at various distances for different equipment.

Table 1 Typical Ground Vibration Generated by Construction Plant

Plant	PPV Vibration Level (mms^{-1}) at Distance (1)					
	5m	10m	20m	30m	40m	50m
Heavy Hydraulic Hammer (1500kg hammer on 30t exc)	4.5	2.5	0.5	0.2	0.12	<0.1
Light Hydraulic Hammer (300kg on 5t exc)	1.5	0.3	0.1	<0.1	-	-
Air trac drill (Ingersoll/Rand CM350)	4.4	1.4	-	0.6	-	<0.1
Jack Hammer	0.2	0.1	<0.1	-	-	-
Rock Sawing	1.2	0.5	0.3	<0.1	-	-
Ripping (measured in Sydney sandstone)	0.7	0.15	<0.1	-	-	-

A review of the site plan and the Sydney Metro tunnel indicates that the minimum distance between the vibration generating activities and the tunnel will be in the order of 21 metres.

It is likely that rock hammers will be used in the excavation of the site, including the use of rock saws and ripping. Reviewing the data in Table 1 indicates that the Sydney Metro criterion of 15mm/s will not be exceeded at the tunnel from all plant including the largest hydraulic hammers.

If required by Metro, the contractor may need to install vibration monitors and conduct trial testing of equipment such as rock hammers. The detail of these investigations should form part of the project Noise and Vibration Management Plan.

CONCLUSION

As required by the SSD10393 consent, Wilkinson Murray Pty Limited has conducted an addendum report to the previous reports addressing the items in conditions B7, B8 and B9.

The report has found that:

- Noise from train passbys from the Metro rail line are well below the criteria from the Development Near Rail Corridors and Busy Roads – Interim Guideline (DoP, 2008) for both groundborne noise and vibration. As such, no additional noise mitigation is required to be incorporated in the school design.
- It is likely that rock hammers will be used in the excavation of the site, including the use of rock saws and ripping. Reviewing the data in Table 1 indicates that the Sydney Metro criterion of 15mm/s will not be exceeded at the tunnel from all plant including the largest hydraulic hammers.

About the author:

Mr John Wassermann is suitably qualified to issue this addendum report as a Director of Wilkinson Murray with over 30 years' experience in the field of acoustics, having extensive experience with many similar projects. He is a member of the Australian Acoustical Society (AAS).

Wilkinson Murray Pty Limited is a member firm of the Association of Australasian Acoustical Consultants (AAAC).

I trust this information is sufficient. Please contact me if you have further questions.

Yours faithfully
WILKINSON MURRAY

John Wassermann
Director

WILKINSON MURRAY

23 July 2020

WM Project Number: 19363
Our Ref: PB 130720 Response.docx
Email: pbrogan@bloompark.com.au

Peter Brogan
Bloompark
Suite 2.04/41 McLaren Street
NORTH SYDNEY NSW 2060

Dear Peter

Re: Monte-SSBP RFP-Response to Submissions - Acoustics

The following response to submissions is provided with respect to noise issues

Item 1 ***Noise/Acoustic privacy*** *- Noise and acoustic privacy from the use of site must demonstrate compliance with Section 3.2.5 NSDCP 2013 together with all other relevant noise criteria. Hours of use should be detailed as part of any approval.*

WM Response

The project specific noise trigger levels in the application are derived from the EPA'S Noise Policy for Industry (2017) and are lower that the levels in the references in council's DCP. That is, the assessment criteria is more stringent and therefore compliance with site specific criteria will also result in compliance with the Council criteria.

Item 2 ***Use of Large Rock Hammers*** *- Clarifications on the followings with regards to Noise Assessment Report by Wilkinson Murray 4.8 Railway Easement – it is stated that "Therefore if large hammers are used in the site within this distance further detailed review and assessment will be required contingent on Sydney Metro's site-specific vibration criteria.", confirmation no large hammer will be used on the site if required.*

WM Response

This is an issue to be addressed by the contractor in their Construction Noise and Vibration Management Plan. It can be addressed by trial vibration monitoring or exclusion of the use of large rock breakers.

The assessment indicated that there is potential for excessive vibration levels due to large rock breakers, however this is a function of the site-specific rock strata . This is different to saying that large rockbreakers can not be used, rather it has been determined that caution and trial testing should be conducted if this type of equipment is to be used in the vicinity of the metro tunnel.

Item 3 ***Cumulative Construction Noise*** *- The construction noise assessment did not consider cumulative noise impact from other heavy truck movements. Wilkinson Murray to respond and assess cumulative construction noise impact; and*

Provide a cumulative assessment of construction impacts, in particular for noise and traffic impacts on the on-going operation of the school and adjacent businesses and residences, as a result of the proposed redevelopment.

WM Response

An assessment of indicative construction stages has been conducted including heavy trucks operating on site. Noise from trucks on the surrounding road network are not required or addressed in the Interim Construction Noise Guideline on which the construction assessment has been based .

In relation to the maximum number of truck movements associated with the development a review of the Scientia Project Preliminary Construction Traffic Management Plan prepared by Cornerstone indicates that the following maximum truck movements to and from site will occur:

Estimated daily volume of heavy vehicle traffic is expected to be in the order listed below;

Phase of Project	Fcast duration	Estimated No. of Truck movements
Demolition / Excavation	20 weeks	Ave. 10 / day
Structure	26 weeks	Ave. 5 / day
Balance of the works	20 weeks	Ave. 3 / day

Further the report notes that "*Generally, the haulage routes will be via arterial roads/ freeway or Tollway*".

A review of potential surrounding projects indicates that the only other project that may occur in the vicinity of the project site is Victoria Cross OSD project. A review of this developments traffic report by TTPP Consultants reveals :

" *During the busiest period of the construction works there would be approximately 30 truck movements per day. On average, this equates to three truck movements per hour across a 10-hour workday which would have a minor impact on the adjacent road network*."

The figure attached at the end of this letter shows the proposed construction routes for these two projects.

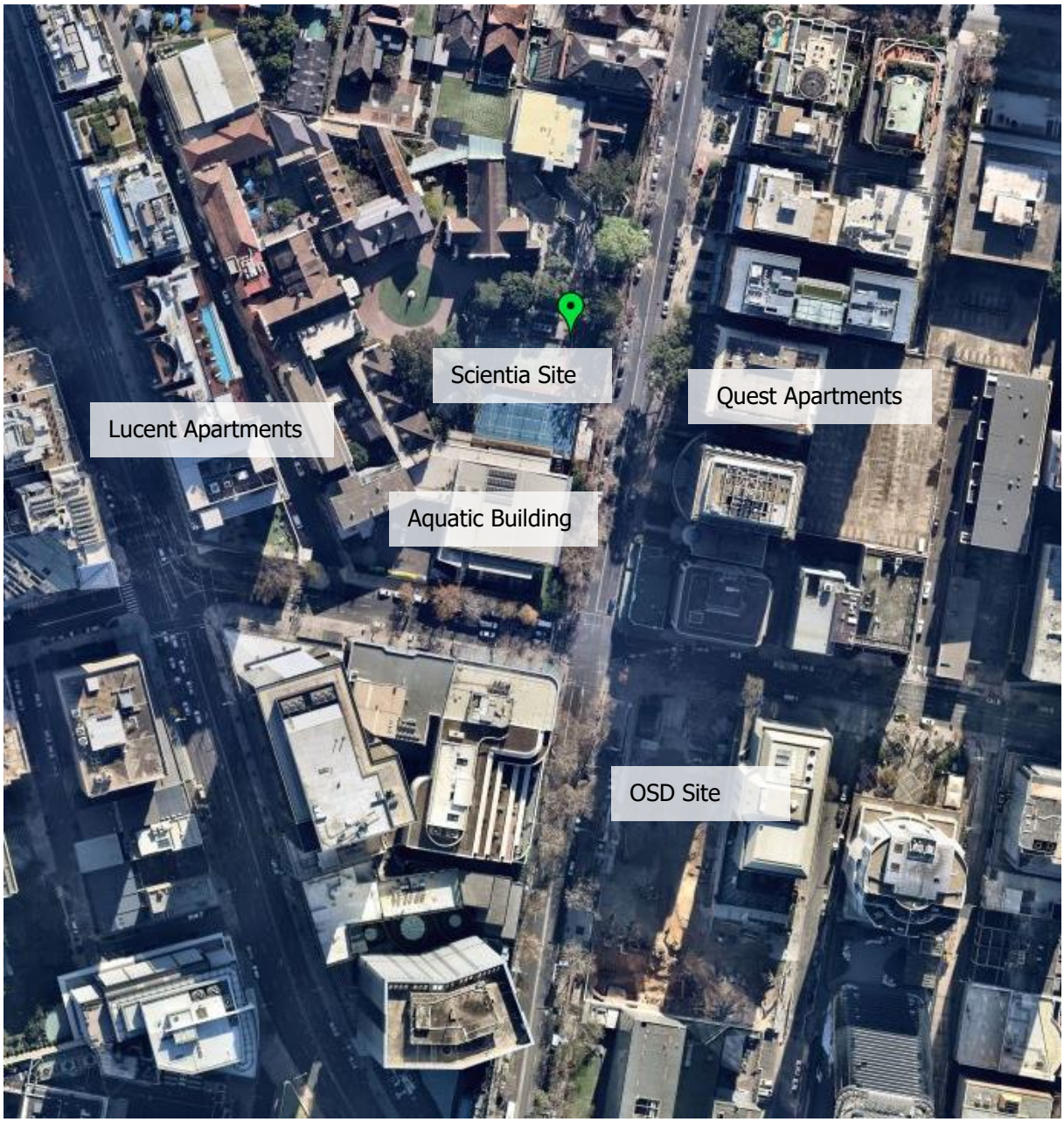
Therefore the combined hourly truck movement of the two developments should they occur simultaneously on any of the common routes would potentially be up to 2-3 truck movements an hour on the Pacific Highway or Miller Street.

Such low hourly additional traffic volumes on busy roads such as Miller Street and Pacific Highway will result in a negligible noise contribution on overall traffic noise levels generated by traffic at the identified residences on Miller Street and the Pacific Highway. Therefore there is no risk of adverse cumulative construction traffic noise impact at the surrounding residences.

In the case of cumulative construction noise it is noted that the OSD site is 90 metres to the south from the Scientia site and currently nearing the end of the excavation stage of the project . This is the stage that will generate the highest construction levels and therefore will not occur concurrently with the Scientia Project works.

In addition the intervening Aquatic Centre will shield the rest of the school from any OSD construction noise. Figure 1 shows this site.

Figure 1 Scientia and OSD Sites



Taking these factors into account construction noise from the OSD site at the school will be more than 10 dBA lower than predicted construction noise levels associated with the Scientia project. As such there will be no increase in construction noise at the school as a result of surrounding construction activities.

Given the orientation and stages of each of these projects there will be no cumulative construction noise impacts at identified residences surrounding the Scientia site.

Item 4 **Community Use** - *Provide an assessment of the likely extent and frequency of out-of-hours community use, including weekend use of the proposed building and the surrounds. This assessment should include, but not be limited to, consideration and management strategies for noise impacts and traffic impacts associated with the proposed use of the school facilities by the community in the evenings or the weekends. Provide an assessment of the likely use of the building by the school community during out-of-school hours or the weekends. The assessment must include Monte to consider and respond. Wilkinson Murray and Traffix to assess noise and traffic impact from community use, and recommend management strategies – prepare response, details of the likely number of users, frequency of use, noise and traffic impacts with associated management strategies.*

WM Response

The school currently makes school facilities available to the community for events and activities such as sports, weddings and pool use. In the case of the Scientia buildings the following "Community uses" are envisaged.

- Use of the underground carpark for existing community uses.
- Use of the Level -2 courts for team sport.
- Occasional functions such a lunches.

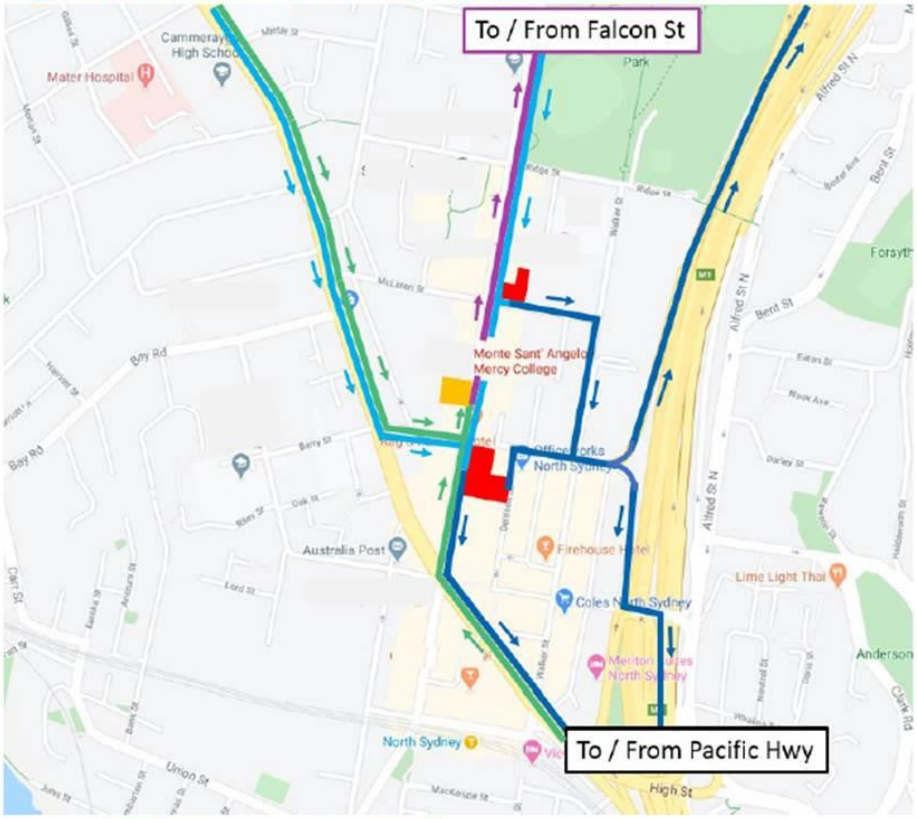
These have been addressed in section 5.7 of the noise assessment and determined to be acceptable from an acoustic perspective

It trust this is of assistance. Please contact us if you have any further queries.

Yours faithfully
WILKINSON MURRAY

Brian Clarke

Fig A4.3.3 : Scientia and Victoria Cross North & South Sites – Haulage Routes



Key

- Monte Sant Angelo Site
- Primary Route Scientia Inbound Construction Traffic
- Primary Route Scientia Outbound Construction Traffic
- Victoria Cross North & South Sites
- Primary VC North & South Inbound Construction Traffic
- Primary VC North & South Outbound Construction Traffic

ACOUSTICS AND AIR

SCIENTIA PROJECT
MONTE SANT ANGELO MERCY COLLEGE
PROJECT APPLICATION

CONSTRUCTION & OPERATIONAL NOISE REPORT

REPORT NO. 19363
VERSION E

APRIL 2020

PREPARED FOR

MONTE SANT ANGELO MERCY COLLEGE
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WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	24 January 2020	Brian Clarke	Ben Lawrence
A	Final	24 February 2020	Brian Clarke	John Wassermann
B	Final	26 February 2020	Brian Clarke	John Wassermann
C	Final	3 March 2020	Brian Clarke	John Wassermann
D	Final	24 March 2020	Brian Clarke	John Wassermann
E	Final	6 April 2020	Brian Clarke	John Wassermann

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AAAC
This firm is a member firm of the Association of Australasian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Celebrating 50 Years in 2012
Wilkinson Murray is an independent firm established in 1962, originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. Today, with offices in Sydney, Newcastle, Wollongong, Orange, Queensland and Hong Kong, Wilkinson Murray services the entire Asia-Pacific region.

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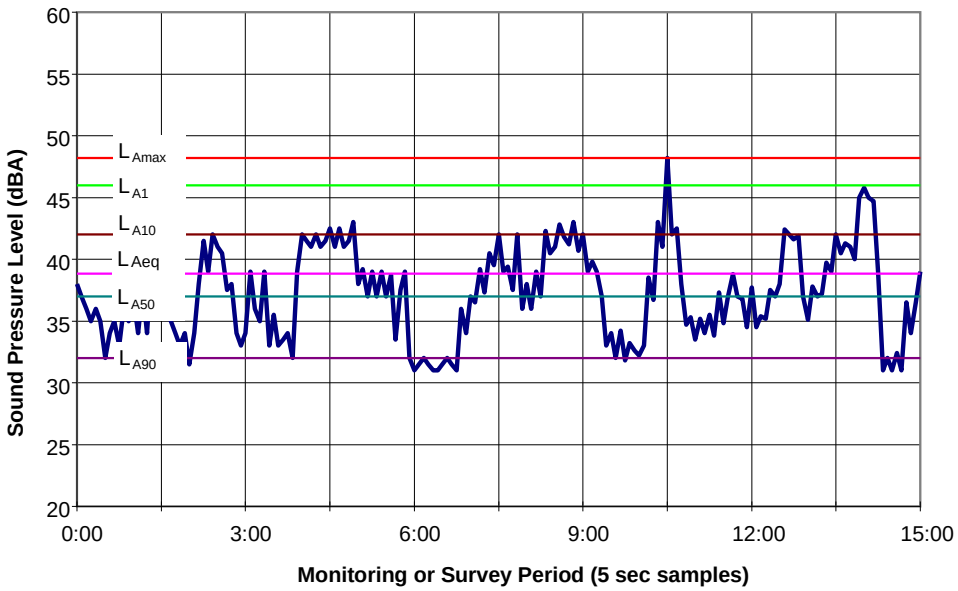
GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax})	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
L_{A1}	The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.
L_{A10}	The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.
L_{A90}	The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.
L_{Aeq}	The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
ABL	The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening, and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



GLOSSARY OF REPORT TERMS

Term	**Definition**
The Site	128 Miller Street: Lots 3, 4, 5 in DP 262534
The Project	Demolition and the construction of a new Sports and Science Building and associated landscape works.

ABBREVIATIONS

Abbreviation	**Meaning**
ACHA	Aboriginal Cultural Heritage Assessment
AHIMS	Aboriginal Heritage Information Management System
AS	Australian Standard
ASS	Acid Sulfate Soils
BC Act	*Biodiversity Conservation Act 2016*
BCA	Building Code of Australia
BDAR	Biodiversity Assessment Report
CMP	Construction Management Plan
Council	North Sydney Council
CPTED	Crime Prevention Through Environmental Design
CPTMP	Construction Parking and Traffic Management Plan
District Plan	*North District Plan*
DOPIE/Department	NSW Department of Planning, Industry and Environment
DP	Deposited Plan
DSI	Detailed Site Investigation
EIS	Environmental Impact Statement
EPA	*NSW Environment Protection Authority*

Abbreviation	Meaning
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Ecologically Sustainable Development
Education SEPP	*State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017*
GANSW	NSW Government Architect's Office
HIS	Heritage Impact Statement
HMS	Hazardous Materials Survey
IMP	Infrastructure Management Plan
Infrastructure Strategy	*State Infrastructure Strategy 2018-2038*
LGA	Local Government Area
m	metre
Monte	Monte Sant Angelo Mercy College
NIA	Noise Impact Assessment
North Sydney LEP 2013	North Sydney Local Environmental Plan 2013
OEH	Office of Environment and Heritage
OWMP	Operational Waste Management Plan
PSI	Preliminary Site Investigation
Region Plan	*A Metropolis of Three Cities – Greater Sydney Region Plan*
RAP	Remediation Action Plan
RAPs	Registered Aboriginal Parties
RMS	Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 55	*State Environmental Planning Policy No.55 – Remediation of Land*
sqm	Square Metres
SSD	State Significant Development

Abbreviation	Meaning
SEPP SRD	*State Environmental Planning Policy (State and Regional Development) 2011*
SSDA	State Significant Development Application
TfNSW	Transport for New South Wales
The Minister	The Minister for Planning, Industry and Environment
The Regulation	*Environmental Planning and Assessment Regulation 2000*
The Site	The new Sports and Science Building site
TPZ	Tree Protection Zone
Transport Strategy	*Future Transport Strategy 2056*
Urbis	Urbis Pty Ltd
WSUD	Water Sensitive Urban Design

1 INTRODUCTION

Wilkinson Murray Pty Limited has been commissioned by Monte Sant Angelo Mercy College (the **Applicant**) to prepare this noise impact assessment in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (**SEARs**), and in support of the SSD-10393 for the development of a new Sports and Science Building at Monte Sant Angelo Mercy College, North Sydney (**Monte**).

This assessment responds to the issues raised in item 12 of the SEARs and the following table details the areas in this Assessment that address the items identified.

SEARs	Report Reference	
12. Noise and Vibration	**Item**	**Section**
Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.	Construction Noise	Section 4.5
Identify and assess operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.	Construction Vibration	Section 4.7
Relevant Policies and Guidelines: • *NSW Noise Policy for Industry 2017 (NSW Environment Protection Authority (EPA)* • *Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009)* • *Assessing Vibration: A Technical Guideline 2006 (Department of Environment and Conservation, 2006)* • *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning, 2008)*	Operational Noise	Section 5.1
	Mechanical Services	Section 5.3
	Sport Gymnasium	Section 5.4
	Public Address System and School Bell	Section 5.6

2 DESCRIPTION OF SITE

The Monte campus is approximately 2.52 hectares comprises 18 allotments, which are described in Table 2-1 below and shown in Figure 2-1. It is noted that the new Sports and Science Building and the proposed works are located on Lots 3, 4 and 5 in DP 262534 (the **Site**) (refer to Figure 2-2).

Table 2-1 Monte Campus Allotments

Address	Legal Description
128 Miller Street	Lot 8 in DP 262534
	Lots 1, 2, 3, 4, 5, 6 and 7 in DP 262534
	Lot 4 in DP 5030
	Lot 1 in DP 780403
5 McLaren Street	Lot 1 in DP 104072
9 McLaren Street	Lot A in DP 339358
11 McLaren Street	Lot 11 in DP 5030
21-23 McLaren Street	Lot 10 in DP 5030
27 and 27A McLaren Street*	Lots 7 and 8 in DP 5030
29 McLaren Street*	Lot 6 in DP 5030
31 McLaren Street	Lot 5 in DP 5030

*Sisters of Mercy land is not used by the College.

Figure 2-1 Monte Sant Angelo Mercy College landholdings

Source: Six Maps

Figure 2-2 The Site: Location of proposed Sports and Science Building (coloured)

Source: Hayball Architect

The key school elements within and surrounding the Site include:

- The main vehicle entry to the School, the 'Circular-Drive' driveway is located to the north of the Site.
- The 'Holy Grass' lawn is located to the north-west of the Site and is surrounded by several original School buildings including the Chapel, Masalou Building, and Mercy Hall.
- Two existing sports courts centrally located within the Site.
- The McQuoin Hall / Aquatic Centre is located to the south of the Site.
- To the west of the Site is the Treanor Building, which comprises arts and textile teaching rooms.
- To the north of the 'Holy Grass' is the School Chapel and the O'Regan Arts and Cultural Common Building completed in 2014.

2.1 Monte and the Surrounding Context

Monte is located in the North Sydney Council local government area (LGA). It is directly to the north of the North Sydney CBD, which is the major commercial centre of North Sydney.

Monte is located approximately 3.5km north of the Sydney CBD, 500 metres north of North Sydney Railway Station. Victoria Cross Metro Station is currently under construction diagonally opposite the school at the south-eastern corner of Miller Street and Berry Street, as well as an entrance to the north-east on the corner of McLaren Street. Miller Street runs along the eastern boundary of the Site which provides a major bus corridor to the North Shore and Northern Beaches.

The key land use characteristics surrounding the School campus are:

- **South:** North Sydney CBD commercial core, primarily characterised by high-rise commercial buildings and support services including hotels, retail uses, and Shore Grammar School.
- **North:** mixed precinct including:
    - Low-density residential area within a heritage conservation area
    - Community buildings including the North Sydney Council Chambers
    - Schools including St Mary's Primary, Wenona School, Marist College and North Sydney Boys High School
    - St Leonards Park
- **East:** The extension of the North Sydney CBD Commercial Core, generally characterised by high density residential and commercial buildings.
- **West:** Medium density residential and high-rise commercial buildings along the Pacific Highway. Further west is a low-density residential area which is identified as a heritage conservation area, and the Australian Catholic University.

Immediately surrounding the Monte campus is best described as:

- **South** (Berry Street): Commercial buildings and the Victoria Cross Metro Station currently under construction.
- **North** (McLaren Street): McLaren Street is a heritage conservation area under the North Sydney LEP. Monte own most of the buildings on the southern side of McLaren Street which are generally single, and two storey buildings originally built for residential purposes. The site at the south-western corner of Miller Street and McLaren Street is an Italian restaurant and a four-storey commercial building with basement parking. The northern side of McLaren Street is primarily used for community facilities including a preschool, Council Chambers, community hall, and public plaza/park used for a weekend fresh produce market.
- **East** (Miller Street): Mix of commercial, residential and hotel towers, as well as the Rag and Famish Hotel at the corner of Miller and Berry Streets. A northern pedestrian portal to the Victoria Cross Metro Station is proposed on the north-eastern corner of Miller Street and McLaren Street intersection.

- **West** (Angelo Lane): mix of commercial and high-density residential buildings up to 16-storeys with basement parking.

2.2 Project Description

The proposed works comprise the following:

- Demolition of two existing sports courts and associated undercroft staff carpark. The demolition works will include demolition of all structures between the main 'circular-drive' driveway entry from Miller Street, and the McQuoin Hall/Aquatic Centre at the corner of Miller and Berry Streets.
- Construction of a new four-storey sports and science building with a basement staff carpark, partially underground dual sports court facility, three levels of new teaching spaces (innovation / science labs) and a rooftop sports court.
- Landscaping works surrounding the new sports and science building.

3 AMBINET NOISE MONITORING

3.1 Ambient Noise Levels at the Site

Residential receivers surrounding the site that may be affected by construction and operational noise have been identified and other nearby land holdings are occupied for commercial use. These are detailed in Table 3-1 and shown in Figure 3-1.

Figure 3-1 Aerial showing noise monitoring locations

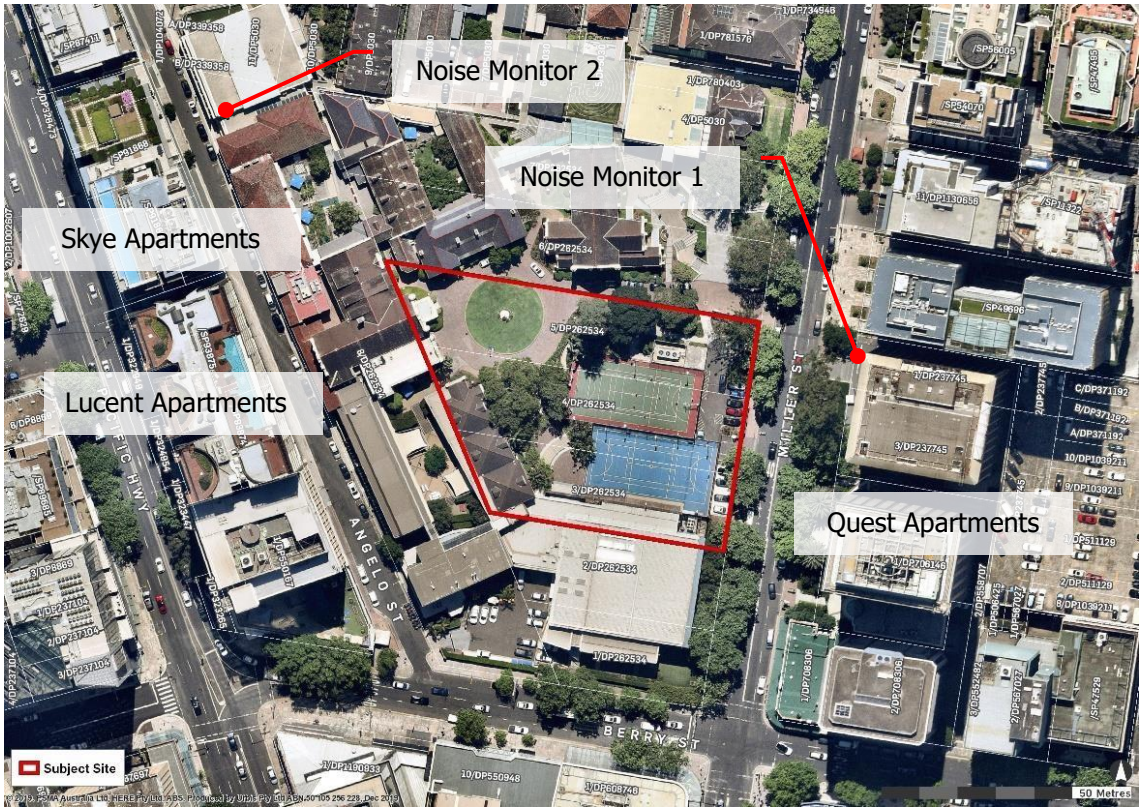


Table 3-1 Surrounding receivers

Receivers	Address
A – Quest Apartments North Sydney	223 Miller Street, North Sydney
B – Skye & Lucent Apartment Buildings	Pacific Highway, North Sydney

In order to quantify the existing noise environment, long-term ambient noise levels were monitored at two (2) locations surrounding the site, selected to cover the range of environments in the potentially affected areas.

Long-term noise monitoring locations are presented in Table 3-2 and shown in Figure 3-1.

Table 3-2 Long-term noise monitoring locations

Logger	Location	Monitoring Period
1	Quest Apartments	8 – 18 November 2019
2	School Roof Angelo Lane	23 – 27 November 2019

The noise monitoring equipment used for the Wilkinson Murray noise measurements consisted of ARL Type EL-215 environmental noise loggers set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level during the relevant period.

Detailed results for each monitoring location are shown in graphical form in Appendix A. The graphs show measured values of L_{Aeq}, L_{A90}, L_{A10} and L_{A1} for each 15-minute monitoring period.

Table 3-3 summarises the noise results, for daytime, evening and night time periods as defined in the EPA's *Interim Construction Noise Guidelines (ICNG)* and the NSW *Noise Policy for Industry (NPfI)*.

Table 3-3 Summary of measured ambient noise levels

Noise Logging Site	RBL (dBA)				$L_{Aeq,period}$ (dBA)			
	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 8am-1pm	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 8am-1pm
1	54	48	42	50	65	59	54	57
2	53	52	50	51	57	55	54	55

Background noise levels at all locations were free of the influence of extraneous noise sources, such as plant or construction activities. Noise data measured during inclement weather was excluded in accordance with EPA procedures.

Results of noise monitoring are presented in Appendix A.

4 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

4.1 Construction Noise Criteria

The following sections detail the applicable site-specific noise and vibration criteria based on the EPA *Interim Construction Noise Guideline*.

4.1.1 Construction Noise Management Levels

The EPA released the *Interim Construction Noise Guideline (ICNG)* in July 2009. The guideline provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the $L_{Aeq,15min}$ noise management level should not exceed the background noise by more than 10dBA. This is for standard hours: Monday to Friday 7.00am-6.00pm, and Saturday 8.00am-1.00pm. Outside the standard hours, where construction is justified, the noise management level would be background + 5dBA. Table 4-1 details the *ICNG* noise management levels (NMLs).

Table 4-1 Construction noise management levels at residences using quantitative assessment

Time of day	Management level $L_{Aeq,(15min)}$	How to apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. 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 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.

Time of day	Management level $L_{Aeq,(15min)}$	How to apply
Outside recommended standard hours	Noise affected RBL + 5dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(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*.

In addition, the following NMLs ($L_{Aeq,15min}$) are recommended for other receivers and areas:

- Active recreation areas (such as parks): external $L_{Aeq,15min}$ 65dBA
- Industrial premises: external $L_{Aeq,15min}$ 75dBA
- Offices, retail outlets: external $L_{Aeq,15min}$ 70dBA
- Classrooms at schools and other educational institutions: internal $L_{Aeq,15min}$ 45dBA

Based on the above, Table 4-2 presents the applicable NMLs for construction activities at surrounding receivers that have been adopted for all applications.

Table 4-2 Site-specific construction noise management levels

Area	NML (L_{Aeq} – dBA)				Highly noise affected noise level, L_{Aeq} dBA
	Day	Evening	Night	Saturday	
A – Quest Apartments North Sydney	64	53	47	60	75
B – Skye & Lucent Apartment Buildings	63	57	55	61	75

4.2 Hours of Operation & Programme

The proposed working hours for this project are standard EPA hours as follows:

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm
- Sunday and Public Holidays No work

It is noted that the proposed hours are EPA's standard hours of construction. If required, after hours permits will be sought from the relevant authorities.

4.3 Vibration Criteria

Criteria for assessment of the effects of vibration on human comfort are set out in British Standard 6472-1992. Methods and criteria in that Standard are used to set "preferred" and "maximum" vibration levels in the document *Assessing Vibration: A Technical Guideline* (2006) produced by the NSW DECCW.

Acceptable values of human exposure to continuous vibration, such as that associated with drilling, are dependent on the time of day and the activity taking place in the occupied space (e.g. workshop, office, residence, or a vibration-critical area). Guidance on preferred values for continuous vibration is set out in Table 4-3.

Table 4-3 Criteria for exposure to continuous vibration

Place	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. hospital operating theatres precision laboratories)	Day or Night time	0.14	0.28
Residences	Daytime	0.28	0.56
	Night time	0.20	0.40
Offices	Day or Night time	0.56	1.1
Workshops	Day or Night time	1.1	2.2

In the case of intermittent vibration, which is caused by plant such as rock breakers, the criteria are expressed as a Vibration Dose Value (VDV) and are presented in Table 4-4.

Table 4-4 Acceptable Vibration Dose Values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime		Night Time	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Calculation of VDV requires knowledge of the number of events, and their duration in the relevant time period.

4.3.1 Building Damage

In terms of the most recent relevant vibration damage objectives, Australian Standard AS 2187: Part 2-2006 *"Explosives – Storage and Use – Part 2: Use of Explosives"* recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2"*, as they "are applicable to Australian conditions".

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

The recommended limits (guide values) from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4-5.

Table 4-5 Transient vibration guide values – minimal risk of cosmetic damage

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

The Standard states that the guide values in Table 4-5 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Note that rock breaking / hammering, and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may therefore be appropriate to reduce the transient values by 50%.

The British Standard goes on to state that "*Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity*". In addition, a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

In addition to the British Standard, for the case of nearby heritage buildings, guidance for structural damage is derived from the German Standard DIN 4150 -3 *Structural Vibration Part 3 – Effects of Vibration on Structures*. Table 4-6 details these recommendations for heritage buildings.

Figure 4-1 Graph of transient vibration guide values for cosmetic damage

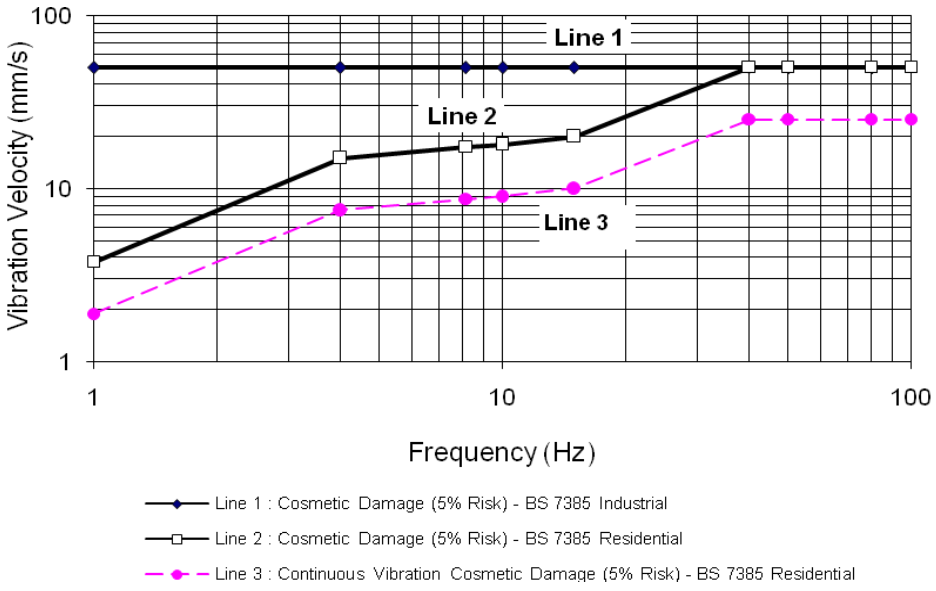


Table 4-6 DIN 4150 recommended Peak Particle Velocity (PPV) vibration levels for heritage buildings

Guideline values for PPV – mm/s		
1-10 Hz	10 to 15 Hz	40 to 50 Hz
3	3 to 8	8-10

4.4 Construction Equipment & Noise Source Levels

Sound Power Levels (SWLs) for typical construction plant are identified in Table 4-7. These SWLs have been measured at other similar construction sites. The table gives both Sound Power Level and Sound Pressure Levels (SPL) at 7m for the equipment. Sound Power Level is independent of measurement position.

Table 4-7 Typical construction plant sound levels – dBA

Plant	Sound Power Level	Sound Pressure Level at 7m
Concrete Truck	109	84
Angle Grinder	109	84
Concrete Pump – 120mm diameter / 50 bar	112	87
Concrete Saw	116	91
Mobile Crane	98	73
Dump Truck	108	83
Compressor	100	75
Bobcat	103	78

Plant	Sound Power Level	Sound Pressure Level at 7m
Hand Tools	90	65
Excavator	108	83
Crawler Cranes	98	73
Tower Crane	104	79
Front End Loader	112	87
Excavator	107	82
Hammer Hydraulic	122	97
Bored Pile Rig	112	87

4.5 Construction Noise Predictions

Assessment of likely construction noise at surrounding receivers has been undertaken for the proposed construction works. Assessment has been based on the construction of a new school building on the site.

Site-related noise emissions were modeled with the "CadnaA" noise prediction program, using the ISO 9613 noise prediction algorithms. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location
- Screening effects from buildings
- Receiver locations
- Ground topography
- Noise attenuation due to geometric spreading
- Ground absorption
- Atmospheric absorption.

Modelling has been conducted for a number of construction scenarios. The four works scenarios considered are summarised in Table 4-8.

Table 4-8 Construction scenarios for construction works

Scenario	Description	Works
A	Demolition	Removal of existing structure using excavators fitted with jaw crushers and hammers. Truck movements – loaded into trucks sent off site.
B	Excavation	Removal of soil and rock using excavators and rock saws. Truck movements – loaded into trucks sent off site.
C	Building Construction	This scenario includes concreting and lifting. 1 concrete pump, 2 forklifts, 1 compressor, 1 crane, a boom truck and tower crane are assumed to operate in 15 minutes. Also, concrete trucks and normal delivery trucks assumed to be two movements in 15 minutes.

Scenario	Description	Works
D	Facade / Fitout	In the event that the construction of the facade occurs in isolation. Forklift, truck, tower crane and power tools assumed. Two truck movements in 15 minutes assumed.

Noise modelling has been conducted for each of the above scenarios, with plant located across the construction site.

The modelling assumes a "typical worst-case" scenario whereby all plant, is running continuously. As such, the modelling represents likely noise levels that would occur during intensive periods of construction. Therefore, the presented noise levels can be considered in the upper range of noise levels that can be expected at surrounding receivers when the various construction scenarios occur.

Once noise sources have been applied to the model, the resultant noise levels at identified surrounding receivers are predicted. These results are then compared with established site-specific noise criteria. Table 4-9 details results of construction noise modelling for each scenario.

Table 4-9 Predicted construction noise levels at residences – $L_{Aeq(15\ min)}$ – dBA

Residential Receiver	Predicted Noise Level (dBA)	NML (Weekday/ Saturday)	Exceedance (Weekday/ Saturday)
Scenario A – Demolition			
A – Quest Apartments North Sydney	72	64 / 60	8 / 12
B – Skye & Lucent Apartment Buildings	67	63 / 61	4 / 6
Scenario B – Excavation			
A – Quest Apartments North Sydney	62	64 / 60	0 / 2
B – Skye & Lucent Apartment Buildings	57	63 / 61	0 /1
Scenario C – Building Construction			
A – Quest Apartments North Sydney	62	64 / 60	0 / 2
B – Skye & Lucent Apartment Buildings	61	63 / 61	0 /0
Scenario D – Façade / Fitout			
A – Quest Apartments North Sydney	61	64 / 60	0 / 1
B – Skye & Lucent Apartment Buildings	54	63 / 61	0 / 0

A review of results of construction noise predictions indicates that these may be, at times, well above construction noise management levels at nearby residences particularly during the demolition stage; however, no predictions exceed the highly noise affected management level of 75dBA.

4.6 Discussion of Results

Exceedances of noise management levels of up to 8 dBA (Weekdays) and 12 dBA (Saturdays) at residences to the east of the site may be expected during demolition period when major equipment is located on site. This magnitude of exceedance is consistent with similar sites where residences overlook development sites.

During the structure and fitout stages, the magnitude of exceedance will reduce due to the nature of construction activities.

Based on these findings, the adoption of reasonable and feasible noise management and mitigation will be required. These measures should be determined in detail when a contractor, with defined construction techniques, has been engaged on the project. However, "in-principle" mitigation measures are detailed in the following sections.

4.7 Construction Vibration Assessment

Operation of rock breakers and the like generate ground vibration that has the potential to transmit to nearby buildings.

Table 4-10 sets out the typical ground vibration levels at various distances for safe working distances.

Table 4-10 Recommended safe working distances for vibration intensive plant

Item	Description	Safe working distance	
		Cosmetic damage	Human response
Small Hydraulic Hammer	(300kg – 5 to 12t Excavator)	2m	7m
Medium Hydraulic Hammer	(900kg – 12 to 18t Excavator)	7m	23m
Large Hydraulic Hammer	(1600kg – 18 to 34t Excavator)	22m	73m
Vibratory Pile Driver	Sheet piles	2m to 20m	20m
Pile Boring	≤ 800mm	2m (nominal)	N/A
Jackhammer	Handheld	1m (nominal)	Avoid contact with structure

- Construction Noise Strategy, 2012, Transportation Construction Authority.

The highest vibration levels will occur when construction equipment is located on the eastern side of the site near residences on the eastern boundary.

A review of the site plant and surrounding receivers indicates that the minimum distance between the vibration generating activities and surrounding buildings will be in the order of 40 metres. Therefore, the use of medium to large rock breakers in the ground should not cause any impact on the structural damage to nearby buildings.

It is noted that the use of rock breakers in the excavation of the site is proposed and will be limited as it is proposed as the use of rock saws, which generate much lower vibration levels and as a result will not adversely impact on surrounding residential receivers.

Structural damage vibration criteria in residential buildings are much higher than human comfort criteria and predicted vibration levels are within these criteria under most circumstances. The exception, should heavy rock breakers be used, is for areas near eastern residences on Miller Street.

Therefore, the uses of alternative excavation measures, such as rock-saws on excavators are recommended. If hammers are required, test vibration monitoring is recommended to ensure that vibration levels at residences are not excessive.

4.8 Railway Easement

The Sydney Metro easement runs along Miller Street, approximately 10 metres from the construction site. Sydney Metro will have vibration criteria that must not be exceeded during construction works. Therefore, the principal contractor will need to assess potential vibration levels at the easement and compare these with established criteria.

A review of the safe working distances for vibration intensive plant as detailed in Table 3-10 indicates that cosmetic damage criteria will not be exceeded for all plant with the exception of Large hydraulic hammers when within 22 metres of the metro. Therefore if large hammers are used in the site within this distance further detailed review and assessment will be required contingent on Sydney Metro's site-specific vibration criteria. The used of rock saws and medium hammers may be warranted during excavation.

If warranted the contractor may need to install vibration monitors and conduct trial testing of equipment such as rock breakers. The detail of these investigations should form part of the project Noise and Vibration Management Plan.

4.9 Construction Noise & Vibration Mitigation Measures

Without mitigation, noise levels from construction activities have been predicted to exceed the noise management levels nominated in the guidelines at some surrounding receivers. Therefore, noise control measures are recommended to ensure that noise is reduced where feasible.

The following project-specific mitigation measures are recommended:

- Installation of a 2.4 metre plywood hoarding around the construction site.
- Selection of quietest feasible construction equipment.
- Use of jaw crushers in preference to rock breakers where feasible; and
- Localised treatment such as barriers, shrouds, and the like around fixed plant such as pumps, generators, and concrete pumps.

In addition, the following measures should be included in a Noise and Vibration Management Plan.

- **Plant Noise Audit**: Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. To this end, testing should be established with the contractor.

- **Operator Instruction:** Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.
- **Equipment Selection:** All fixed plant at the work sites should be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures, and other noise attenuation measures in order to ensure that the total noise emission from each work site complies with EPA guidelines.
- **Real-time Noise Monitoring:** Real-time noise monitoring systems should be considered at the nearest affected receivers. This will provide valuable feedback to the construction team who can react accordingly to reduce exposure to unusually high noise levels.
- **Site Noise Planning:** Where practical, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.

The adoption of the above measures is aimed at working towards achieving the noise management levels established at surrounding receivers.

4.10 Community Liaison & General Approaches to Mitigation

An effective community relations programme should be put in place to keep the community that has been identified as being potentially affected appraised of progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, meetings with surrounding owners/tenants, etc) of any anticipated changes in noise and vibration emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms. This programme should include a *Community and Stakeholder Engagement Strategy* developed specifically for the Project.

Close liaison should be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.

4.11 Noise & Vibration Management Plan

A Construction Noise and Vibration Management Plan for the site is recommended which should be prepared by the successful contractor. The plan should reference the findings of this assessment. Areas that should be addressed in plan include:

- Noise and vibration mitigation measures;
- Noise and vibration monitoring;
- Response to complaints**;**
- Responsibilities;
- Monitoring of noise emissions from plant items;
- Reporting and record keeping;
- Non-compliance and corrective action; and

- Community consultation and complaint handling.

4.12 Management of Construction Noise & Vibration to the School

Noise and vibration levels from construction are likely to be similar to the levels predicted for receivers immediately surrounding the site. The Construction Noise Management Plan would adopt procedures to manage construction noise within the school.

Measures that can be adopted to manage noise and vibration impacts at the school will be managed between the school and the successful contractor and could include:

- Closing of classroom windows and installation of secondary windows were deemed necessary;
- Relocating classes during busy construction periods; and
- Scheduling works during school holidays.

The management of construction noise and vibration between the site and school areas will be managed internally by the school itself.

5 OPERATIONAL NOISE & VIBRATION

Operational noise from the proposed facilities will be from activities within the new buildings and on the rooftop of the proposed buildings, as well as mechanical plant located predominantly on roofs.

5.1 Operational Noise Criteria

The NSW *NPfI* provides a framework and process for deriving noise criteria for consents and licences that enable the EPA and others to regulate premises that are scheduled under the Protection of the Environment Operations Act 1997. Whilst specifically aimed at assessment and control of noise from industrial premises regulated by the EPA, the policy is also appropriate for use by the DP&E when assessing major development proposals.

Having been designed for large industrial and agricultural sources, the monitoring and assessment procedures may not be applicable to the smaller developments and noise sources regulated by local government. It is recognised however, that Councils may find the policy to be of assistance in noise assessment and land-use planning.

The *NPfI* documents a procedure for assessment and management of industrial noise which involves the following steps:

- Determining the project noise trigger levels for a development. The project noise trigger level is a benchmark level above which noise management measures are required to be considered. They are derived by considering short-term intrusiveness due to changes in the existing noise environment (applicable to residential receivers only) and maintaining noise level amenity for particular land uses for residents and other sensitive receivers.
- Predicting or measuring noise produced by the development (having regard to any associated annoying characteristics and prevailing meteorological effects).
- Comparing the predicted or measured noise level with the project noise trigger level and assessing impacts and the need for noise mitigation and management measures.
- Considering any residual noise impacts following the application of feasible and reasonable noise mitigation measures.
- Setting statutory compliance levels that reflect the best achievable and agreed noise limits for development; and
- Monitoring and reporting environmental noise levels from the development.

The project noise trigger level represents the level that, if exceeded, may indicate a potential noise impact upon a community. It is a benchmark or objective and is not intended for use as a mandatory requirement.

Intrusiveness Noise Level

For assessing intrusiveness, the background noise level (L_{A90}) is measured and the Rating Background Level (RBL) determined. The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous noise level (L_{Aeq}) of the source (measured over a 15-minute period) does not exceed the background noise level (RBL) by more than 5dBA.

Amenity Noise Level

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include transportation noise (when on public transport corridors), noise from motor sport, construction noise, community noise, blasting, shooting ranges, occupational workplace noise, wind farms, amplified music/patron noise.

The amenity noise level aims to limit continuing increases in noise levels which may occur if the intrusiveness level alone is applied to successive development within an area.

The recommended amenity noise level represents the objective for total industrial noise at a receiver location. The project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To prevent increases in industrial noise due to the cumulative effect of several developments, the project amenity noise level for each new source of industrial noise is set at 5dBA below the recommended amenity nose level.

The following exceptions apply to determining the project amenity noise level:

- For high-traffic areas the amenity criterion for industrial noise becomes the $L_{Aeq,period(traffic)}$ minus 15dBA.
- In proposed developments in major industrial clusters.
- If the resulting project amenity noise level is 10dB or lower than the existing industrial noise level, the project amenity noise level can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
- Where cumulative industrial noise is not a consideration because no other industries are present in, or likely to be introduced into the area, the relevant amenity noise level is assigned as the project amenity noise level for the development.

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, assess mitigation options and determine achievable noise requirements.

An extract from the NSW *NPfI* that relates to the amenity noise levels for surrounding receivers is given in Table 5-1.

Table 5-1 Amenity noise levels

Receiver	Noise amenity area	Time of day[1]	Recommended amenity noise level L_{Aeq} (dBA)
Residence	Urban	Day	60
		Evening	50
		Night	45

Note 1: Daytime 7.00am–6.00pm; Evening 6.00pm–10.00pm; Night 10.00pm–7.00am.

Maximum Noise Level Events

Noise sources of short duration and high level that may cause disturbance to sleep if occurring during the night time need to be considered.

The approach recommended by the *NPfI* is to apply the following initial screening noise levels:

- $L_{Aeq,15min}$ 40dBA or the prevailing RBL + 5dB, whichever is the greater; and/or
- L_{AFmax} 52dBA or the prevailing RBL + 15dB, whichever is the greater.

The sleep disturbance screening noise levels apply outside bedroom windows during the night time period.

Where the screening noise levels cannot be met, a detailed maximum noise level event assessment should be undertaken. It may also be appropriate to consider other guidelines including the NSW *Road Noise Policy (RNP)* which contains additional guidance relating to potential sleep disturbance impacts.

A review of research on sleep disturbance in the *RNP* indicates that in some circumstances, higher noise levels may occur without significant sleep disturbance. Based on currently available research results, the *RNP* concludes that:

- "Maximum internal noise levels below 50dBA to 55dBA are unlikely to cause awakening reactions."
- "One or two noise events per night, with maximum internal noise levels of 65dBA to 70dBA, are not likely to affect health and wellbeing significantly."

5.2 Project Noise Trigger Levels

The amenity and intrusiveness noise levels and resulting project trigger levels (shown in **bold**) applicable to sources of continuous operational noise associated with the project (i.e. mechanical plant and equipment) are shown in Table 5-2.

Table 5-2 Project noise trigger levels

Receiver	Period	Intrusiveness noise level[1] $L_{Aeq,15min}$ (dBA)	Project amenity noise level[2] $L_{Aeq,15min}$ (dBA)
A – Quest Apartments North Sydney	Day	59	58
	Evening	53	48
	Night	47	43
B – Skye & Lucent Apartment Buildings	Day	58	58
	Evening	57	48
	Night	55	43

Note 1: Intrusiveness noise level is $L_{Aeq,15min} \leq$ RBL +5.
Note 2: Project amenity noise level (ANL) is suburban ANL minus 5dBA plus 3dBA to convert from a period level to a 15-minute level.

For maximum noise level events (night time period only), the following screening noise levels apply.

Table 5-3 Sleep disturbance trigger levels

Receiver	$L_{Aeq,15min}$	L_{AFmax}
A – Quest Apartments North Sydney	47	57
B – Skye & Lucent Apartment Buildings	55	65

5.3 Mechanical Services

The major mechanical noise sources associated with the development will be the carpark exhaust fans and air-cooled condenser plant that will be located on the roof of the new building. These will consist of roof mounted condensers or plant that have yet to be determined.

Noise from most major plant, such fan coil units and pumps will be contained by the building structure. Therefore, it is the roof condensers and car park exhaust fan that may require noise mitigation to achieve the established site-specific noise criteria at surrounding receivers.

Detailed specifications of mechanical services equipment that would otherwise allow an acoustic assessment of noise emissions from the site are not available at this stage of the project as selection and design is conducted after project approval.

Preliminary selection of major plant consists of:

- Rooftop Heat Pumps x3 with a sound pressure level of 65dBA at 1 metre;
- Car Park Exhaust Fan with a sound pressure level of 65dBA at 1 metre;
- Toilet Exhaust Fan with a sound pressure level of 43dBA at 1 metre.

Based on the above plant, a preliminary calculation at nearby residences indicates the following resultant noise levels as detailed in Table 4-4.

Table 5-4 Preliminary services noise levels at residences – dBA

Receiver	Prediected noise level	Day / evening noise criteria
A – Quest Apartments North Sydney	40	59 / 48
B – Skye & Lucent Apartment Buildings	30	58 / 48

A review of the results indicates that compliance is likely without the need for any noise mitigation plant. However, a detailed assessment of operational noise emission will be conducted at detailed design stage to confirm these findings.

Should it be determined at detail design stage that some mitigation to noise from mechanical plant is required, the following measures can be adopted where necessary:

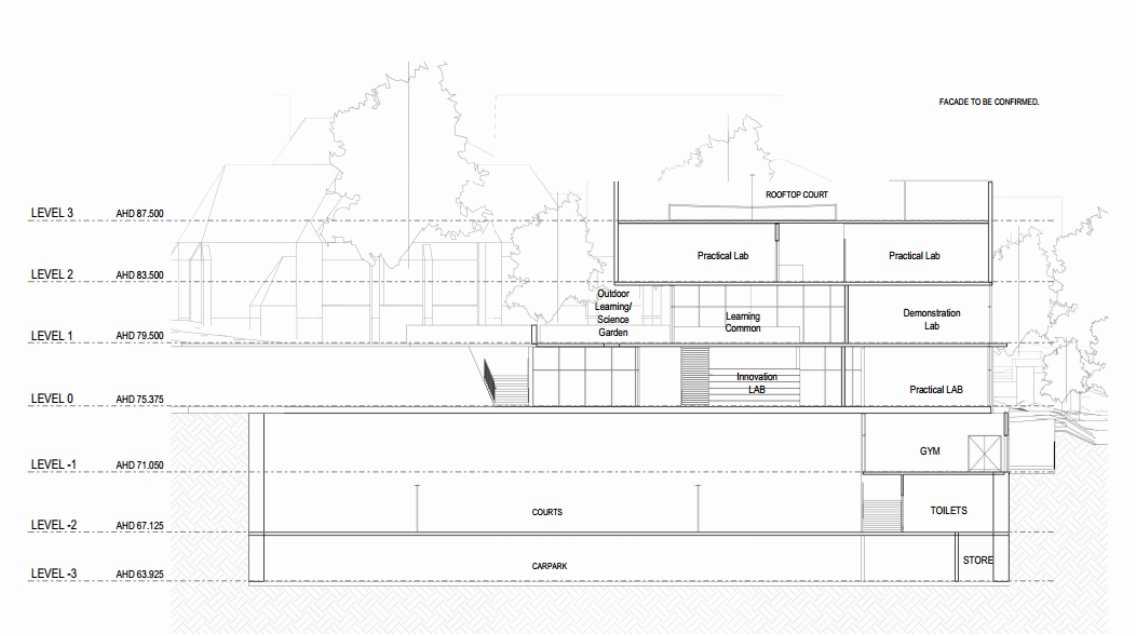
- Silencers on carpark and other fans;
- Acoustic louvres;
- Noise barriers; and
- Variable speed controls on condenser fans.

The mechanical plant will be designed to meet the criteria presented in Table 5-2 at the identified nearby receivers.

5.4 Sports Gymnasium

The sport gymnasium building will be located in the building below the new classrooms ground level. Figure 5-1 illustrates its location.

Figure 5-1 East – West section of development



A review of its location indicates that any noise generated within this space can be adequately contained by the existing concrete building structure and because the gym will be underground and any noise generated in the space will be contained by the ground, building levels above and ancillary areas (such as Gym and toilets) on the eastern side of the gymnasium.

5.5 Roof Top Court

The existing two courts (at a level of approximately RL 76) on site are to be demolished and replaced with an external single court that will be located on top of the new building at a level of approximately RL 88.

No change to usage of the court is proposed. Given this, and the fact that surrounding residences already overlook the site, no perceptible change in noise emissions form associated with activities on the single courts when compared to the existing court can be expected. Figure 5-2 illustrates its location.

Figure 5-2 New court location (looking west from Miller Street)

5.6 School Announcements & Bells

Announcements and school bells are typical activities associated with school operations. Typically, these are produced by the school PA system and can vary significantly depending on the final volume settings of the system.

At this stage, no design of the PA system has been determined. However, the following measures should be adopted to ensure that their impact at all surrounding residences is minimised:

- Speakers should be located and orientated to provide good coverage of the school areas whilst being directed away from residences. The coverage of the system should be subject of the detail design of the system.
- The volume of the system should be adjusted on site so that announcements and bells are clearly audible on the school site without being excessive. The system should initially be set so that noise at surrounding residences does not exceed the ambient noise levels by more than 5dBA.
- Once the appropriate level has been determined on site, the system should be limited to the acceptable level so that staff cannot increase noise levels.

The system bell should be set so that it only occurs on school days.

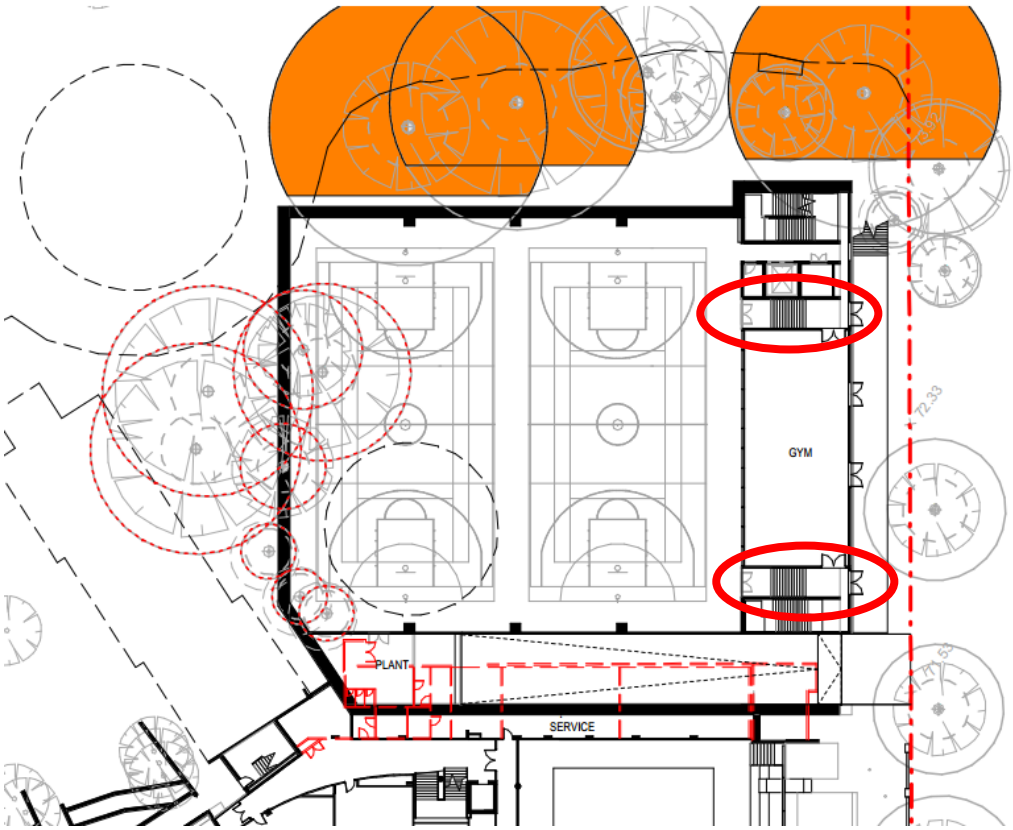
5.7 Additional Community Uses

The school currently makes school facilities available to the community for events and activities such as sports, weddings and pool use. In the case of the Scientia buildings the following "Community uses" are envisaged.

- Use of the underground carpark for existing community uses.
- Use of the Level -2 courts for team sport.
- Occasional functions such a lunches.

It is noted that all the proposed potential additional community uses will be located below ground level and be contained within the building structure by concrete walls and roof with no openings to the outside that would permit noise emission to outside areas. Further, the eastern entrance to the sports area is separated by 2 sets of doors that will act as a noise lock to the east as illustrated in Figure 5-2.

Figure 5-3 Level -1 Plan Showing Sports Area and Noise Lock (Red)



In the case of the proposed carparking, this area will replace existing ground level parking and as a result a reduction in any noise associated with current on-grade parking. Any car noise will be contained in the Level -3 basement carpark.

6 SUMMARY OF RECOMMENDATIONS

Based on Wilkinson Murray's acoustic assessment of the project, the following findings have been determined.

6.1 Construction Noise

Noise objectives for construction have been established based on EPA guidelines. The noise management levels should be adopted as objectives to work toward in minimising any noise impact at surrounding residences.

Table 6-1 presents applicable noise management levels at residential receivers in the vicinity of the site.

Table 6-1 Site-specific construction noise management levels – dBA

Area	Construction noise management level, L_{Aeq} – dBA				Highly noise affected noise level, L_{Aeq} dBA
	Day	Evening	Night	Saturday*	
A – Quest Apartments North Sydney	64	53	47	60	75
B – Skye & Lucent Apartment Buildings	63	57	55	61	75

* Extended Saturday construction hours 7am to 5pm.

It has been determined that noise from construction activities during the day period will potentially exceed established construction noise management levels; however, no predictions exceed the highly noise affected management level of 75dBA. Therefore, the planning and management of construction activities must consider the sensitivities of surrounding residents so as to minimise the impact of construction activities at these receivers.

The control of construction noise and vibration should be addressed in a Noise & Vibration Management Plan developed when the successful contractor has been appointed for the project.

The following project-specific mitigation measures are recommended:

- Selection of quietest feasible construction equipment.
- A 2.4m plywood hoarding around the construction site.
- Use of jaw crushers or smaller rock breakers where feasible.
- Use of rock saws for excavation.
- Localised treatment, such as barriers, shrouds, and the like around fixed plant such as pumps, generators, and concrete pumps, etc.
- Provision of respite periods, particularly on Saturdays.

6.2 Operational Noise

Site-specific noise criteria for the development have been established based on the lower of intrusive and amenity noise criteria.

The applicable operational noise levels at residential in the vicinity of the site are presented in Table 6-2.

Table 6-2 Project noise trigger levels – dBA

Receiver	Period	Intrusiveness noise level $L_{Aeq,15min}$ (dBA)	Project amenity noise level $L_{Aeq,15min}$ (dBA)
A – Quest Apartments North Sydney	Day	59	58
	Evening	53	48
	Night	47	43
B – Skye & Lucent Apartment Buildings	Day	58	58
	Evening	57	48
	Night	55	43

Mechanical plant such as rooftop exhausts and major plant associated with the development should be assessed at the time of detailed design and selection, having regard to nearby residential and commercial properties surrounding the development, and to future uses in the school area.

To mitigate noise from mechanical plant, attenuators could be incorporated in the outlets of the exhaust fans. Attenuators can be installed to the fans if required. The mechanical plant noise emission would be designed to meet the criteria present in Table 6-2 at the closest receivers.

In the case of the proposed Sports Hall uses, noise will be contained by appropriate design which is below ground level.

Noise from bells and announcements will be managed by design and adjustment techniques.

No change to usage of the court is proposed. Given this, and the fact that surrounding residences already overlook the site, no perceptible change in noise emissions form associated with activities on the single courts when compared to the existing court can be expected.

7 CONCLUSION

A construction and operational noise and vibration assessment of the Project at Monte Sant Angelo Mercy College, North Sydney development has been conducted. Site-specific noise criteria that are applicable to this project have been presented.

A noise assessment has been conducted for the proposed construction activities associated with the development to determine the potential for noise and vibration impact at surrounding receivers. Exceedances of construction noise management levels are expected at surrounding receivers to the east of construction site on Miller Street and, to a lesser degree, residences to the west backing onto Angelo Lane.

Vibration associated with on-site construction activities is unlikely to impact on surrounding receivers. Accordingly, management of noise from construction activities should be included in the Site Construction Environmental Management Plan.

Site-specific operational noise criteria have been determined for the project based on ambient noise monitoring. A review of likely major plant indicates that noise levels can comply with established noise criteria during proposed operation with the inclusion of acoustic treatment. A review of all plant with respect to site-specific noise criteria is required at detailed design stage.

Noise emissions from the proposed new building will be designed to achieve the site-specific assessment criteria under operation.

APPENDIX A

NOISE MEASUREMENT RESULTS

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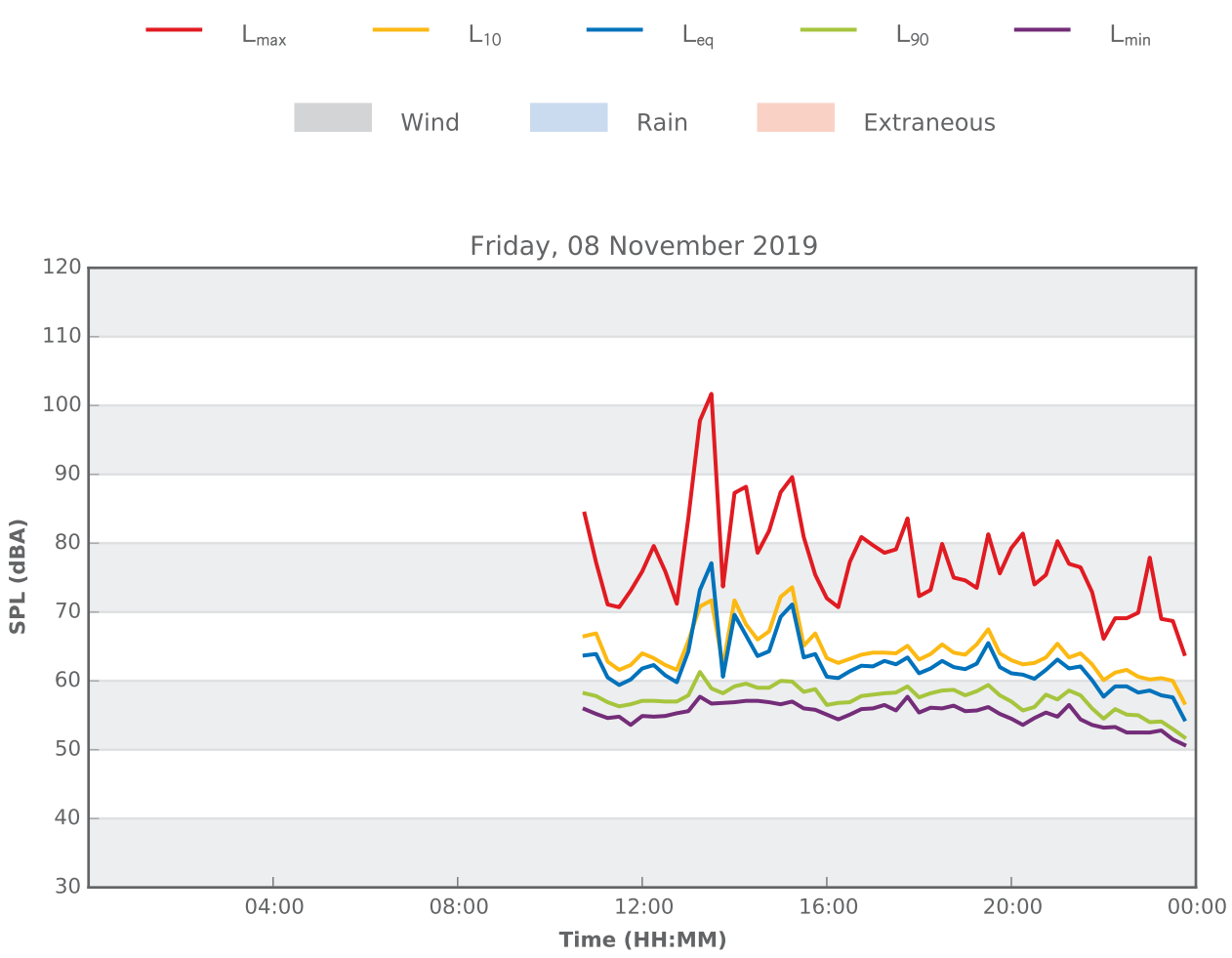

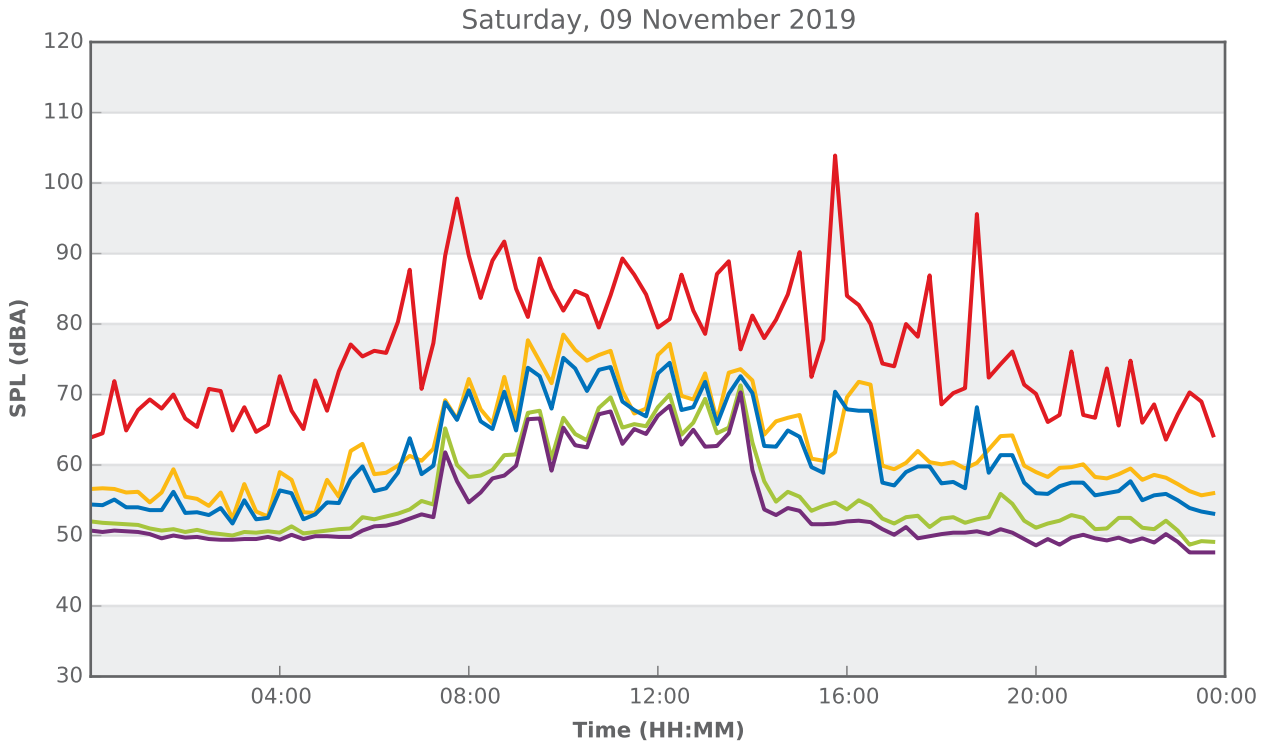

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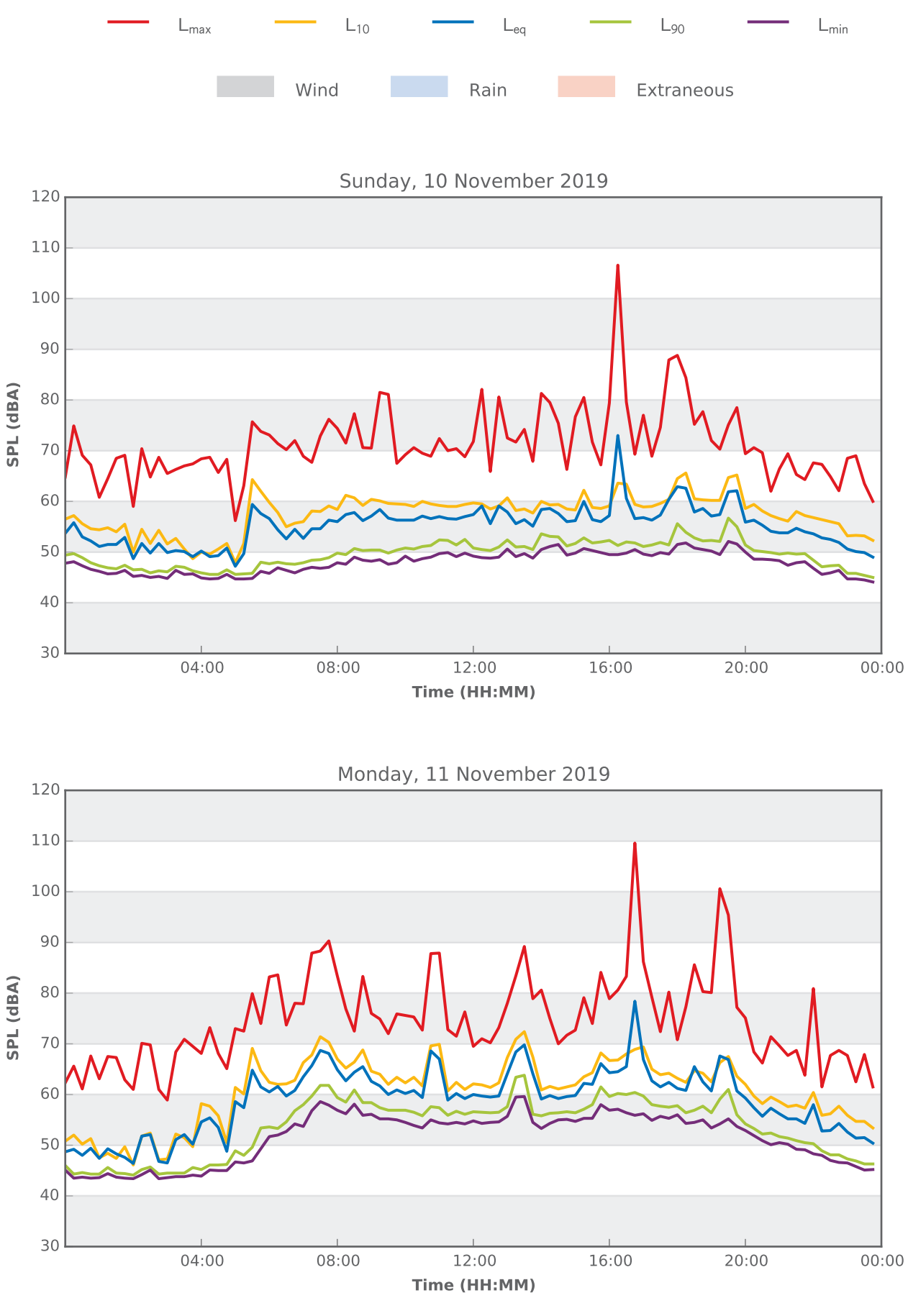

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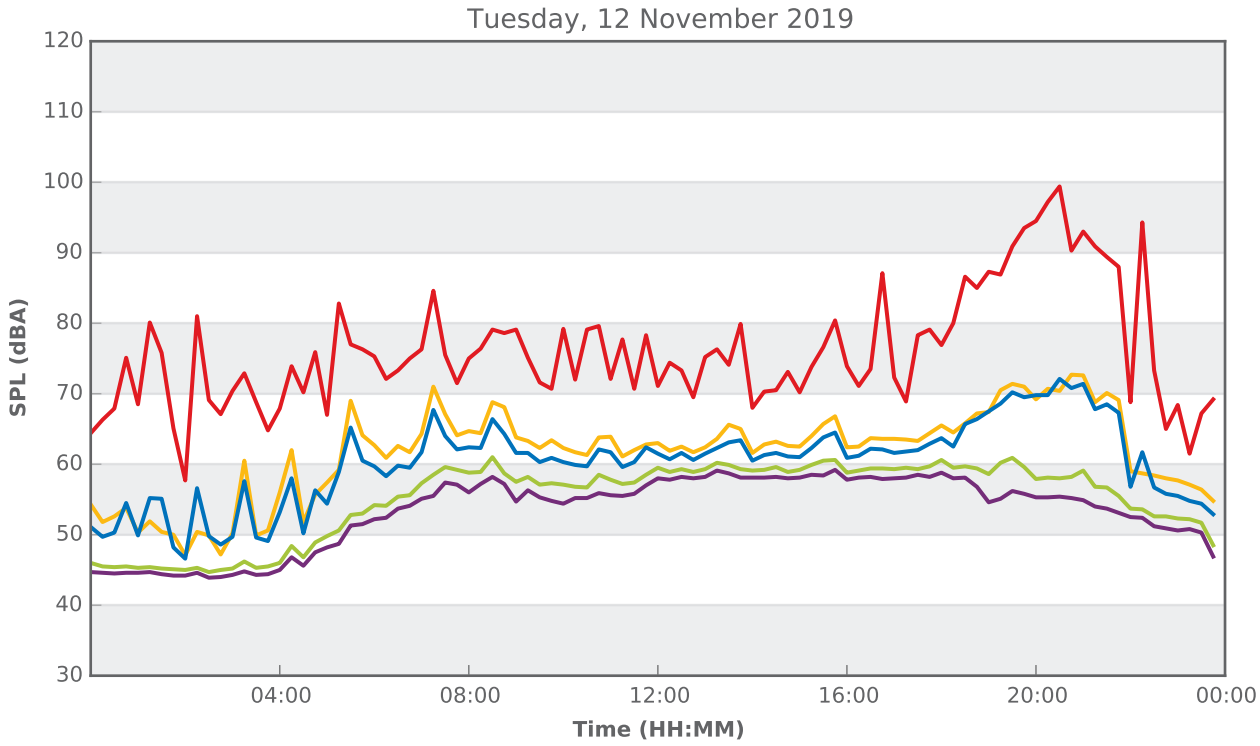

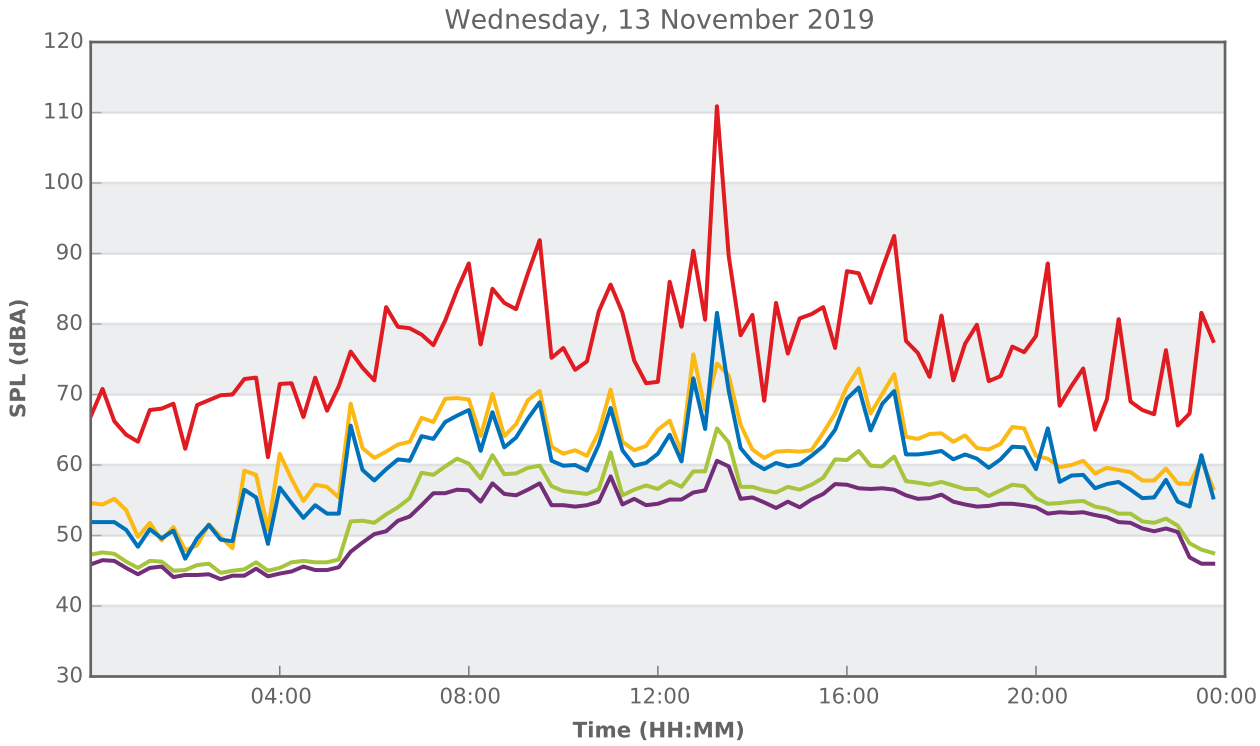

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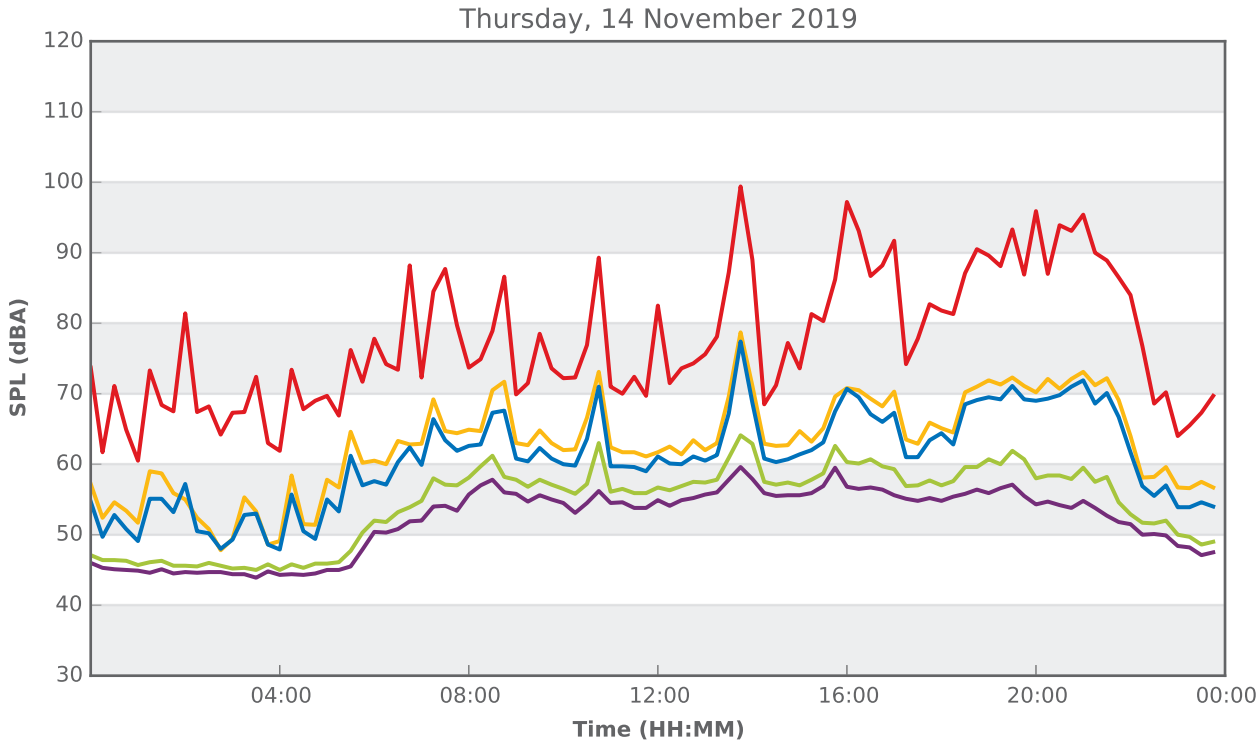
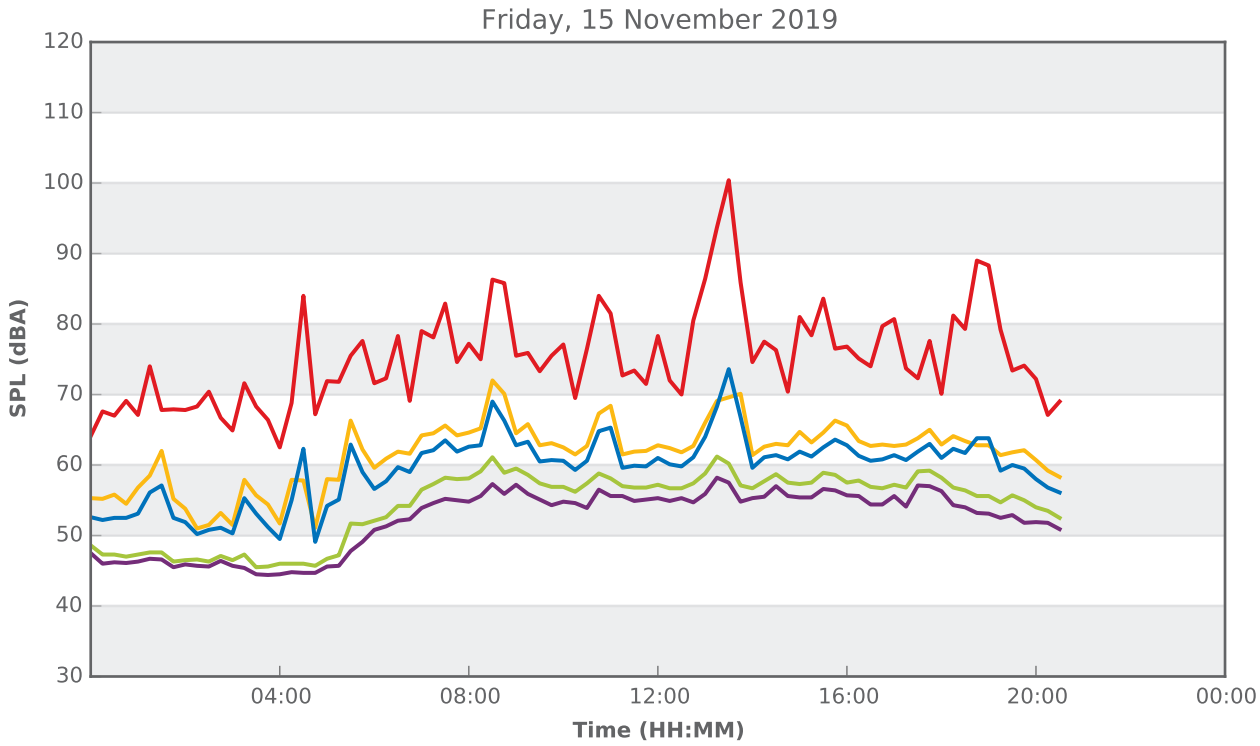
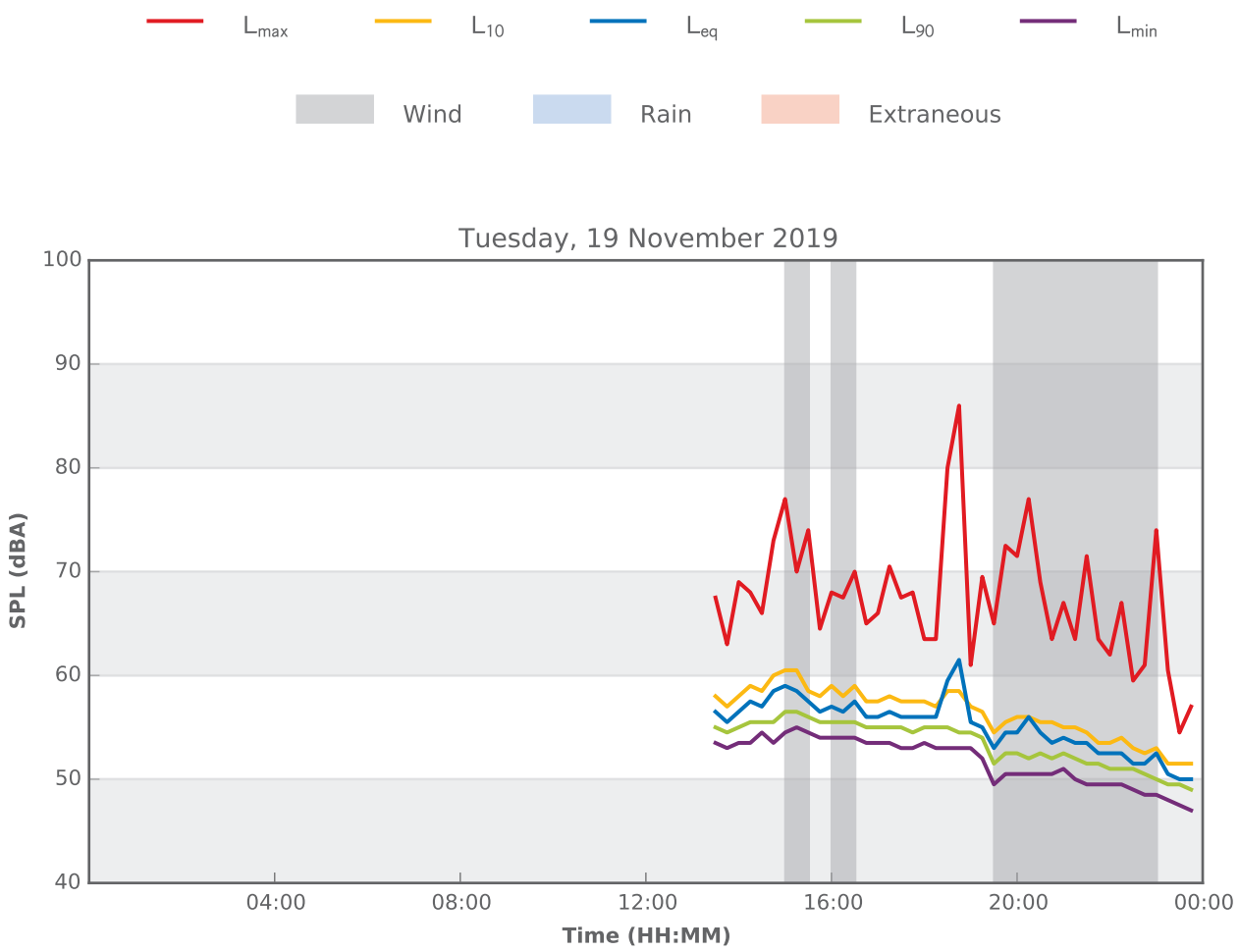
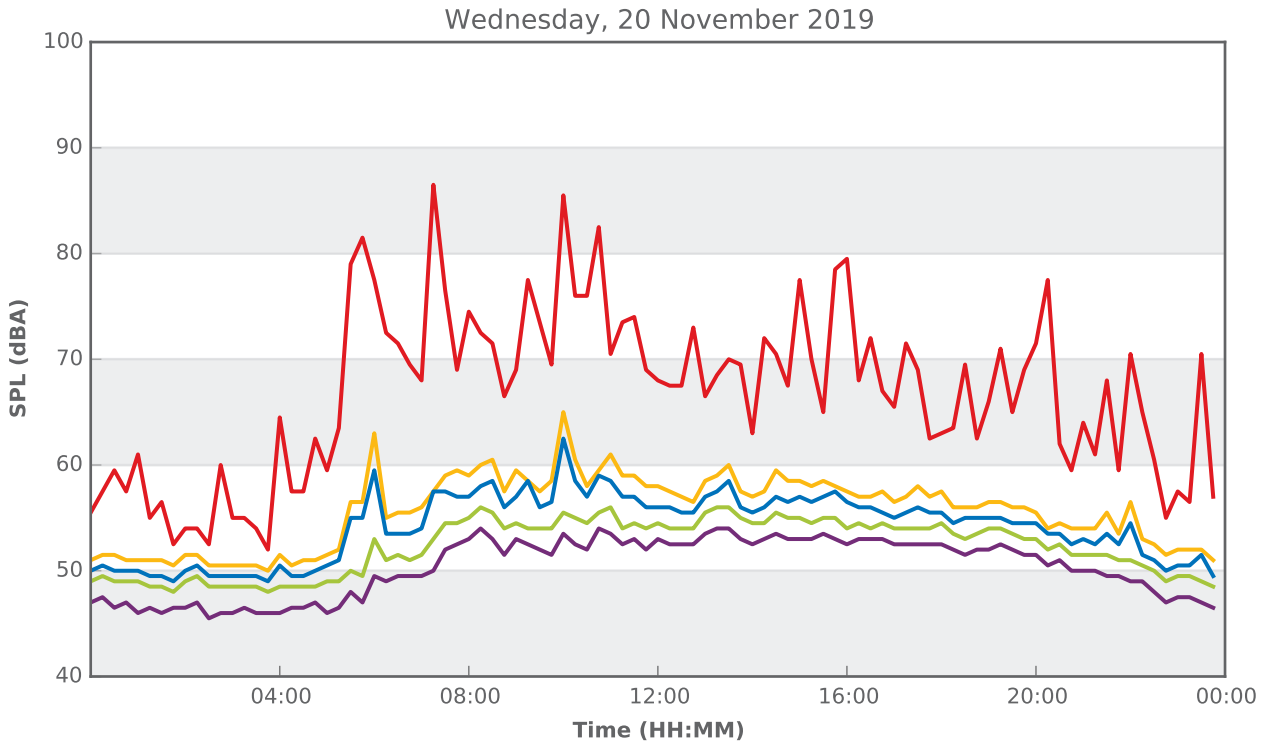




Angelo Street North Sydney





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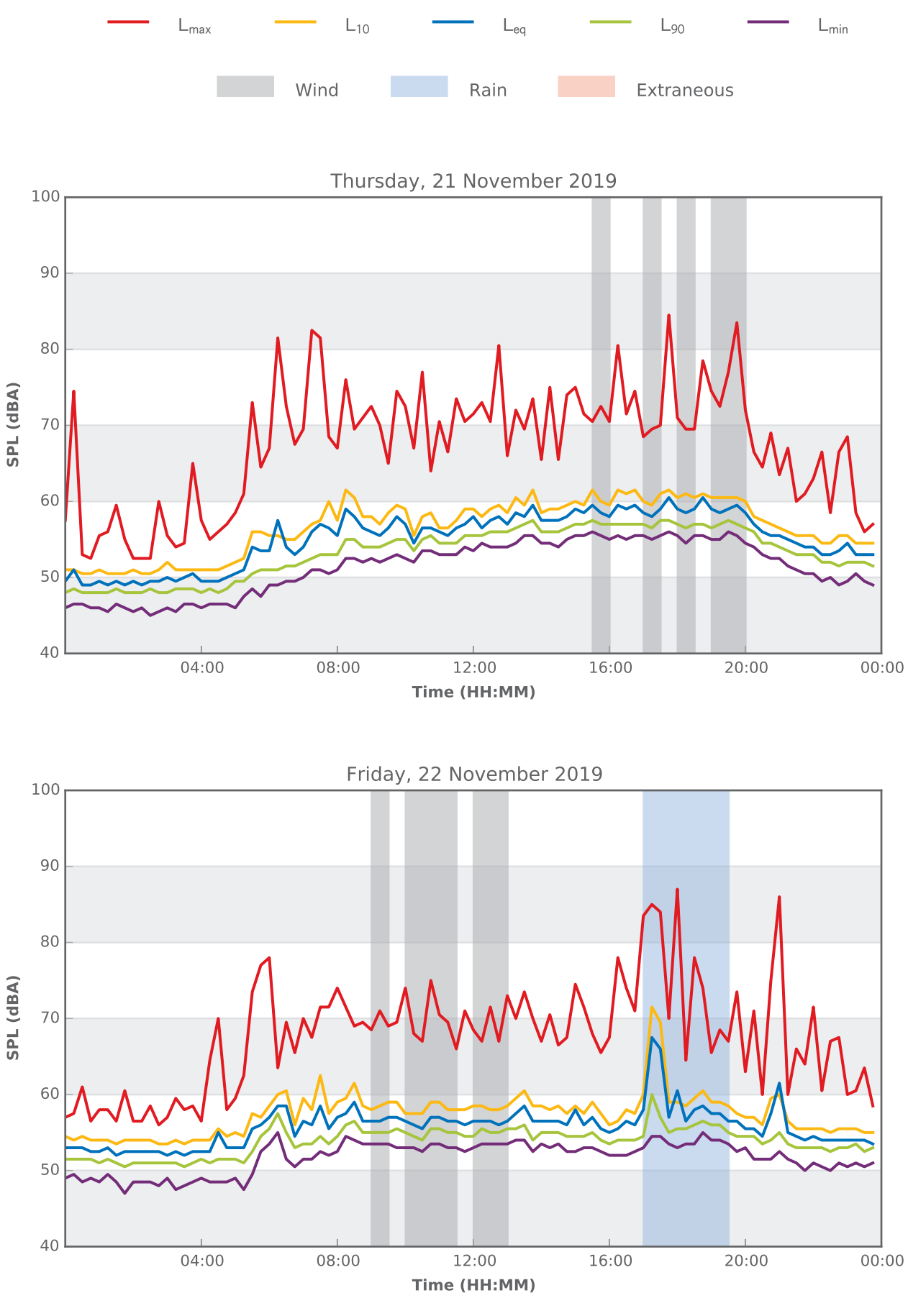

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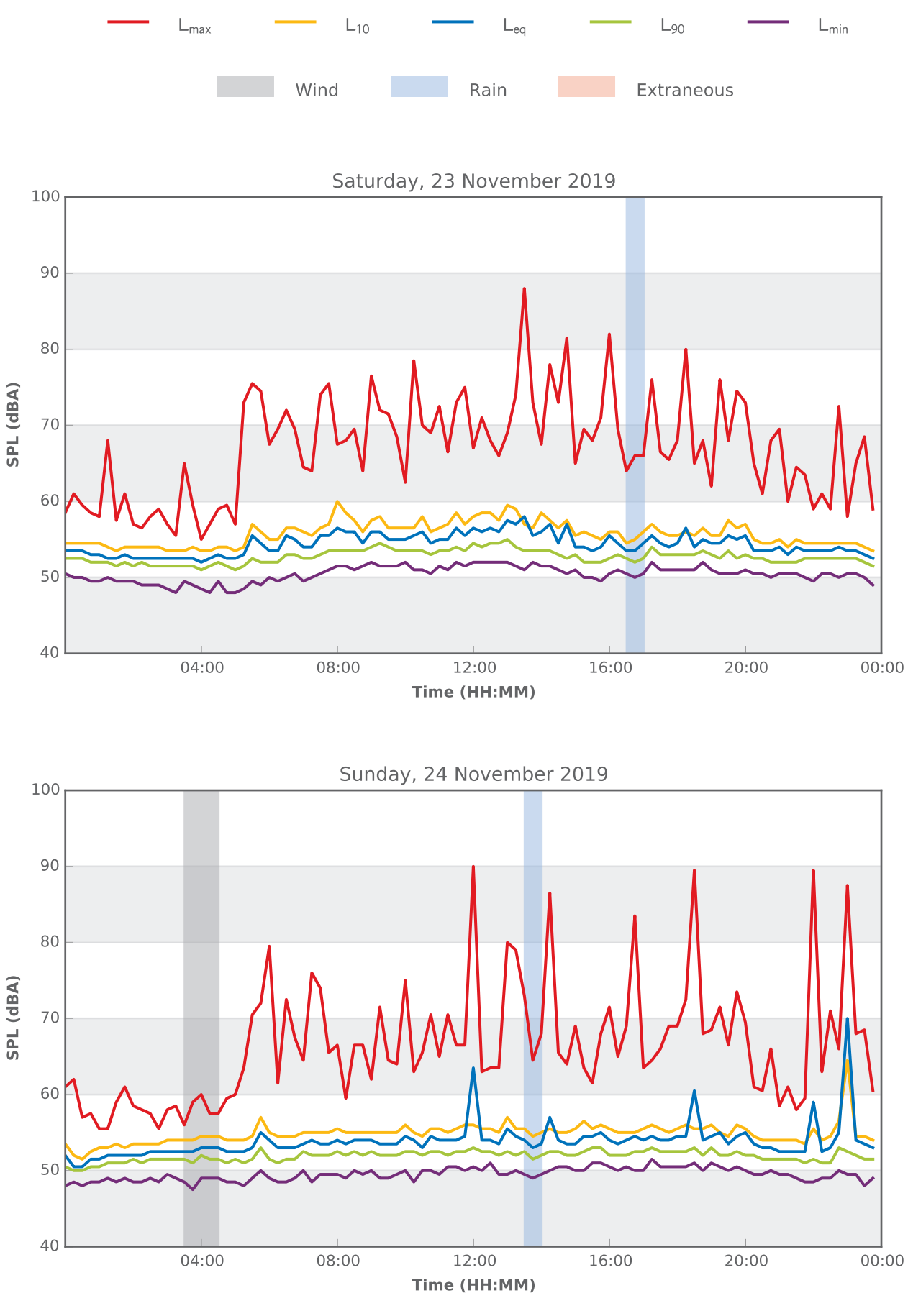

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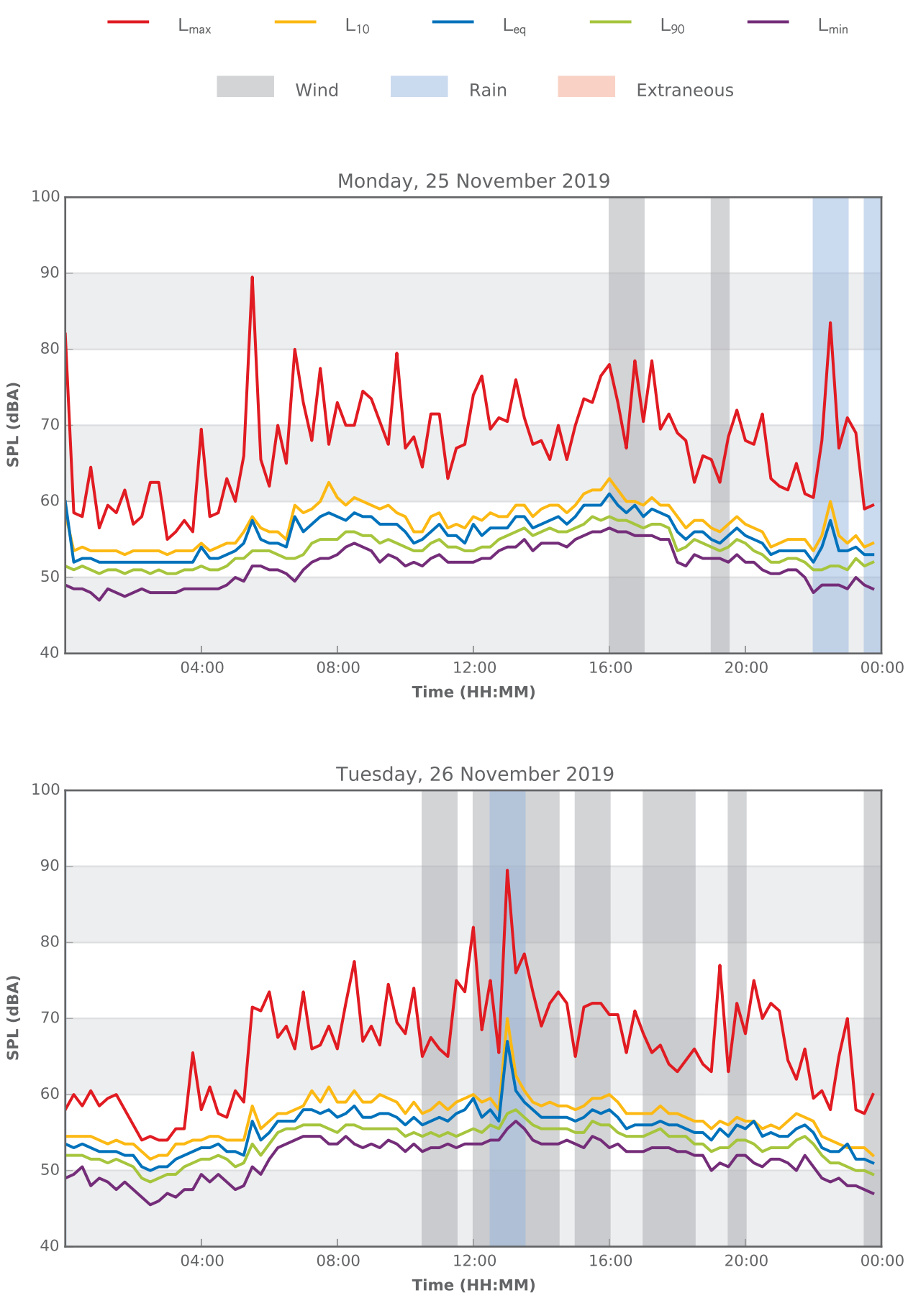

Angelo Street North Sydney