ACOUSTICS AND AIR

KAMBALA SPORT, WELLBEING AND SENIOR LEARNING PRECINCT

NOISE AND VIBRATION IMPACT ASSESSMENT
SSDA ISSUE

REPORT NO. 19514-SSDA
VERSION B

SEPTEMBER 2020

PREPARED FOR

KAMBALA
C/- CARMICHAEL TOMPKINS PROPERTY GROUP
LEVEL 13, 333 GEORGE STREET
SYDNEY NSW 2000

WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
B	Updated SSDA Issue	28 September 2020	Lee Hudson	John Wassermann
A	SSDA Issue	20 July 2020	Lee Hudson	John Wassermann
A	Draft SSDA Issue	17 June 2020	Lee Hudson	John Wassermann
A	Draft 2	27 April 2020	Lee Hudson	John Wassermann
A	Draft 1	7 April 2020	Lee Hudson	John Wassermann

Note
All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

Quality Assurance
Wilkinson Murray operates a 'Quality Management System' which complies with the requirements of AS/NZS ISO 9001:2015. This management system has been externally certified by SAI Global and Licence No. QEC 13457 has been issued.

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.

TABLE OF CONTENTS

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.

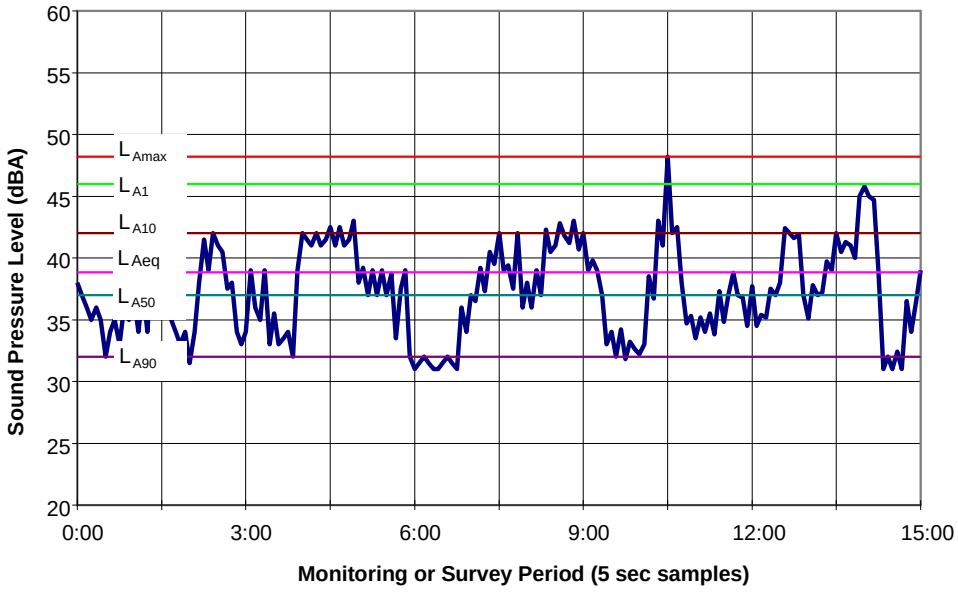
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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



1 INTRODUCTION

This report supports a State Significant Development Application (SSDA) submitted to the Department of Planning, Industry and Environment (DPIE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act), for the proposed redevelopment of the sports precinct of Kambala School at 794 -796 New South Head Road, Rose Bay.

This application is SSD by way of clause 8 and schedule 1 under *State Environmental Planning Policy (State and Regional Development) 2011* on the basis that the development is for the purpose of an existing school and has a Capital Investment Value of more than $20 million.

This report has been prepared having regard to the Secretary's Environmental Assessment Requirements issued for the project by DPIE, ref no SSD-10385 issued on 24 November 2019.

Table 1-1 SEARS – Key Issues

5. Environmental Amenity	Report Reference
Assess amenity impacts on the surrounding locality, including solar access, visual privacy**,** visual amenity, overshadowing and **acoustic impacts**.	Sections 6.3, 6.4, 6.5,0, 7.2.
Identify any proposed use of the school outside of school hours (including weekends) and assess any resultant amenity impacts on the immediate locality and proposed mitigation measures.	Section 7.2.
Detail amenity impacts including solar access, **acoustic impacts**, visual privacy, view loss, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.	Sections 6.4, 6.5, 0, 7.2
12. Noise and Vibration	
Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts upon surrounding occupiers of land.	Section 6.
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.	Section 7.

The acoustic assessment was conducted generally in accordance with the following environmental planning instruments, policies and guidelines:

- *SEPP (Infrastructure) 2007* (iSEPP);
- *Noise Policy for Industry (EPA 2017);*
- *Interim Construction Noise Guideline (DECC 2009);*
- *Assessing Vibration: A Technical Guideline (DECC 2006); and*
- *NSW Road Noise Policy (DECCW 2011).*

2 BACKGROUND

Kambala is an independent day and boarding school for girls up to 18 years. Kambala also has an early learning centre catering for approximately 70 girls and boys aged between 6 months and 5 years. The school was established in the late 1800s and moved to the current campus in 1913. The campus has evolved in an organic and ad-hoc manner over the last 100 years as the school and its demands have grown.

A new campus-wide planning approach offers the opportunity to strategically plan for the future in a sustainable and effective manner and to preserve the unique aesthetic and heritage qualities of the campus. The preparation of a campus-wide planning approach is also consistent with the School's 2019 - 2023 Strategic Plan which identified the need for a broader strategic plan to coordinate renewal and development in a feasible and staged manner.

3 THE SITE

3.1 Campus Location and Project Scope

Kambala is located at 794 -796 New South Head Road, Rose Bay and is within the Woollahra Council local government area (LGA). Situated in the eastern suburbs of Sydney, the School is approximately 8km east of the Sydney CBD. The School is located on New South Head Road which is a classified road connecting the City with the eastern beaches. The School is surrounded by predominantly residential uses.

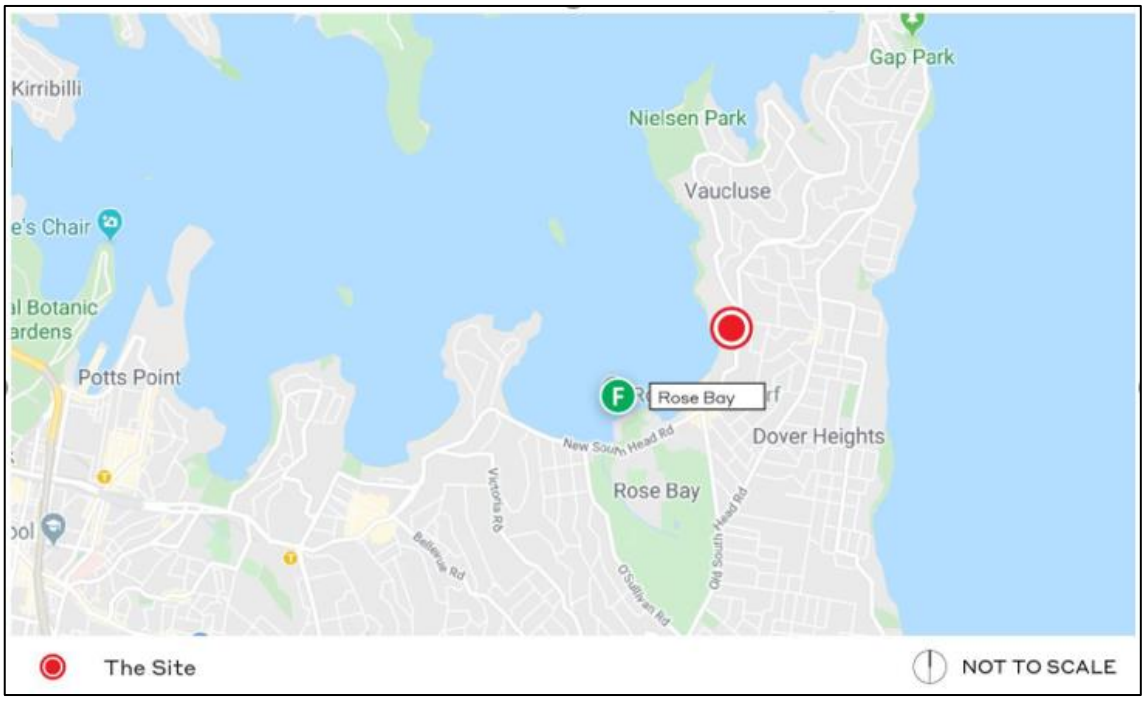
The campus is bound by New South Head (to the east), Bayview Hill Road (to the north) and Tivoli Avenue (to the west). Fernbank Boarding House is located at 1A -3 Bayview Hill Road opposite the Kambala School grounds. No works are proposed to this part of the campus in this DA. The locational context of the School is illustrated at Figure 3-1. Figure 3-2 provides an aerial map of the School and its immediate surrounds.

The School campus slopes down from New South Head Road in the east to the west and comprises a series of existing buildings in the western part of the campus that range in height and age. The south western and north western part of the campus accommodates much of the school's existing built form, while the eastern part has the school's sporting fields and courts.

The Kambala School building known as Tivoli House is in the heart of the campus. The house, its interiors, gateposts, gates and flanking walls with railing facing Tivoli Avenue, as well as 2 Norfolk Island Pines are listed as a heritage item in Woollahra Local Environmental Plan 2014 (WLEP 2014).

Within the School campus, the site of this SSDA is illustrated in Figure 3-3. The site proposed for new buildings is on top of the existing sports field and music building, as shown in green. The site proposed for demolition works and associated facade redevelopment and landscaping works is shown in red and is limited to a portion of the existing Hawthorne Building and the Arts building. The site of new landscape works is shown in yellow and includes all external spaces connecting these works. It is anticipated that the construction works will be staged, so the construction site for any given stage will be smaller than the overall site identified in Figure 3-3. The four key main buildings proposed are identified in Figure 3-4.

Figure 3-1 Kambala School Location Context Plan

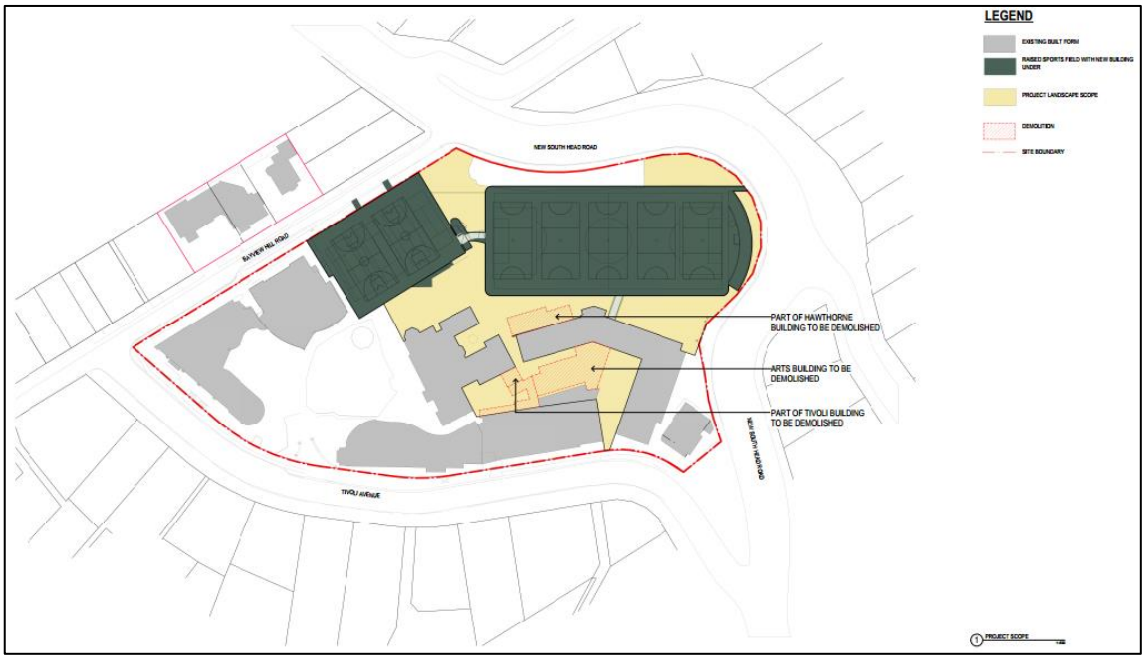


Source: Ethos Urban

Figure 3-2 Aerial Map of the Kambala Campus

Source: Nearmap

Figure 3-3 Project Scope



Source: AJ+C

Figure 3-4 Key Plan

Source: AJ+C

3.2 Legal Description and Ownership

The campus comprises several allotments, the legal descriptions of which are provided in Table 3-1 below. The existing campus has a site area of approximately 22511m^2.

Table 3-1 Legal Description

Address	Lot	Plan
	Lot 67	DP 2538
794-796 New South Head Road	Lot C	DP 210074
	Lot 1	DP 1089403
3 Tivoli Avenue	Null	SP 64653
3 Bayview Hill Road	Lot 1	DP 175832
1A Bayview Hill Road	Lot 45	DP 2538
1 Bayview Hill Road	Lot 46	DP 2538

4 OVERVIEW OF THE PROPOSED DEVELOPMENT

This SSDA includes detailed plans for a new sport, wellbeing and senior learning precinct. Accordingly, consent is sought for the following:

- The excavation of part of the existing sports field to facilitate the construction of the following:
    - sports facilities including weights room and dance rooms;
    - indoor multipurpose sports courts for use by up to 1500 people;
    - innovative and flexible teaching and learning spaces;
    - amenities, store rooms, plant, circulation and ancillary spaces;
    - reinstatement of the sports field surface on the roof (sports field and perimeter fencing);
    - spectator seating / bleachers;
- The removal of the tennis courts (currently on the roof of the music building), and the construction of the following:
    - a wellbeing centre, called the SHINE centre, to accommodate the Kambala SHINE program;
    - a new staff centre, called the KITE centre, to accommodate staff workstations, meeting areas, staff development workshop rooms and amenities;
    - reinstatement of the tennis courts, lighting and perimeter fencing on the new roof;
- a new eastern forecourt for the school, new external landscaped areas and new courtyards;
- minor works to the existing music building to facilitate a new connection to the new courtyard;
- the partial demolition of the Hawthorne building and the construction of a new façade, roof and landscaping; and
- the demolition of the Arts building and the construction of new facades to adjacent affected buildings, and new landscaping to the footprint of the demolished building.

The new Sporting Precinct and SHINE Centre will accommodate all Kambala students from Hampshire House to Year 12. The new learning and teaching spaces have been designed specifically to accommodate Year 11 and 12 as well as facilitating shared space with IB students from other local schools. The project will provide Kambala staff with a variety of new teaching and learning spaces as well as administrative and support spaces.

The Senior Learning Precinct is to provide teaching staff with the opportunity to explore new teaching philosophies and methods. Spaces are to be dedicated yet flexible and adequately accommodate team-based learning, team teaching, group learning and project based self-directed learning.

The Year 12 coordinator's office and Year 11 and 12 studies coordinator's office will be relocated adjacent to the Year 12 learning commons, located on Level 2 of the teaching and learning block. This will allow Year 12 students ease of access between coordinators and students.

The southern end of the new Sports Hall will accommodate the new Sports Staff Room and amenities, including WC, shower, tea point and storage. Additional Staff / Adult amenities will be included throughout the Sports Precinct.

Wellness staff will be relocated to the SHINE Centre, where purpose-built consultation rooms and offices will offer adequate privacy for students, their families and staff.

The existing school operating hours are as follows:

School operating hours:

- Formal teaching hours of School Operation: 8.20am - 3.20pm Monday to Friday during Term time.
- Some Senior classes are conducted before school from 7.30am and after school until 4.30pm during Term time.

Before and after school extra-curricular operating hours:

- Before school: 5.30am - 8.20am
- After school: 3.30pm - 6.15pm

Activities run by the school on weekend – operating hours:

- Saturdays: 7.30am - 1:00pm
- Some Year 12 study days occur during the School holidays prior to the HSC.

Community Use of School Facilities

- Pool operating hours for community use on a 'user pays' basis between 5.30am - 8.00am and 3.30pm - 6.15pm.
- 48 weeks a year.

It is understood that the KSWSLP would operate within the existing school hours with occasional evening use (maximum 12 times per year) up until 10.00pm.

It is understood that no outside organisations have arrangements to use the school facilities with the exception of the pool.

The extent of the proposed sports precinct development in relation to the existing Kambala campus is shown in Figure 3-3. The proposed plans of the KSWSLP have been produced by AJ+C architects and are included separately within the EIS .

An integral part of the School's strategic plan, is the expansion of the DA-approved number of 950 to 1020 students. The acoustic implications of the introduction of an additional 70 students across the overall campus (excluding Hampshire House) are insignificant and do not warrant further consideration in the context of this assessment.

5 EXISTING NOISE ENVIRONMENT

5.1 Ambient Noise Survey

In order to quantify and characterise the existing noise environment in the area, long-term ambient noise levels were monitored between 20 February 2020 and 3 March 2020, at four (4) residential receiver locations, selected to cover the range of ambient noise environments surrounding the site.

Long-term noise monitoring locations are documented in Table 5-1 and illustrated in Figure 5-1.

Figure 5-1 Ambient Noise Monitoring Locations

Source: SIX Maps

Table 5-1 Ambient Noise Monitoring Locations

Location	Address	Instrumentation
R1	Unit 5, 48 Towns Road	ARL Ngara 87807C
R2	Unit 1, 3 Tivoli Avenue	ARL Ngara 878062
R3	10 Tivoli Avenue	ARL Ngara 8780F1
R4	3 Bayview Hill Road (Kambala House)	ARL Ngara 878092

Instrumentation for the survey comprised (4 off) Acoustic Research Laboratories (ARL) Ngara Environmental Noise Loggers (refer Table 5-1) fitted with microphone windshields. Calibration of the loggers was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

The loggers continuously sampled noise levels over the entire survey period and calculated relevant statistical indices for each 15-minute interval. Data measured during periods of adverse weather, established through consultation with historical weather reports provided by the Bureau of Meteorology (BOM), has been excluded. The survey results are included in **Appendix A**.

5.2 Noise Monitoring Results

The results of the unattended noise logging have been processed in accordance with the NSW SEPP *(Infrastructure)* 2007 and NSW *Road Noise Policy* time periods to determine the levels of road traffic noise experienced at the site during the daytime and night-time. Table 5-2 details the $L_{Aeq(15hour)}$ daytime, the $L_{Aeq(9hour)}$ night-time and the $L_{Aeq,1hr}$ road traffic noise levels recorded during the survey.

Table 5-2 Measured Road Traffic Noise Levels

Location	Noise Level - dBA re 20 µPa		
	$L_{Aeq(15hour)}$	$L_{Aeq(9hour)}$	$L_{Aeq(1hour)}$
R1	63	57	64
R2	57	51	58
R3	52	43	51
R4	51	43	53

To determine project specific criteria on which to base assessment of operational noise emissions, the measured data was processed according to the NSW Environment Protection Authority's (EPA) *Noise Policy for Industry* (NPfI) assessment time periods. Table 5-3 details the RBL (background) noise levels and the L_{Aeq} noise levels recorded during the daytime, evening and night-time periods.

Table 5-3 Measured Ambient Noise Levels

Location	Noise Level – dBA re 20 µPa					
	Daytime 7.00am – 6.00pm		Evening 6.00pm – 10.00pm		Night-time 10.00pm – 7.00am	
	RBL	L_{Aeq}	RBL	L_{Aeq}	RBL	L_{Aeq}
R1	54	63	47	62	34	57
R2	48	57	43	56	35	51
R3	39	51	36	53	30	43
R4	43	52	40	50	38	43

The noise environment is dominated by traffic on New South Head Road.

6 CONSTRUCTION NOISE & VIBRATION

This section of the assessment relates to typical construction activities expected to occur during development works on the site, and their impact on the surrounding residential receivers.

6.1 Construction Noise Criteria – Residential Receivers

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

6.1.1 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 (NML) should not exceed the background noise by more than 10dBA. This applies to construction works conducted during standard hours which are defined as 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 applicable is background + 5dBA. Table 6-1 details the *ICNG* noise management levels.

Table 6-1 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 guideline.

On the basis of the background noise logging results presented in Section 5.2 the noise management levels adopted for construction activities during standard hours at residential receivers are presented in Table 6-2.

Table 6-2 Standard Hours Construction Noise Management Levels

Receiver Location		Receiver Catchment Area	Construction Noise Management Level $L_{Aeq,15\ min}$ (dBA) Day	Highly Noise-Affected Noise Level $L_{Aeq,15min}$ (dBA)
R1	48 Towns Road	New South Head Rd - eastern	64	75
R2	3 Tivoli Avenue	Tivoli Ave – southern end	58	
R3	10 Tivoli Avenue	Tivoli Ave - western	49	
R4	1 Bayview Hill Road [1]	Bayview Hill Road -northern	53	

Note 1: Ambient noise monitoring was conducted at 3 Bayview Hill Road "Kambala House". The private residence adjacent, 1 Bayview Hill Road has been substituted as "R4" for prediction and assessment of potential noise emissions.

6.1.2 Hours of Operation

Construction works for this project will be undertaken during standard hours as follows:

- Monday to Friday 7.00am to 6.00pm
- Saturdays 8.00am to 1.00pm
- Sundays and Public Holidays No work

6.2 Vibration Criteria

6.2.1 Human Comfort

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*" (NSW DEC, 2006).

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 6-3.

Table 6-3 Criteria for Exposure to Continuous Vibration

Place	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Residences	Daytime	0.28	0.56
	Night time	0.20	0.40
Offices, schools, educational institutions and places of worship	Day or night time	0.56	1.1

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 6-4.

Table 6-4 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime		Night Time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80

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

6.2.2 Building Damage

In Australia two standards are typically referred to for guidance on structural damage limits. These are:

- German Standard DIN 4150 – 2016 – *Vibrations in Buildings - Part 3: Effects on structures* (DIN 4150-3).
- British Standard BS 7385-2 – 1993 – *Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundborne Vibration* (BS 7385).

Table 6-5 summarises the guideline values for the prevention of building damage, which are derived from the more stringent German Standard.

The values presented in Table 6-5 reference the guideline's goals relating to "short-term vibration" events, which are considered reasonable in this case because it is unlikely that vibration over the duration of this project would cause structural fatigue in adjacent buildings.

Table 6-5 Vibration Guide Values for Building Damage – DIN4150-3

	Guideline Values for Peak Particle Velocity – mm/s			
Frequency	**1 to 10 Hz**	**10 to 50 Hz**	**50 to 100 Hz**	**>100 Hz**
Residential	5	5 to 15	15 to 20	20
Commercial	20	20 to 40	40 to 50	50

The vibration signature of a rock hammer as received within most habitable spaces (eg, offices and residences) will generally be dominant in the 10-50Hz range. Accordingly, this assessment adopts the vibration limits expressed for the 10-50Hz spectrum range (column 3 in Table 6-5).

6.3 Construction Equipment & Noise Source Levels

Sound Power Levels (L_W) for typical construction plant are identified in Table 6-6. These L_w are based upon archival data from measurements at other construction sites.

Table 6-6 Typical Construction Plant Sound Levels

Plant	Sound Power Level L_w dBA	Source
Backhoe	97	DEFRA
Bobcat	104	SLR
CFA Piling Rig	108	WM /DEFRA/SLR
Concrete Truck	103	DEFRA
Concrete Pump	103	DEFRA
Compressor	103	WM
Dump Truck	107	WM
Excavator (40t)	107	DEFRA/SLR
Hand Tools	101	WM/DEFRA
Mobile Crane	98	DEFRA
Rockbreaker	120	DEFRA/SLR

6.4 Construction Noise Assessment

6.4.1 Noise Modelling

Assessment of likely noise generation at surrounding receivers has been undertaken for the proposed construction works.

Site-related noise emissions were calculated addressing the following factors:

- Equipment sound level emissions and location;
- Receiver locations;
- Ground topography;
- Distance between source and receiver;
- Ground absorption;
- Atmospheric absorption.

Modelling of the noise levels potentially generated during the major works stages as summarised in Table 6-7 has been conducted using the computer program, CadnaA version 2020. This noise modelling software enables calculations to be performed using various recognised algorithms taking into account noise generated at the source, attenuation with distance and any shielding provided by intervening topography or structures. Modelling of construction noise was carried out in accordance with ISO 9613.1 procedures.

Table 6-7 Construction Works Scenarios

Construction Works Scenario	Works Included
Bulk Excavation Works Including Rock Excavation	Bulk excavation for sports hall in rock - excavation using rockbreaker and ripping using excavator mounted claws. Loaders load overburden to trucks for offsite removal.
Bulk Excavation Works (no rockbreaker)	Bulk excavation for the sports hall other than rock (OTR) - mainly using excavators to breakdown large rock elements. Loaders load overburden to trucks for offsite removal
Excavation & Contiguous Piling operations	Excavators continue excavation, loaders load overburden to trucks for offsite removal. CFA piling rig, concrete piles for sports hall poured.
Contiguous Piling, Shoring, Drainage works & Slabs	Contiguous piling, concreting and lifting. CFA piling rig, concrete pump & boom, crane are assumed to operate continuously over 15 minutes. Backhoe for drainage works associated with retaining wall. Includes concrete trucks & boom pumps.
Internal Fitout & Facade Works	Mobile crane, power tools, trucks.

Construction Works Scenario	Works Included
Senior Learning and LITE SHINE Centre Building Works & Minor Demolition	Slab constructions and building works. Demolition of Hawthorne front portion and Music building cnr. Major plant includes concrete boom pumps, concrete trucks, cranes, power tools all assumed to operate in 15minutes. Excavator undertaking minor demolition works. Concrete trucks and normal delivery trucks assumed to be 2 movements in 15 minutes.
Additions above existing music building including SHINE & KITE Centre, minor demolition works	Construction of the facades involving mobile crane and power tools. Associated structural alterations to existing. Internal fitout works. Minor demolition of Tivoli SE Wing & art/ceramics/lecture theatre by excavator & small earth moving plant. Tennis courts & fencing. Power tools and 2 truck movements in 15minutes assumed.

Noise modelling has been conducted for each of the above scenarios, with plant positioned in locations representative of typical operation during the works across the construction site.

The modelling assumes a "typical worst-case" scenario whereby it has been assumed plant operates continuously and simultaneously. As such, predictions represent the noise levels that can be expected to occur during intensive periods of construction. The resultant noise levels can be considered in the upper range expected at surrounding receivers throughout the course of construction works.

The results of construction noise modelling are shown in Table 6-8. Exceedances of the construction noise management levels (NMLs) and highly noise affected level (HNL) are listed applicable to works during recommended standard hours.

Table 6-8 Predicted Construction Noise Levels at Residences – $L_{Aeq(15\ min)}$ – dBA

Residential Receiver	Predicted Noise Level	NML	Exceedance	HNL	Exceedance
Bulk Excavation (with rockbreaker)					
R1 48 Towns Road	73	64	+9	75	0
R2 3 Tivoli Avenue	57	58	0	75	0
R3 10 Tivoli Avenue	42	49	0	75	0
R4 1 Bayview Hill Road	65	53	+12	75	0
Bulk Excavation (no rockbreaker)					
R1 48 Towns Road	67	64	+3	75	0
R2 3 Tivoli Avenue	56	58	0	75	0
R3 10 Tivoli Avenue	37	49	0	75	0
R4 1 Bayview Hill Road	59	53	+6	75	0

Residential Receiver	Predicted Noise Level	NML	Exceedance	HNL	Exceedance
Excavation & Piling					
R1 48 Towns Road	67	64	+3	75	0
R2 3 Tivoli Avenue	59	58	+1	75	0
R3 10 Tivoli Avenue	38	49	0	75	0
R4 1 Bayview Hill Road	61	53	+8	75	0
Piling, Shoring, Drainage Works & Slabs					
R1 48 Towns Road	62	64	0	75	0
R2 3 Tivoli Avenue	61	58	+3	75	0
R3 10 Tivoli Avenue	35	49	0	75	0
R4 1 Bayview Hill Road	56	53	+3	75	0
Internal Fitout & Facade Works					
R1 48 Towns Road	59	64	0	75	0
R2 3 Tivoli Avenue	61	58	+3	75	0
R3 10 Tivoli Avenue	32	49	0	75	0
R4 1 Bayview Hill Road	54	53	+1	75	0
Senior Learning & LITE SHINE Centre Slabs, Fitout & Demolition Works (Hawthorne & Music Building cnr)					
R1 48 Towns Road	62	64	0	75	0
R2 3 Tivoli Avenue	38	58	0	75	0
R3 10 Tivoli Avenue	38	49	0	75	0
R4 1 Bayview Hill Road	63	53	+10	75	0
Additions above music building, SHINE & KITE Centres Facade & Internal Works & Demolition works (SE wing Tivoli, art/ceramics/lecture theatre)					
R1 48 Towns Road	61	64	0	75	0
R2 3 Tivoli Avenue	39	58	0	75	0
R3 10 Tivoli Avenue	37	49	0	75	0
R4 1 Bayview Hill Road	54	53	+1	75	0

6.4.2 Discussion of Results

A review of the predicted noise levels indicates maximum exceedances of up to 12dBA at Bayview Hill Road (R4) and 9dBA at receivers opposite along New South Head Road (R1) may occur during excavation works using a rockbreaker. Exceedances reduce to an expected maximum of 6dBA at Bayview Hill Road (R4) during excavation with excavators carrying out the works (ie no rockbreaker operating).

During excavation and piling works, marginal exceedances will be experienced at New South Head Road (R1) and Tivoli Avenue (R2 ie adjacent the school) with up to 8dBA exceedance predicted at Bayview Hill Road (R4) due to excavator operations. When excavator use ceases, piling works alone result in marginal exceedances at Bayview Hill Road (R4).

Marginal exceedances (3dBA) may be experienced at the adjacent Tivoli is Avenue receiver (R2) and 1dBA (insignificant) at Bayview Hill Road (R4) during internal fitout and facade works.

Demolition of the front portion of Hawthorne and the corner of the music building may result in significant exceedances (up to 10dBA) at Bayview Hill Road (R4) due to excavator operations.

During general construction works associated with the SHINE and KITE Centres and demolition works associated with the SE wing of Tivoli, art/ceramics/lecture theatre, noise management levels are generally achieved at all surrounding receivers.

The maximum exceedances predicted are typical of construction works in reasonably close proximity to residential receivers and can be mitigated by the construction noise management procedures detailed in the following sections. The resultant noise levels within surrounding residences would not be likely to adversely impact upon normal daytime residential activities.

The adoption of reasonable and feasible noise management and mitigation is recommended. 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.

6.5 Construction Vibration Assessment

Given the likely construction methodology involved and the distance between works and the closest surrounding residential and associated structures, ground vibration is not considered to be a potential issue.

Table 6-9 sets out the typical safe working distances applicable for structural damage and human comfort for vibration caused by construction plant. On review of the site layout and surrounding receivers, the minimum distance between any potentially vibration generating activities and surrounding residences will be a minimum of 40 metres. Safe working distances will be achieved and vibration levels received are likely to be significantly lower than levels of ambient vibration. No further assessment of vibration is warranted.

Table 6-9 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	6m	23m
Large Hydraulic Hammer	1600kg – 18 to 34t Excavator	22m	73m
Pile Boring	≤ 800mm	2m (nominal)	N/A
Jackhammer	Handheld	1m (nominal)	Avoid contact with structure

6.6 Construction Traffic Noise Assessment

Details of truck movements during construction works were not available at the time of this study. Construction vehicles will enter and leave the site strictly through the access directly from New South Head Road. There will be no vehicular traffic associated with construction works on Tivoli Avenue or Bayview Hill Road.

Given the existing traffic volumes on New South Head Road, it is unlikely that traffic generated during construction works will result in any appreciable change to the levels of road traffic noise currently experienced at residential receivers along the construction traffic route.

6.7 Construction Noise & Vibration Mitigation Measures

When operating in closest proximity to the surrounding residential properties, noise levels from construction works are likely, at times, to exceed the applicable noise management levels. Noise control measures are recommended to ensure that noise is minimised where feasible and reasonable.

The following project-specific mitigation measures should be adopted if practicable:

- Selection of quietest feasible construction equipment;
- Use of rock saws and ripping in preference to rock breakers where rock removal is required;
- Localised treatment, such as barriers, shrouds and the like around fixed plant, such as pumps and generators; and
- Provision of respite periods, particularly on Saturdays.

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 service. To this end, testing should be established with the Contractor.
- *Operator Instruction* – Operators should be trained 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 attenuators, acoustical enclosures and other noise attenuation measures to ensure that the total noise emission from each work site complies with EPA guidelines.
- *Site Noise Planning* – Where practical, the layout and positioning of noise-producing plant and activities should be optimised to minimise noise emission levels.

Adoption of these measures is aimed at working towards achieving the noise management levels established at surrounding receivers.

6.8 Community Liaison & General Approaches to Mitigation

An effective community relations programme should be put in place to keep the surrounding community informed of work progress, and to forewarn potentially affected receivers (e.g. by letterbox drop, meetings with surrounding owners/occupants, 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 residents surrounding the site 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 the neighbouring community, and to ensure prompt response to complaints, should they occur.

6.9 Noise & Vibration Management Plan

A Construction Noise and Vibration Management Plan should be prepared and implemented by the Contractor. The plan should reference the findings of this assessment. Areas to 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.

7 OPERATIONAL NOISE ASSESSMENT

This section of the assessment relates to activities that may generate noise to surrounding residential receivers.

7.1 Assessment Criteria

7.1.1 Operational Noise Emissions

Operational noise from the proposed facilities may be generated by the following activities:

- Mechanical services plant;
- Teaching and practical activities, particularly performing arts-based;
- School announcements and bells;
- Sporting events and concerts in the Sports Hall; and,
- Sporting activities on the courts and sports fields.

Although the NPfI is not intended to be applicable to schools, and there are no criteria specifically relating to noise emissions from primary and secondary schools some noise emissions may be considered consistent with those from industrial or commercial premises, in terms of their continuous or near-continuous nature. These include external mechanical plant and activity-related noise generated during the use of such spaces as the hall and performance areas. It is therefore reasonable and appropriate to consider these sources of noise in the context of the NPfI.

The NPfI documents a procedure for assessment and management of industrial noise which involves 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.

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 developments 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 are applicable 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.
- 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 7-1.

Table 7-1 Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level L_{Aeq} (dBA)
Residential	**Urban**	Day	60
		Evening	50
		Night	45
Residential	**Suburban**	Day	55
		Evening	45
		Night	40

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

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 are shown in Table 7-2. The surrounding noise environment is controlled by road traffic and the existing industrial noise contribution is more than 10dB below the designated amenity criterion during any time period. Accordingly, the relevant amenity noise level is assigned as the project amenity noise level.

Table 7-2 Project Noise Trigger Levels

Receiver	Period	Intrusiveness Noise Level[1] $L_{Aeq,15min}$ (dBA)	Project Amenity Noise Level[2] $L_{Aeq,15min}$ (dBA)
R1 48 Towns Road	Daytime	**59**	63
	Evening	**52**	53
	Night-time	**39**	48
R2 3 Tivoli Avenue	Daytime	**53**	63
	Evening	**48**	53
	Night-time	**40**	48
R3 10 Tivoli Avenue	Daytime	**44**	58
	Evening	**41**	48
	Night-time	**35**	43
R4 1 Bayview Hill Road[1]	Daytime	**48**	63
	Evening	**45**	53
	Night-time	**43**	48

Note 1: Intrusiveness noise level is $L_{Aeq,15min} \leq$ RBL +5.
Note 2: Project amenity noise level (ANL) is the applicable ANL plus 3dBA to convert from a period level to a 15-minute level.
Note 1: Ambient noise monitoring was conducted at 3 Bayview Hill Road "Kambala House". The private residence adjacent, 1 Bayview Hill Road has been substituted as "R4" for prediction and assessment of potential noise emissions.

7.1.2 Road Traffic Noise

The *NSW Road Noise Policy* (2011) was released by the EPA to replace the *Environmental criteria for road traffic noise* (1999) from 1 July 2011. The key provisions of the policy are an emphasis on the use of land use planning, better road design and vehicle noise emission control to avoid or minimise road traffic noise impacts. The assessment criteria for residences potentially affected by additional traffic generated by land use developments on arterial, sub-arterial and local roads are summarised in Table 7-3.

Table 7-3 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Development	Assessment Criteria – dBA	
		Day (7am-10pm)	**Night (10pm-7am)**
Freeway/arterial/sub-arterial roads	Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15hr}$, 60 (external)	$L_{Aeq,9hr}$ 55 (external)
	Relative Increase Criteria	Existing traffic $L_{Aeq,15hr}$ + 12 dB (external)	Existing traffic $L_{Aeq,9hr}$ + 12 dB (external)
Local roads	Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq,(1hour)}$ 55 (external)	$L_{Aeq,(1hour)}$ 50 (external)

Where predicted noise levels exceed the project-specific noise criteria, an assessment of all feasible and reasonable mitigation options should be considered. The *RNP* states that *an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person*.

7.2 Operational Noise Assessment

7.2.1 Mechanical Services

The noise emission of any mechanical plant associated with the KSWSLP should be controlled so that the operation of such plant does not adversely impact upon surrounding residential properties. Given the distance from the proposed buildings, to surrounding residential properties, operational noise emissions from HVAC plant would achieve design limits at surrounding residential receivers.

Mechanical plant selection and location will be finalised during the detailed design phase. At this stage, potentially noise generating equipment will be examined to ensure compliance with the project noise trigger levels for mechanical noise emissions both to surrounding residential properties and at sensitive receiver locations within the school itself.

7.2.2 Use of Built Spaces

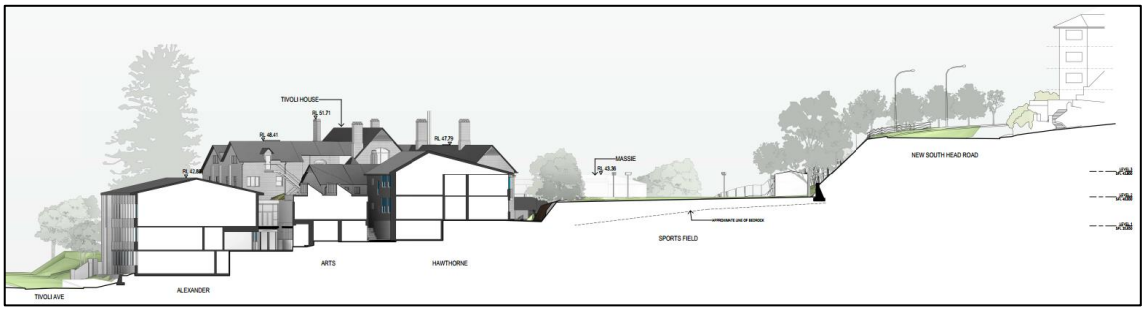
Generally, it is anticipated that the noise levels throughout the general learning areas and other teaching spaces will be relatively low and consistent with current school usage. The sports hall and dance studios are more likely to result in audible noise emissions.

Modelling to determine the indicative levels of noise received at surrounding residential properties due to the use of these spaces has been undertaken using the computer program, CadnaA version 2020.

7.2.3 Sports Hall

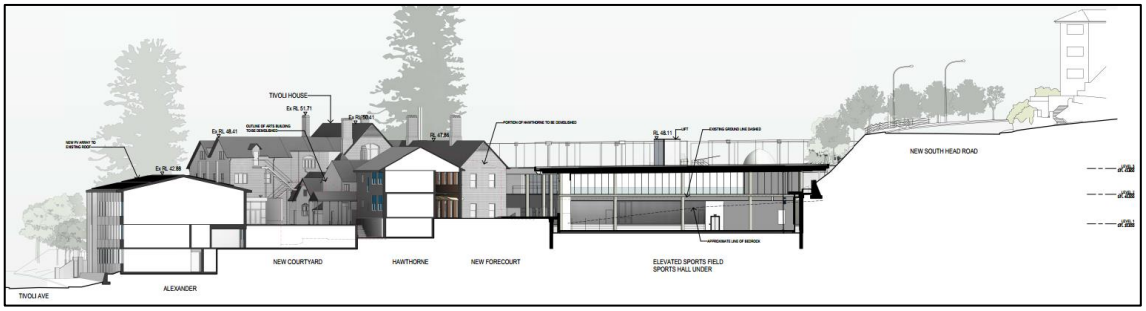
The sports hall will be located on the site of the existing sports oval, adjacent to the north-eastern boundary and the stone wall embankment (and RMS easement) along New South Head Road. Sections showing the existing and the proposed development illustrating the building in relation to the New South Head Road boundaries and surrounding buildings are shown in Figure 7-1, Figure 7-2, Figure 7-3 and Figure 7-4.

Figure 7-1 Section through Existing Sports Field (SW-NE)



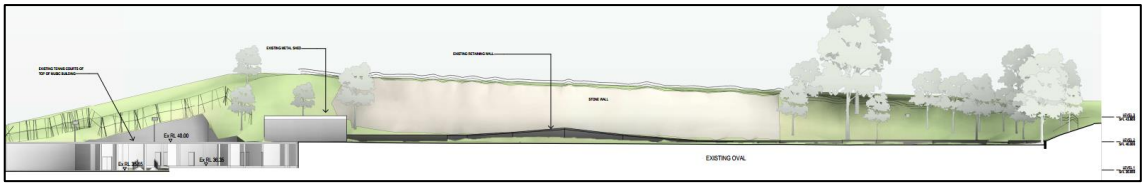
Drawing courtesy AJ+C

Figure 7-2 Section through New Sports Hall and Sports Field (SW-NE)



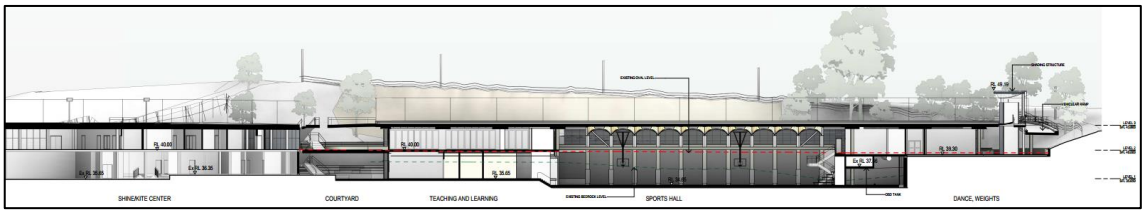
Drawing courtesy AJ+C

Figure 7-3 Existing NW-SE Section



Drawing courtesy AJ+C

Figure 7-4 Proposed KSWSLP NW-SE Section



Drawing courtesy AJ+C

The proposed lower sports hall level will be essentially excavated with the surrounding wall construction formed by the contiguous piles and shoring along the northeast, south and southwest elevations. Operable glazing is proposed from Level 2 to the underside of the cantilevered sporting field structure at Level 3 (refer Figure 7-2).

The building will function primarily as a sports hall but will also facilitate hosting large events. The sports hall will contain the following:

- 2 x Basketball Courts;
- 1 x Netball Court; and
- Spectator seating/bleachers.

It is envisaged that the sports hall would be used a few times per year for major events such as music concerts, (possibly) speech day and special dinners. Whole school assemblies could be accommodated however the school anticipates that the regular school assemblies for the Senior and Junior School would remain in the Alexander Hall and the Junior School multi-purpose room, respectively.

On this basis, noise will be generated by sporting activities, performances and presentations.

In sports mode maximum reverberant sound pressure levels of around 95dBA can be expected during large scale competitions (including whistles, PA and hooter). An L_{Aeq} over 15 minutes of around 84dBA (reverberant sound pressure level) is typical during school basketball games.

When operating in event/performance mode, the worst-case acoustical scenario would involve a band or amplified music playing within the space. The assumed reverberant sound pressure level within the space in this scenario is 91dBA (based upon a sound power level L_w 115dBA).

Modelling has been conducted for potentially worst-case emissions with open glazing. The predicted results, together with the relevant assessment criteria, are shown in Table 7-4.

Table 7-4 Predicted Noise Emissions – Sports Hall

Receiver	Predicted Noise Level $L_{Aeq,15min}$ dBA			Noise Trigger Limit $L_{Aeq,15min}$ dBA Day[1]	Noise Trigger Limit $L_{Aeq,15min}$ dBA Evening[2]	Complies
	Sports Mode Competition	Sports Mode School Use	Event Mode			
R1 48 Towns Road	47	38	46	59	52	Yes
R2 3 Tivoli Avenue	48	39	46	53	48	Yes
R3 10 Tivoli Avenue	23	15	23	44	41	Yes
R4 1 Bayview Hill Road	27	19	29	48	45	Yes

Note 1: Daytime is 7.00am to 6.00pm.
Note 2: Evening is 6.00pm to 10.00pm.

Use of the sports hall in both performance mode (worst case scenario with band or amplified music) and sports mode (competition and normal school use), will achieve the project specific noise trigger limits for environmental noise emissions during during all operational periods including evening use.

7.2.4 Dance Studios & Weights Room

For the dance studio and weights room, a reverberant sound pressure level of 79dBA (based upon a sound power level L_w 90dBA) has been adopted as typical of pre-recorded amplified music.

Modelling of noise emissions have assumed open windows along the south-eastern and south-western elevations. The predicted results, together with the relevant assessment criteria, are shown in Table 7-5.

Table 7-5 Predicted Noise Emissions – Dance Studios

Receiver	Predicted Noise Level $L_{Aeq,15min}$ dBA	Noise Trigger Limit $L_{Aeq,15min}$ dBA Day[1]	Noise Trigger Limit $L_{Aeq,15min}$ dBA Evening[2]	Complies
R1 48 Towns Road	22	59	52	Yes
R2 3 Tivoli Avenue	21	53	48	Yes
R3 10 Tivoli Avenue	8	44	41	Yes
R4 1 Bayview Hill Road	10	48	45	Yes

Note 1: Daytime is 7.00am to 6.00pm.
Note 2: Evening is 6.00pm to 10.00pm

These levels comply with the project trigger limits applicable to operational noise during both daytime and evening periods.

7.2.5 Cumulative Operational Noise

Based upon the results of noise modelling, the cumulative noise levels at surrounding residential properties with all acoustically significant spaces functioning simultaneously are shown in Table 7-6. The overall levels have been predicted for both operational scenarios applicable to the sports hall. It is unlikely that the dance studios and weights room would be in use during worst case operation of the sports hall.

Table 7-6 Cumulative Operational Noise KSWSLP

Receiver	Predicted Noise Level $L_{Aeq,15min}$ dBA			Noise Trigger Limit $L_{Aeq,15min}$ dBA Day[1]	Noise Trigger Limit $L_{Aeq,15min}$ dBA Evening[2]	Complies
	Sports Mode Competition	Sports Mode School Use	Event Mode			
R1 48 Towns Road	47	38	46	59	52	Yes
R2 3 Tivoli Avenue	48	39	46	53	48	Yes
R3 10 Tivoli Avenue	23	16	23	44	41	Yes
R4 1 Bayview Hill Road	27	20	29	48	45	Yes

Note 1: Daytime is 7.00am to 6.00pm.
Note 2: Evening is 6.00pm to 10.00pm

When all potentially acoustically significant spaces are simultaneously operational in worst-case operational scenarios (with glazing open), the project trigger limits applicable to operational noise during both daytime and evening periods can be achieved at all surrounding residential properties.

7.2.6 School Announcements and Bells

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

At this stage, PA system design has not been finalised. However, the following measures should be adopted to ensure that 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. System coverage should be reviewed during the detailed design stage.
- 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.

7.2.7 Outdoor Noise

The new outdoor sporting facilities include:

- 1 x Football (soccer)/touch football field;
- 5 x Netball courts (line-marked over the football field);
- 4 x Tennis courts (2 double + 2 single & lighting provided to match existing);
- 2 x Basketball courts (line-marked over the tennis courts).

Spectator seating/bleachers will be provided ideally accommodating multiples of 110 to facilitate years group meetings. LED screens will function as scoreboards and a PA system to cover the field. Sports lighting will not be provided.

The football field and netball courts are located approximately 3.8m above the level of the existing sporting oval upon which football and netball are currently played.

The new tennis and basketball courts will be located on the roof level above the existing music building, an additional floor level above the location of the current courts.

Tennis Courts

No change to the current usage of the tennis courts will result from the redevelopment.

Residences in closest proximity are mainly level with, or overlook the courts, and as such no perceptible change in the noise emissions received is expected.

Playing Fields

Noise from school students engaged in outdoor sports cannot be assessed in the same manner as noise generated by the use of learning facilities such as classrooms, gymnasiums and halls. The EPA's *NPfI* has previously been referred to for the assessment of such classroom and activity noise emissions (and noise from mechanical plant) however, the policy does not present appropriate criteria for the assessment of noise from outdoor areas and sporting fields.

Schools traditionally form an essential part of all residential communities. Noise emissions from students engaged in active outdoor games are unlikely to achieve a "background + 5 dBA" criterion at the site boundary. This is common across all educational facilities, particularly if the students are located near the boundary, and is often the case, in close proximity to residences.

In general, the impact of outdoor activity noise from schools is considered to be sufficiently mitigated by the site zoning and the limited periods of outdoor recreational and physical activities, during the school year, and, as such, does not typically warrant quantitative assessment.

A "background + 10dBA" criterion, based upon the guideline for the assessment of noise from child care centres prepared by the Association of Australasian Acoustical Consultants (AAAC), has been applied to schools in other local government areas within the Sydney Metropolitan area.

In the case of *Al Faisal College Limited v Canterbury Bankstown Council* (2018), which involved the development of a new school, whilst the Court accepted that the "background + 10dBA" approach may, be considered a 'datum' of acceptability when considering whether acoustical impacts arising from an educational establishment are reasonable in a merit assessment of the application, Commissioner Dixon found that this guideline was not intended to be directly applied to the assessment of noise from outdoor play at a school.

In the absence of any quantitative criterion for assessment of noise emissions from outdoor play, the "background + 10dBA" criterion will be applied as a 'yardstick' or 'datum' for determining the acceptability of noise emissions from the redeveloped sporting fields.

Applying this guideline for the assessment of noise emissions from the sports fields, the relevant 'limits' are presented in Table 7-7.

Table 7-7 Emission "Guidelines" for Noise from the Sports Fields

Receiver Location	RBL [1] $L_{A90,(15min)}$ dBA	Emission Guideline $L_{Aeq,15min}$ dBA
R1 48 Towns Road	54	64
R2 3 Tivoli Avenue	48	58
R3 10 Tivoli Avenue	39	49
R4 1 Bayview Hill Road	43	53

Note 1: Outdoor sporting fields currently used during daytime period only.

The playing fields are used by the school only and inter-school sport is not currently hosted on weekends. As a result of the proposed development, Kambala will be able to host weekend sports events involving other schools for the first time.

The increase in the relative level of the grounds may potentially reduce the shielding currently experienced at surrounding residences due to the embankment. Although the resulting change in noise emissions to surrounding receivers is expected to be marginal, modelling of crowd-generated noise during sporting matches on the oval has been carried out. Spectators have been assumed along both sides of the ground and occupying the grandstand at the south-eastern end. A sound power level of 76dBA, representing raised voice level, has been adopted for each spectator.

The predicted noise levels ($L_{Aeq, 15min}$) at the surrounding residential receivers, are shown in Table 7-8.

Table 7-8 Predicted $L_{Aeq15min}$ Noise Level from Spectators

Receiver Location	Predicted $L_{Aeq15min}$ dBA	Emission Guideline $L_{Aeq,15min}$ dBA
R1 48 Towns Road	52	64
R2 3 Tivoli Avenue	42	58
R3 10 Tivoli Avenue	22	49
R4 1 Bayview Hill Road	40	53

Noise emissions from spectators at competitive sporting events held on the redeveloped sporting fields will generally be within the range of background L_{A90} + 10dBA.

7.2.8 Road Traffic Noise

The nearest traffic counting station on New South Head Road is at Edgecliff, 90m east of Bayswater Road (RMS Station 10011). The 2020 Annual Average Daily Traffic volume was reported as 70,606 at this location. The traffic on New South Head Road, Rose Bay near Kambala would not reach this volume, however the AADT is expected to exceed 40,000. The measured daytime $L_{Aeq15hour}$ at location R1, overlooking New South Head Road was 64dBA. An L_{Aeq} of 72dBA resulted from attended measurements undertaken at 1m from the road near the school entry.

The additional 70 students associated with the School's strategic plan and the projected typical usage of the KSWSLP project are not expected to generate any significant additional traffic. Accordingly, existing levels of road traffic noise will be unaffected.

8 CONCLUSION

An assessment of the noise and vibration impacts associated with the development of the Kambala Sport, Wellbeing and Senior Learning Precinct at the school's Rose Bay campus has been conducted. This assessment has been carried out in accordance with NSW regulatory requirements and this report is forms part of the EIS submission to the NSW Department of Planning, Industry and Environment.

The scope of the assessment involved a survey of the existing noise environment; establishment of assessment criteria for noise emissions; a noise impact assessment relative to appropriate criteria; and recommendations for measures to minimise the potential for disturbance to surrounding residents. The findings are as follows:

Construction Noise and Vibration

No detailed construction plan or schedule is available at this staging of the project, therefore prediction of construction noise levels has been based upon the proposed staging of the project and should be regarded as indicative. A variety of representative construction work scenarios have been considered with an overall sound power level adopted for each based upon the likely plant operating throughout. Predictions for surrounding residential receivers have been carried out based upon the sound power levels of typical construction plant and assuming the concurrent operation of all plant at typical (and generally worst-case) locations.

The NMLs at nearby residential receivers can be expected to be exceeded, at times significantly, mainly during periods of intensive high noise level works associated with site preparation, excavation, demolition and to a lesser extent during building construction involving bored piling, concrete pours and the like. During general construction works, for example facade and fitout, the NMLs would be generally achieved at all surrounding receivers.

Throughout the noisier work periods adoption of reasonable and feasible noise management and mitigation will be required to minimise impact at residences.

A Construction Noise Management Plan, to be implemented by the Contractor, should be prepared. This plan should clearly identify the strategies to be put in place to minimise potentially adverse noise impacts upon the surrounding community.

Vibration impacts are unlikely given the distances between surrounding receivers and plant exceed those recommended for safe work in terms of structural damage.

Operational Noise

The predominant sources of potential operational noise were identified as the sports hall, dance studios, weights room and future mechanical plant. The noise level emissions from assumed worst-case operational scenarios of the future potentially noise-generating spaces have been predicted to the nearest surrounding residential receivers.

The results of modelling of "continuous" operational noise sources were compared with design goals for environmental noise, determined in accordance with State Government guidelines. All relevant criteria can be achieved by the development. Detailed mechanical plant selection will take place during the detailed design phase. Acceptable noise levels due to plant operation are

likely to be achieved given the distance between plant locations and receivers. Further assessment should be carried out when detailed mechanical services design and plant selection becomes available.

Noise from outdoor activities on the new sporting fields are expected to generally achieve a L_{A90} background + 10dBA emission benchmark. Noise emissions associated with the new tennis courts will be consistent with current levels and no perceptible change is expected. Operation of outdoor areas should be managed to minimise noise emissions to nearby residences by measures such as restricting use prior to 7.00am and limiting the use of whistles and PA system (where feasible).

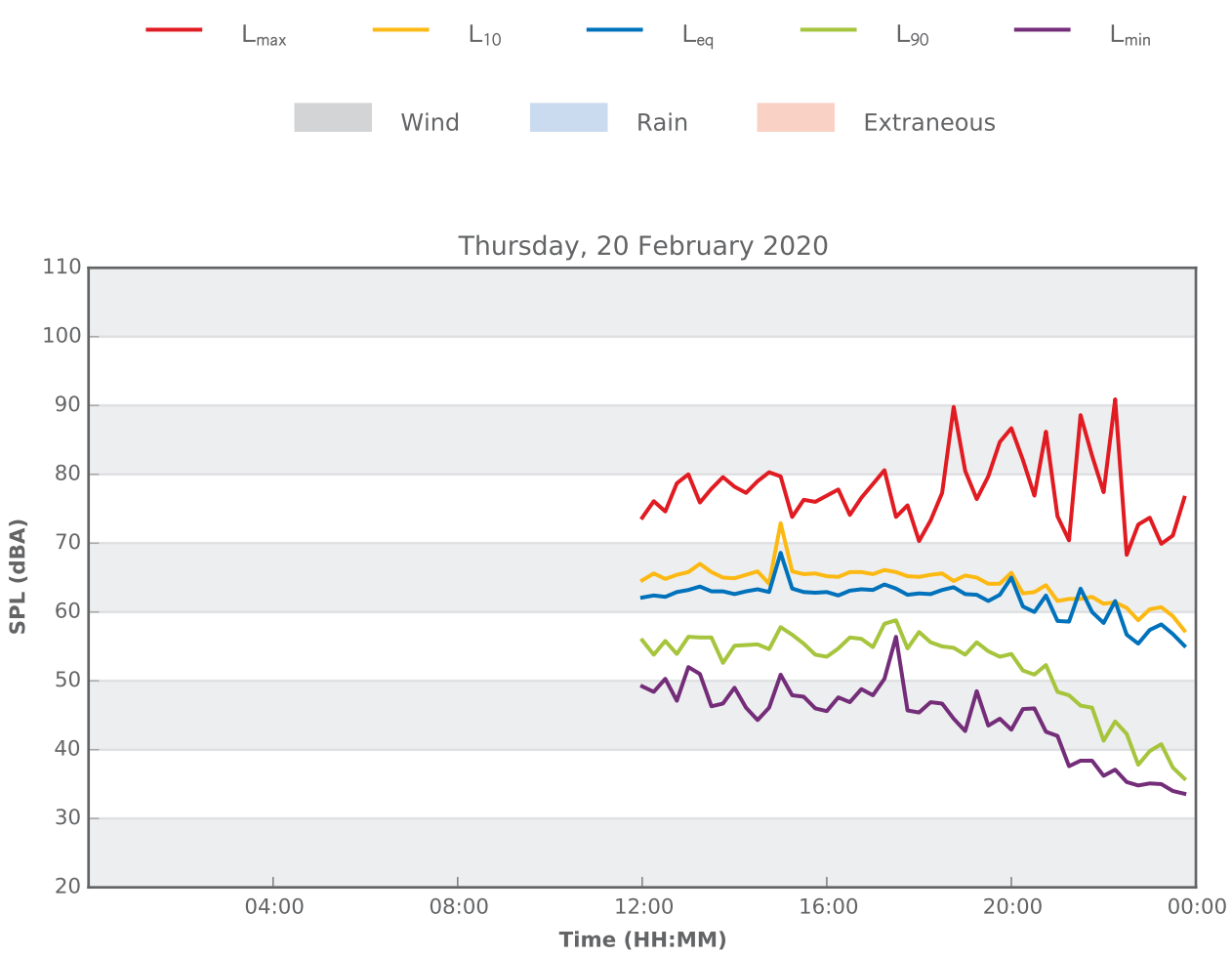
Road Traffic Noise

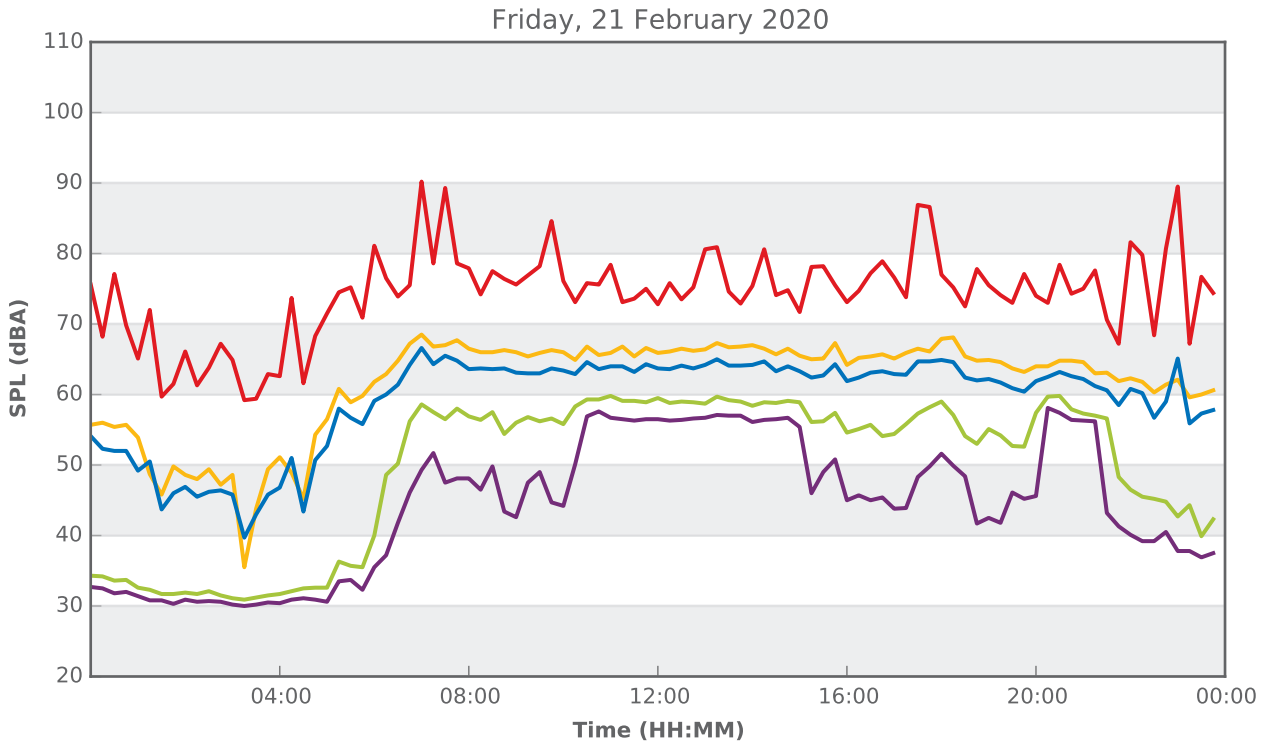
Road traffic generated by the development is expected to comply with the NSW *Road Noise Policy* (RNP) guidelines at all surrounding receivers during construction works. The projected minor increase in student numbers and the typical usage associated with the project are unlikely to generate any additional traffic. Accordingly, no increase in existing levels of road traffic noise are expected.

APPENDIX A

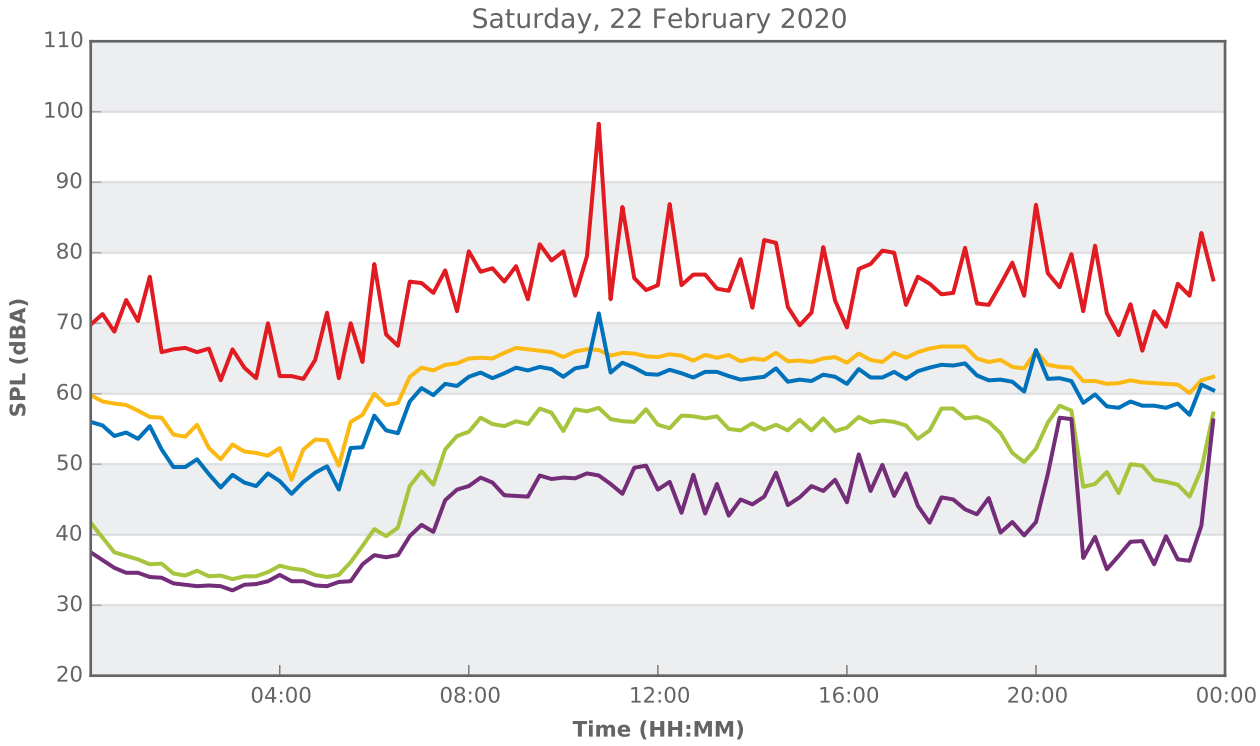
Ambient Noise Monitoring Results

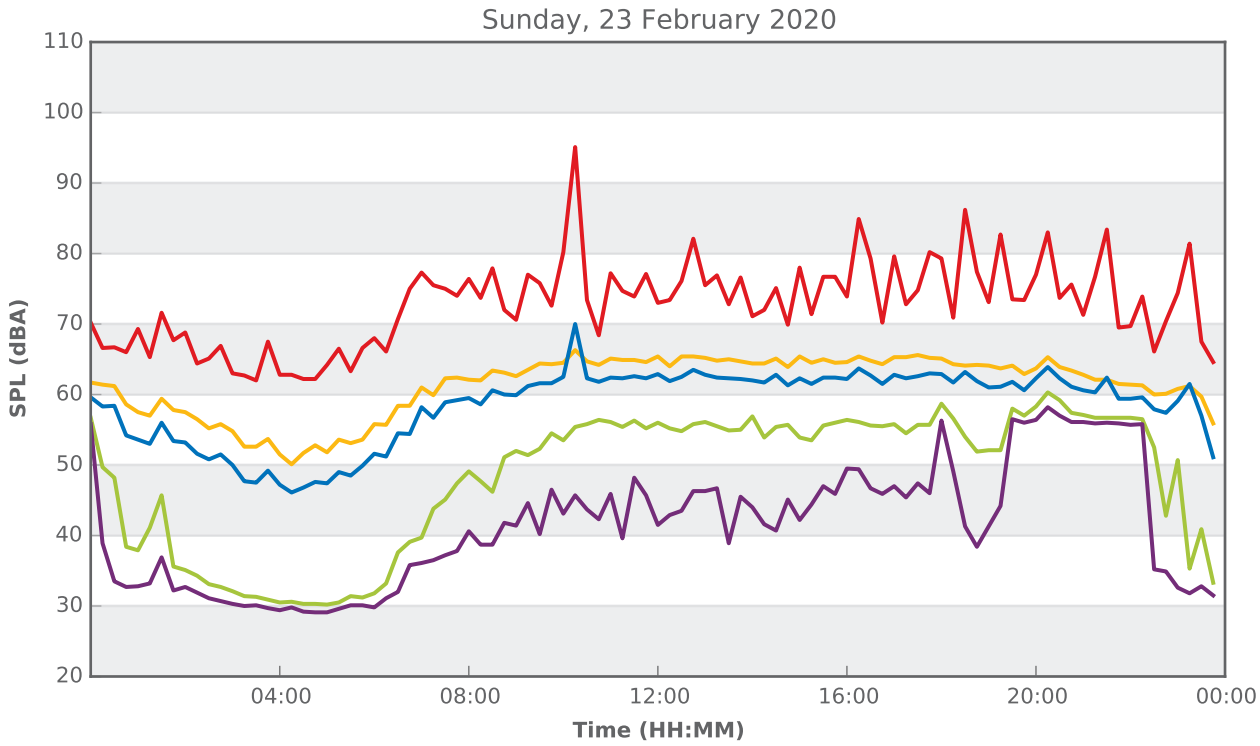
48 Towns Road, Vaucluse



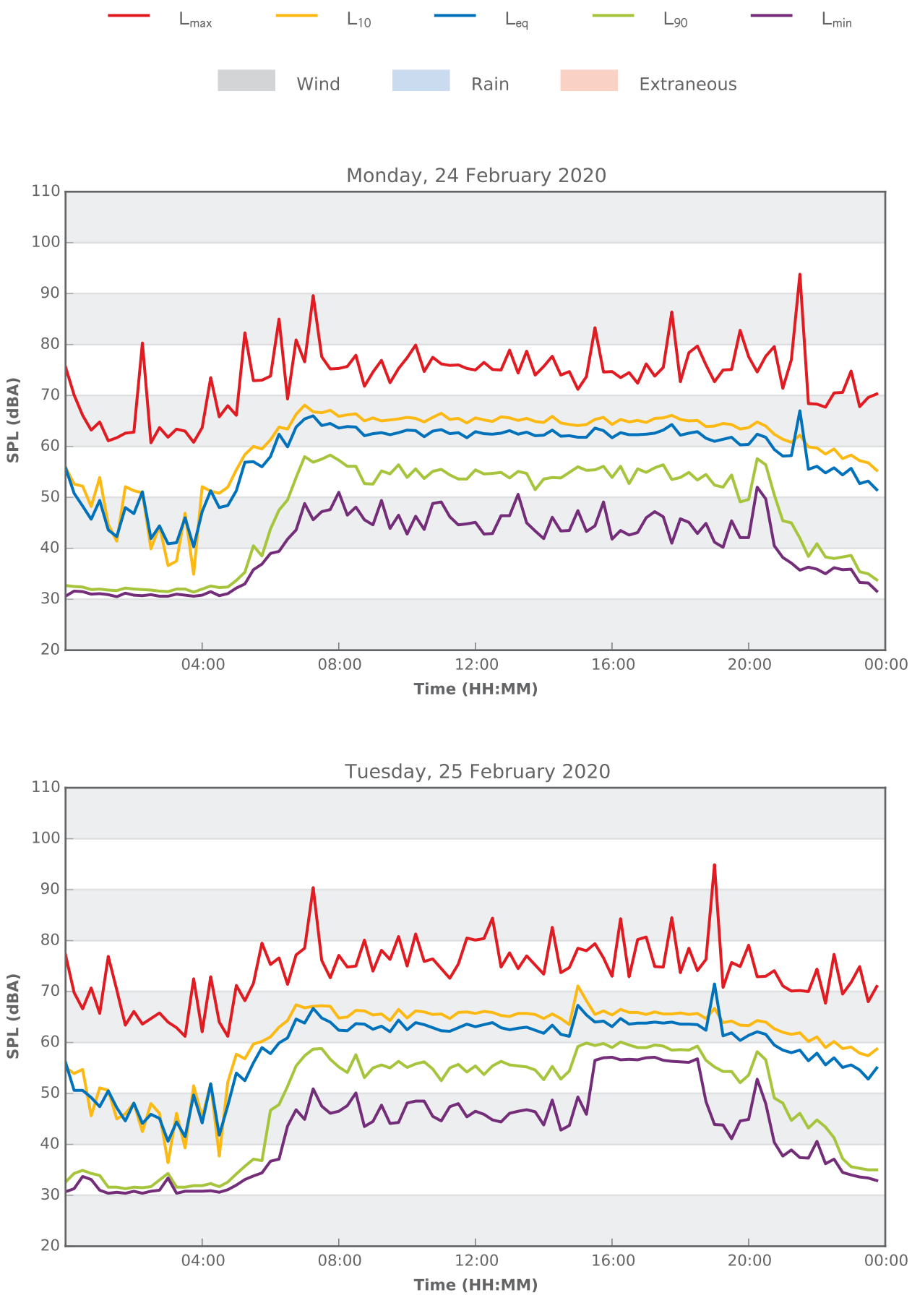


48 Towns Road, Vaucluse

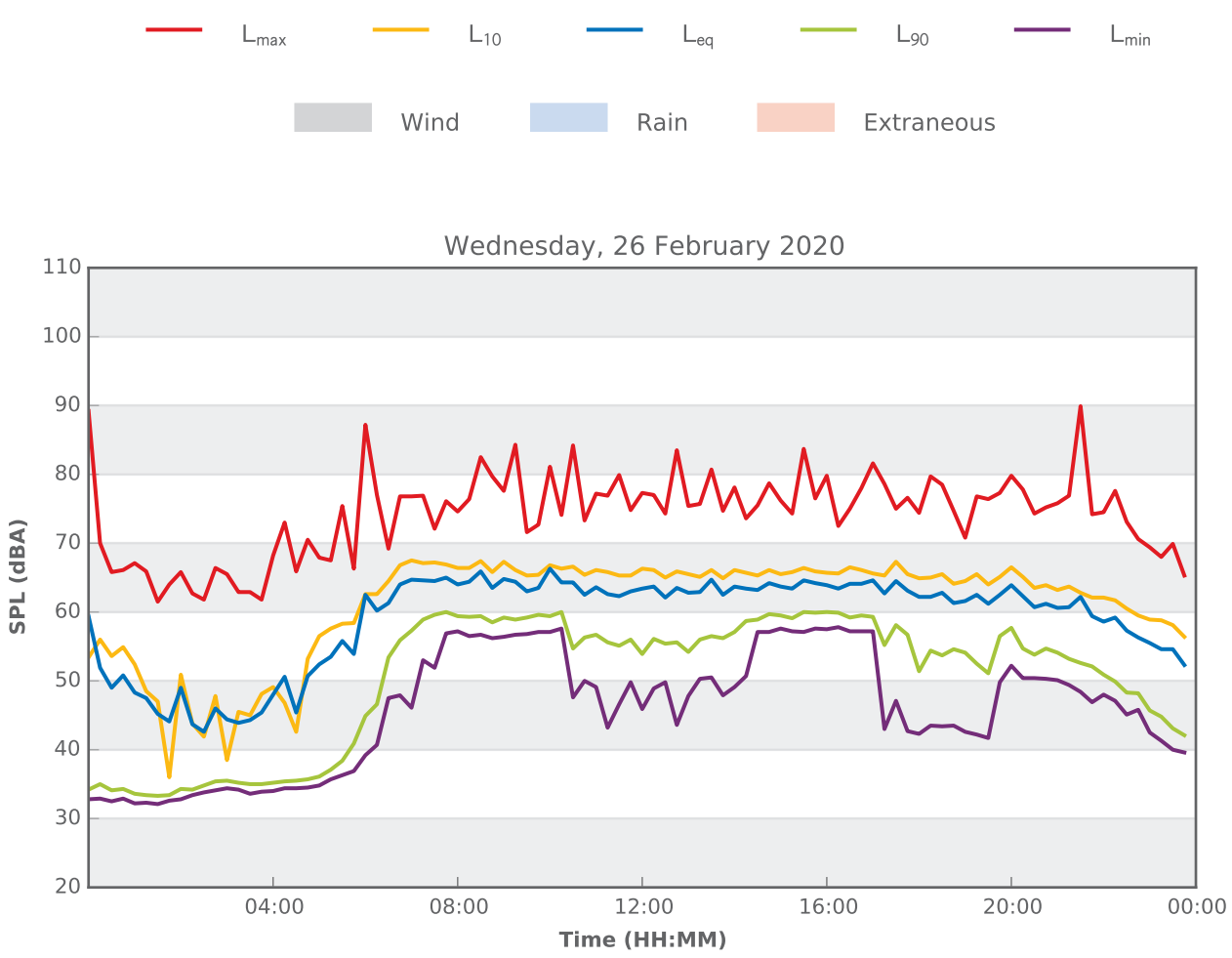


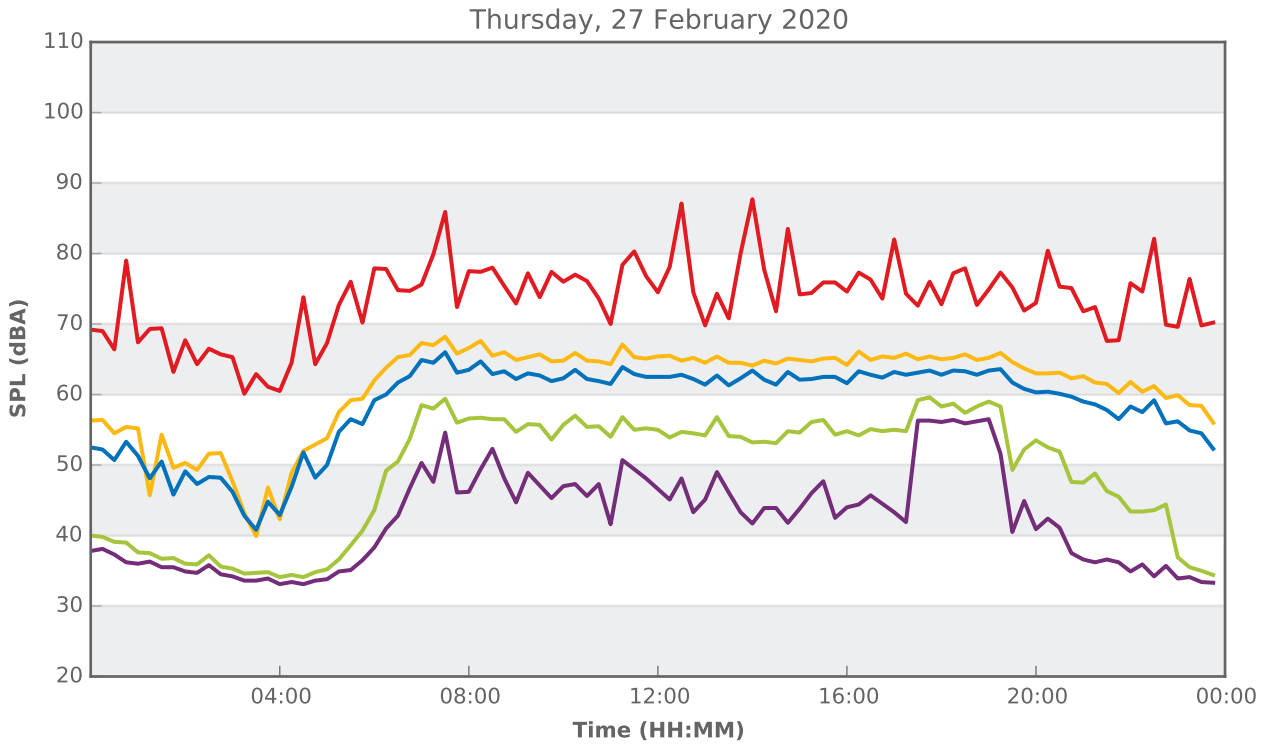


48 Towns Road, Vaucluse

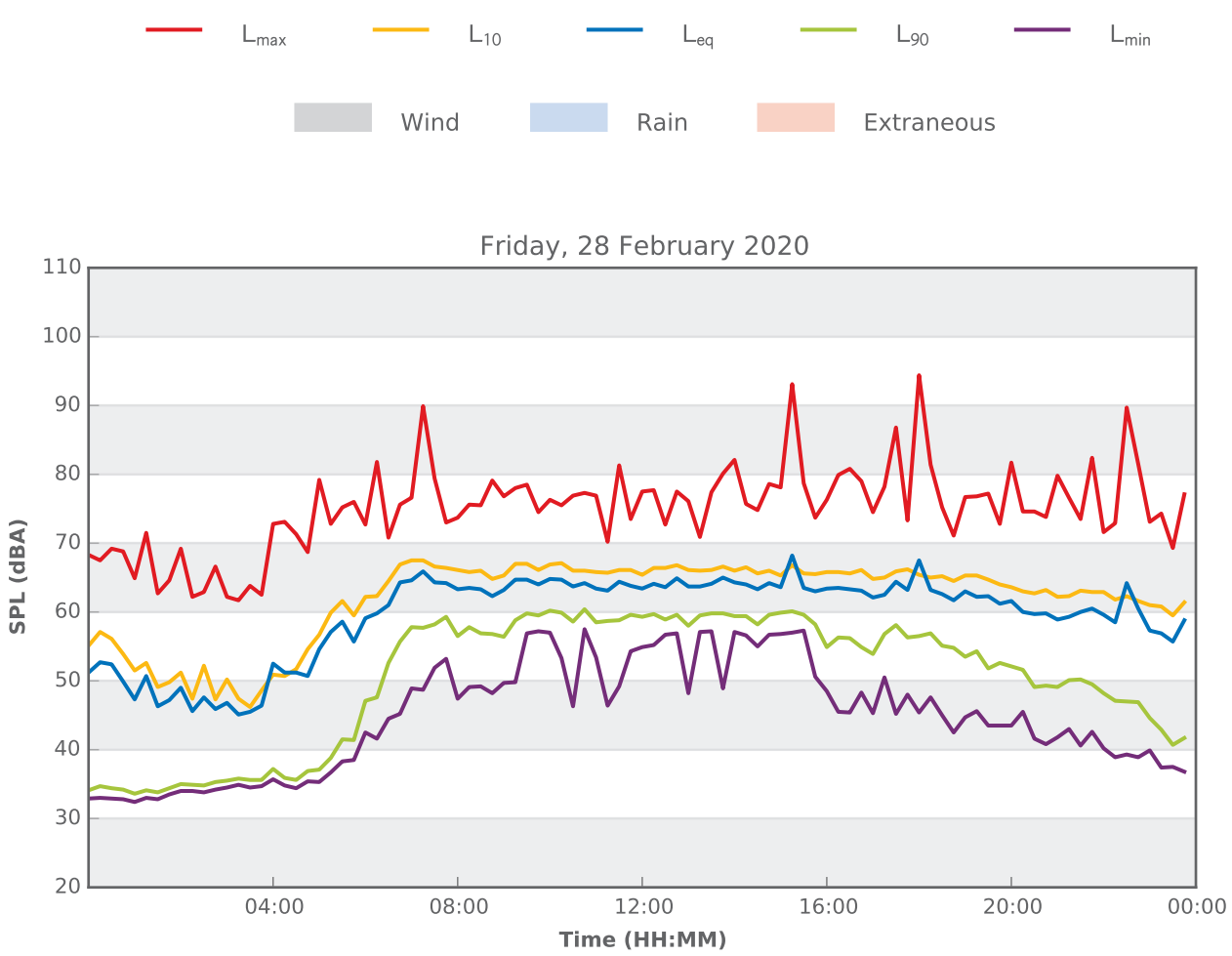


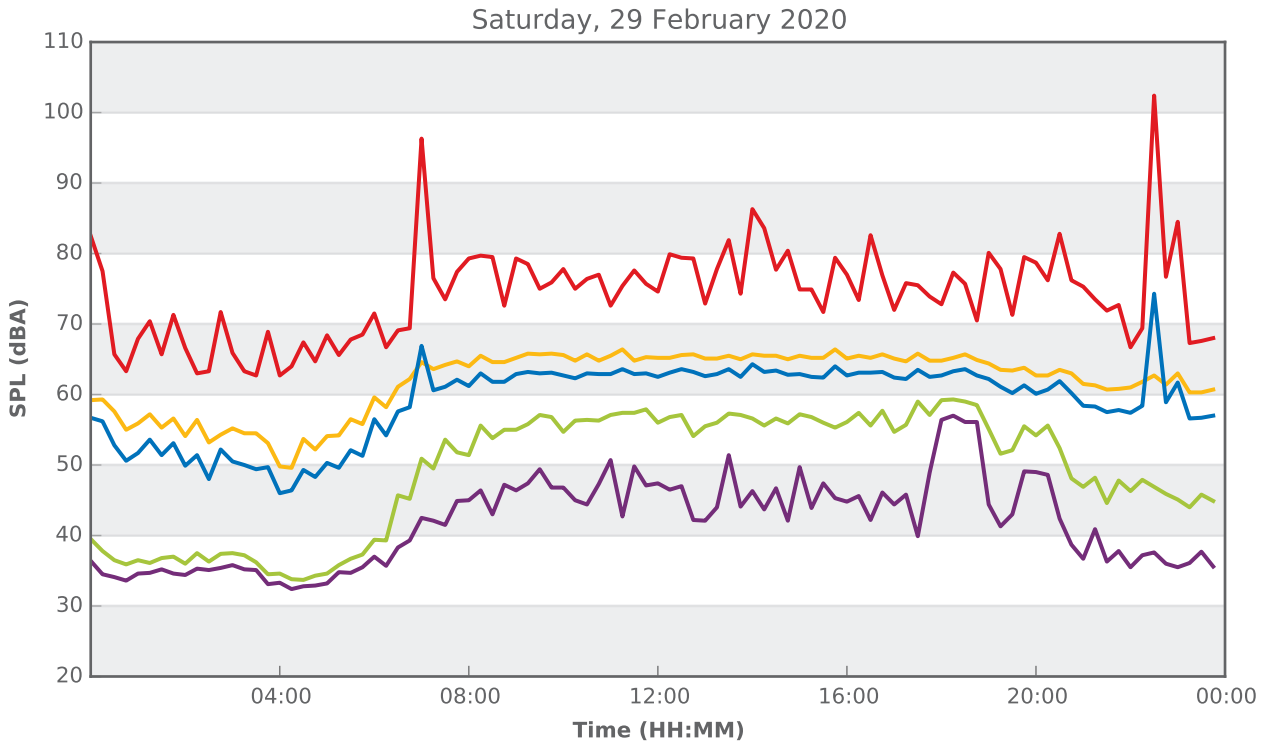
48 Towns Road, Vaucluse



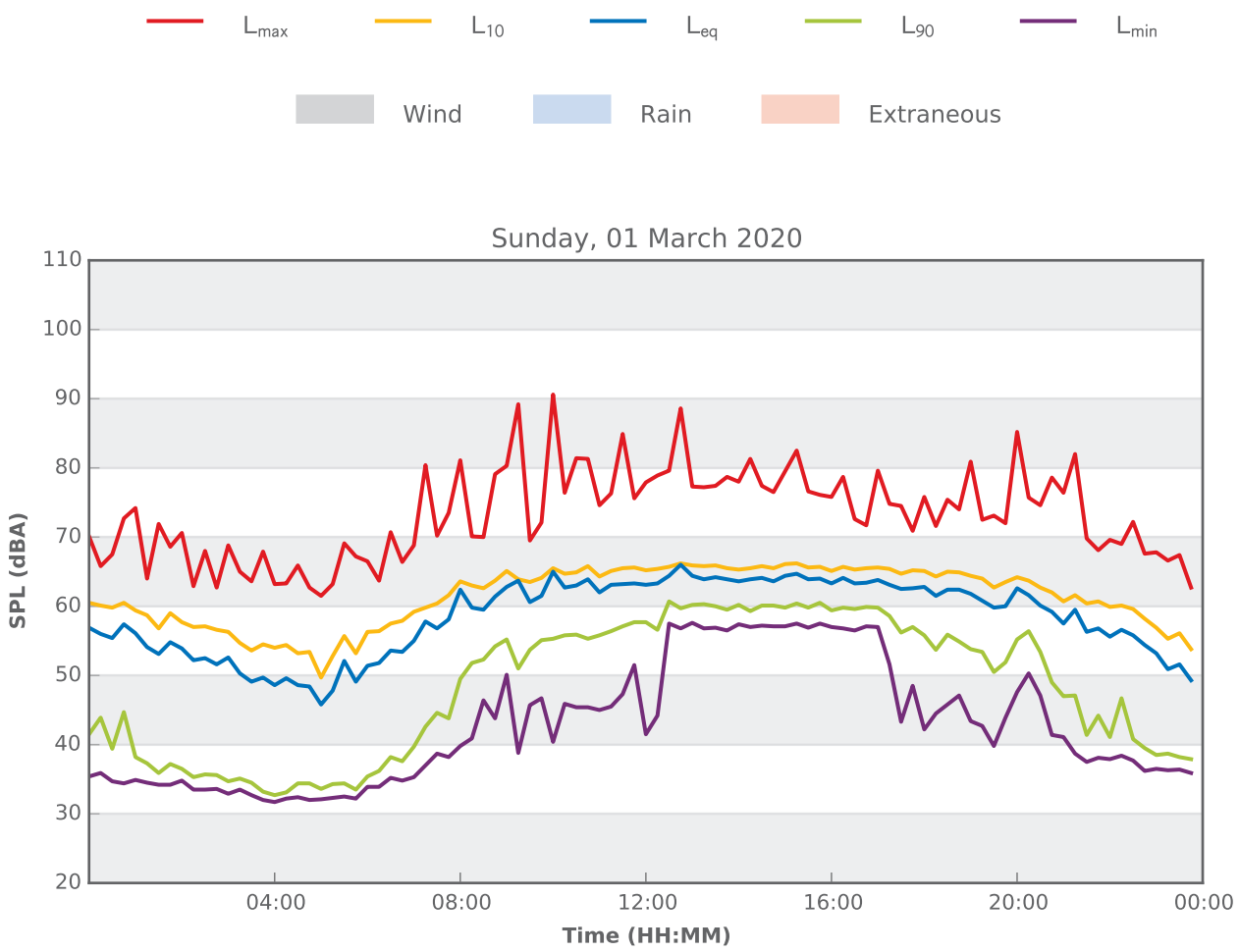


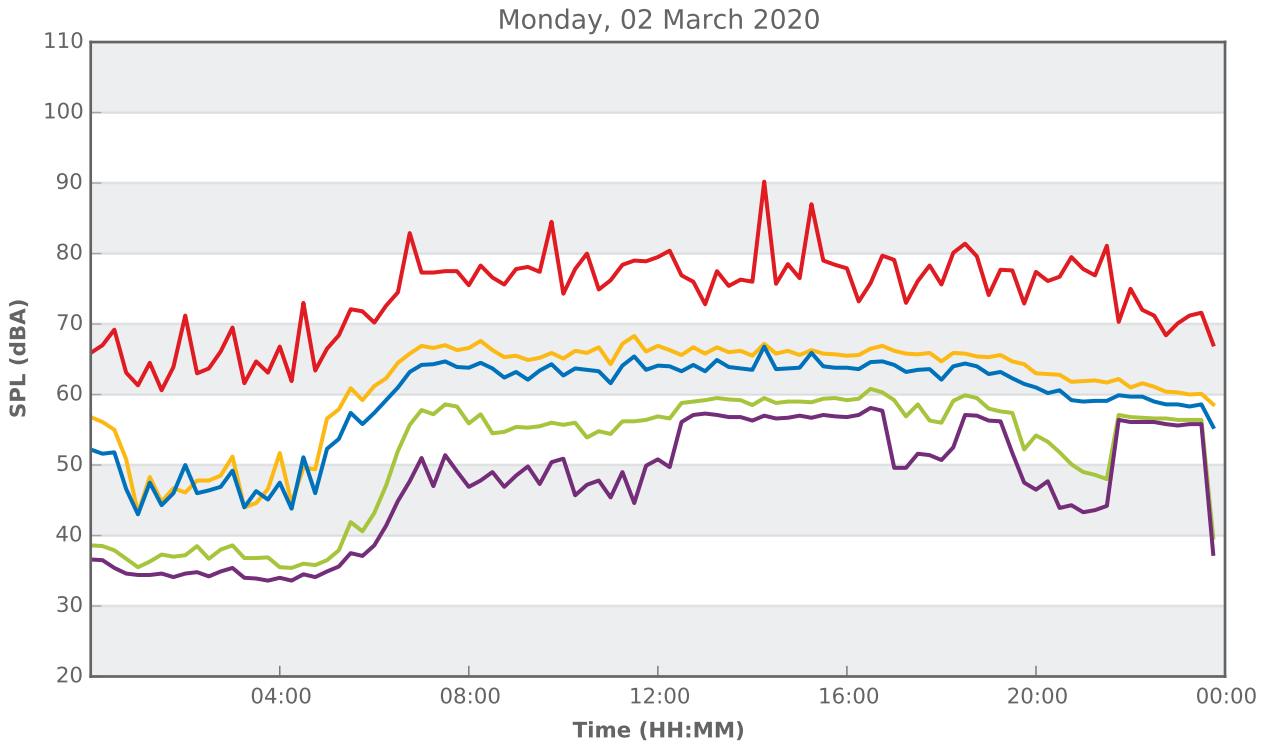
48 Towns Road, Vaucluse



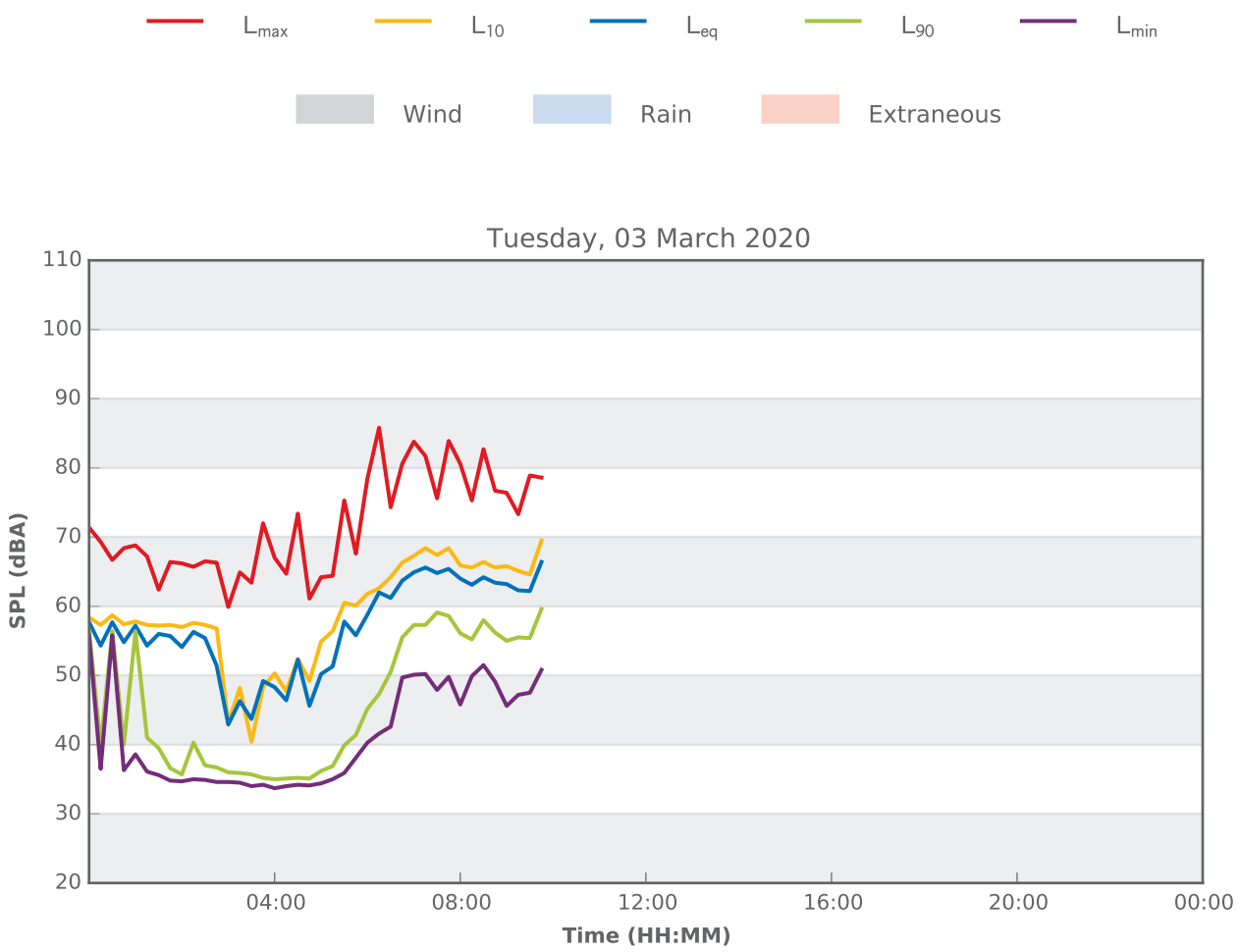


48 Towns Road, Vaucluse

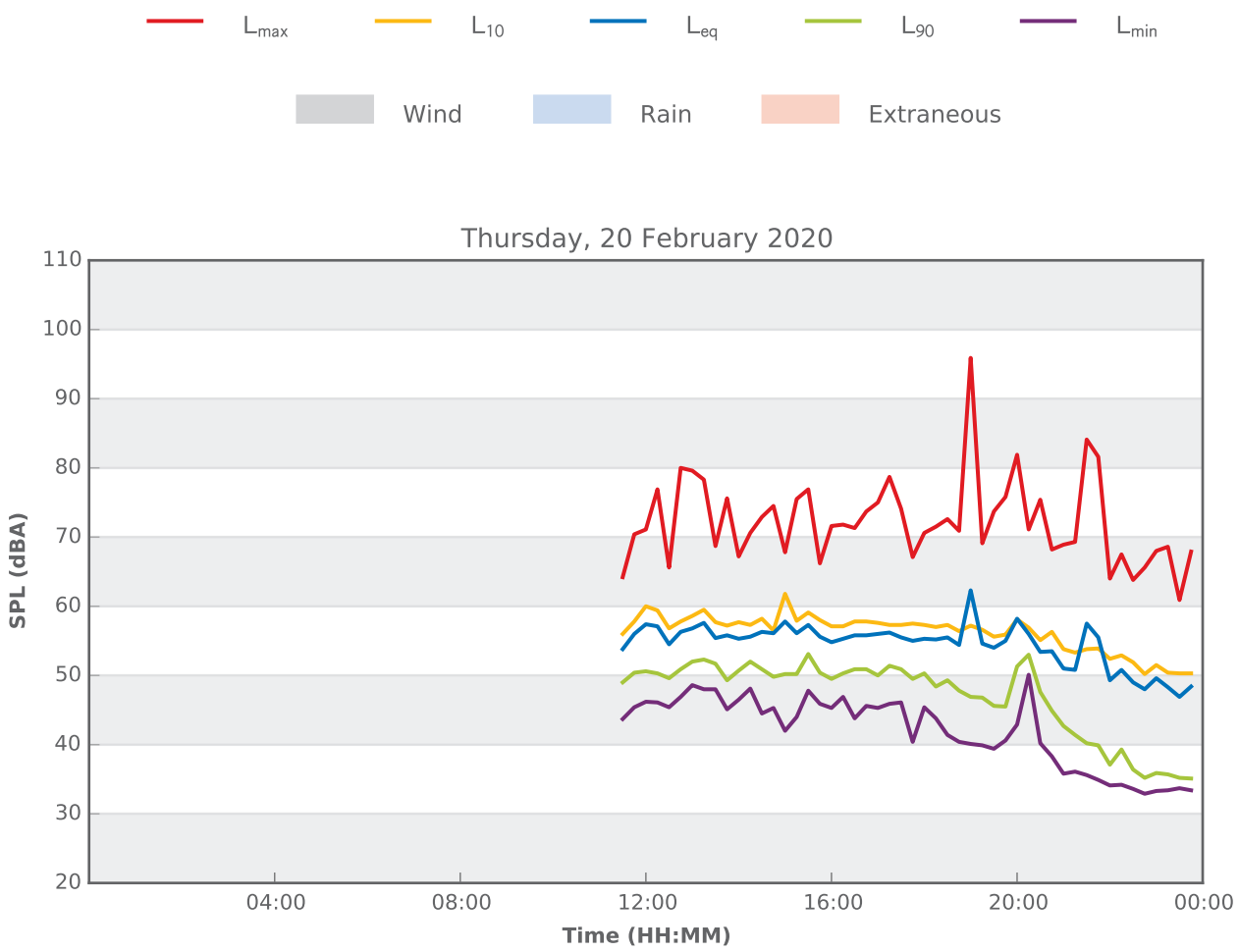


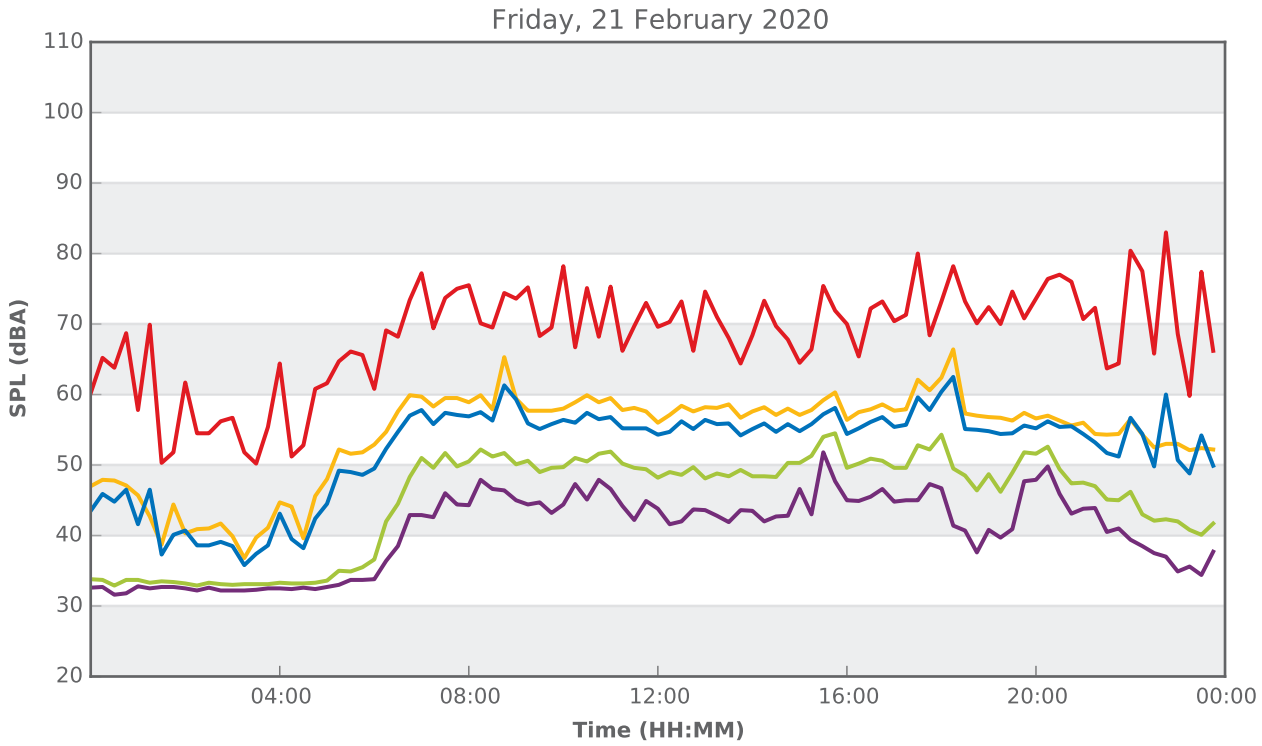


48 Towns Road, Vaucluse

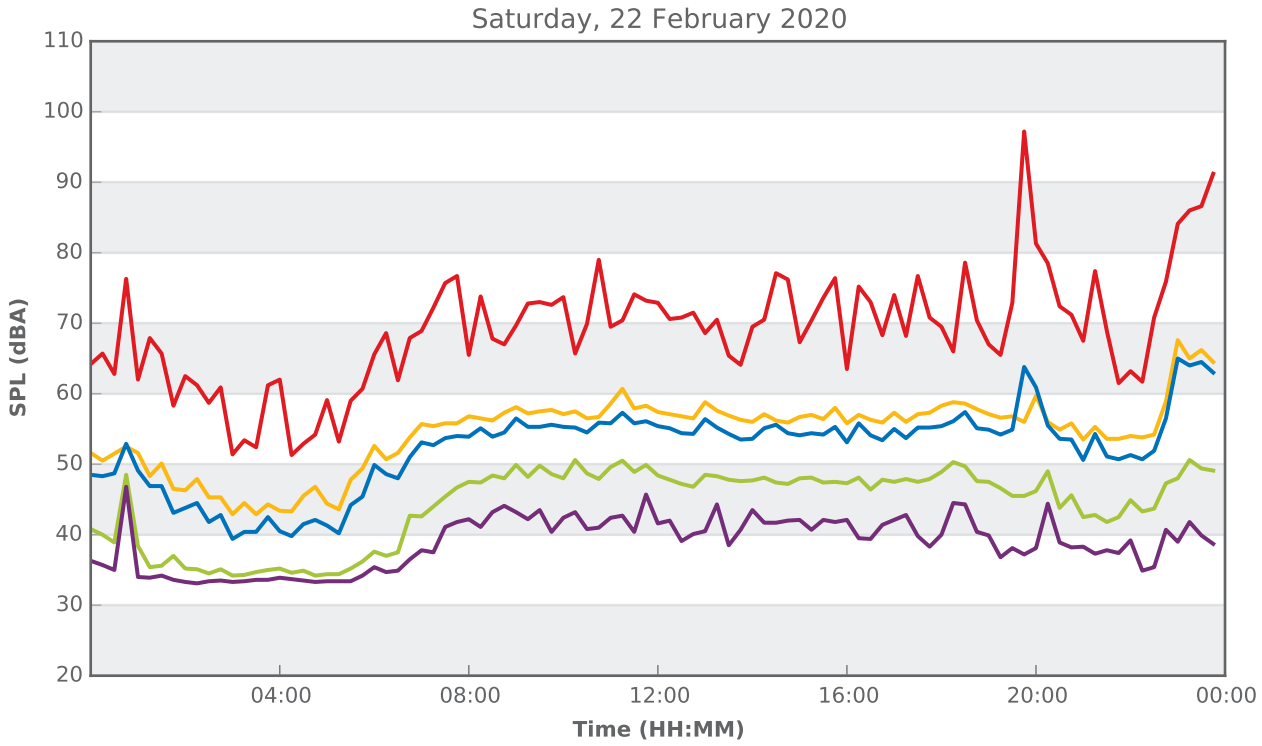


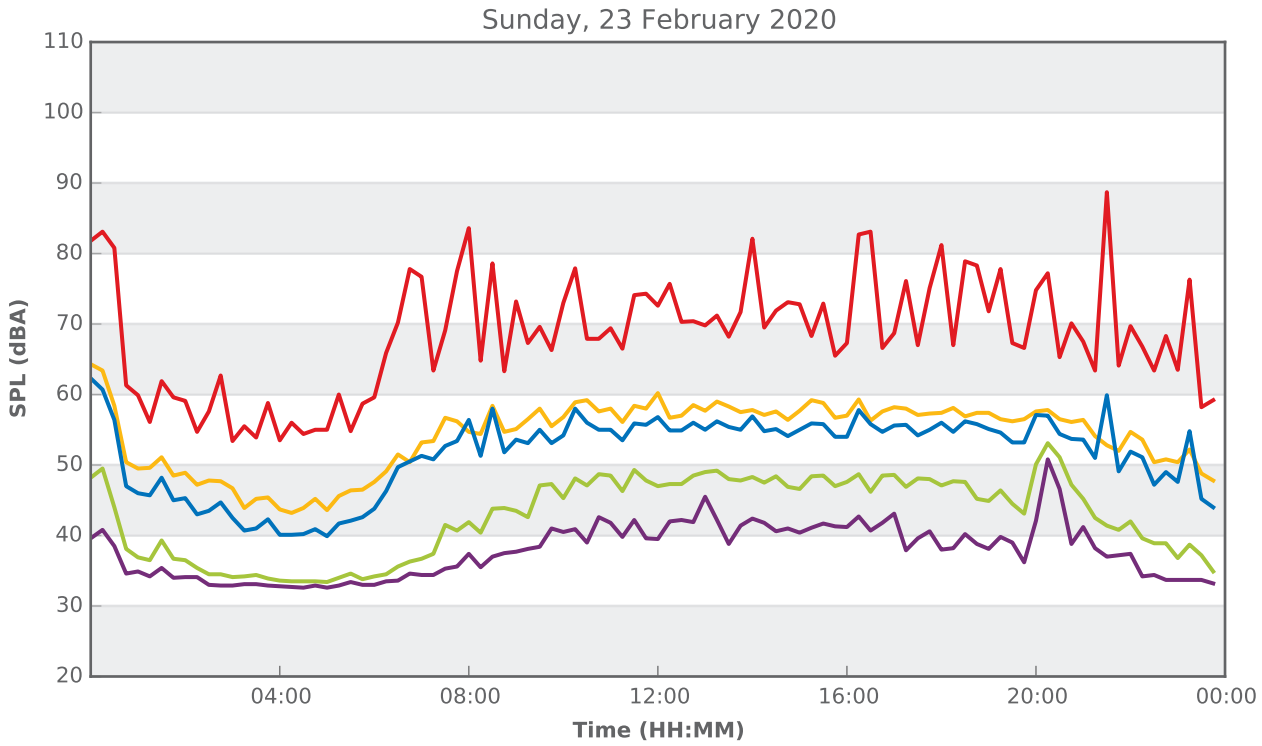
3 Tivoli Avenue, Rose Bay



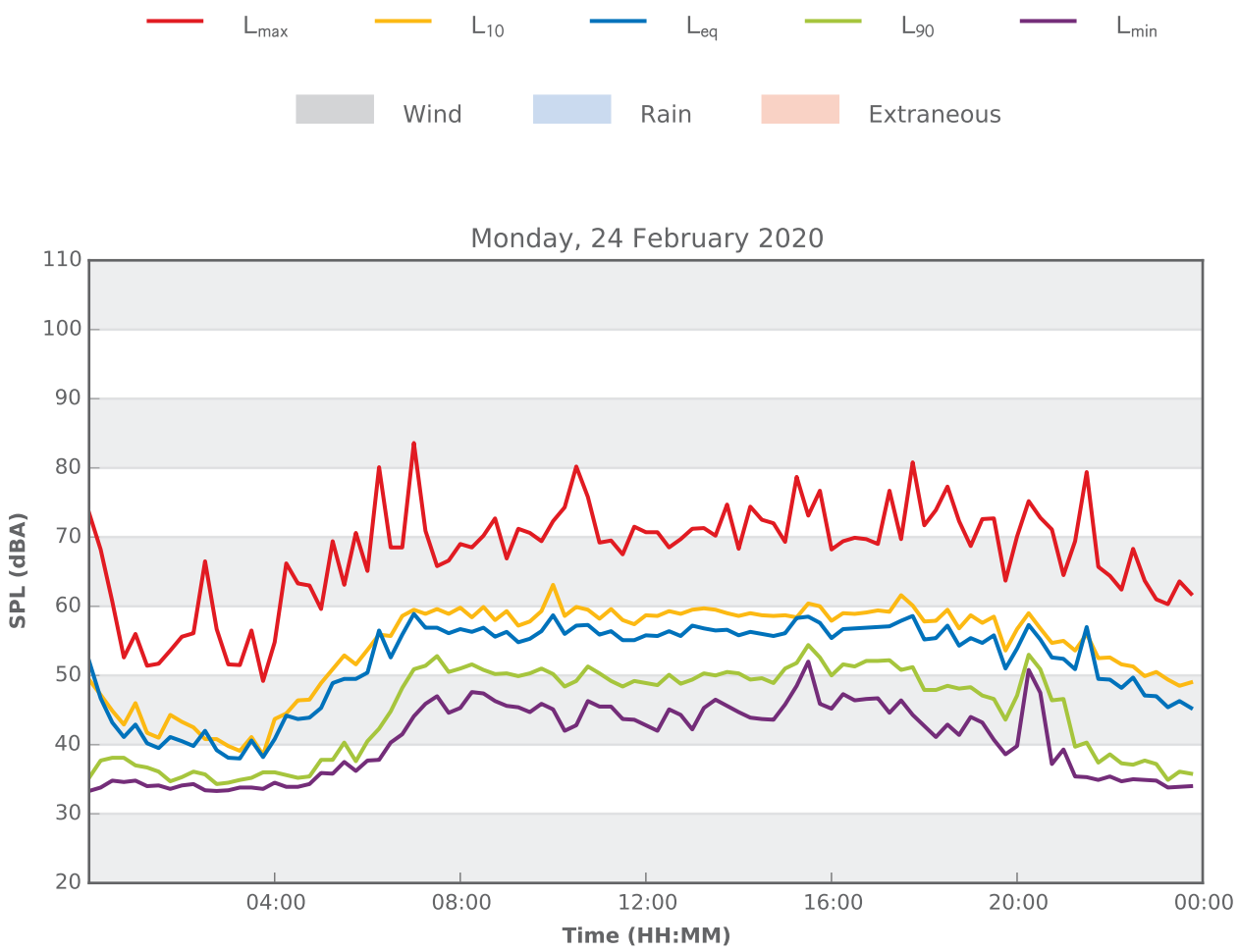


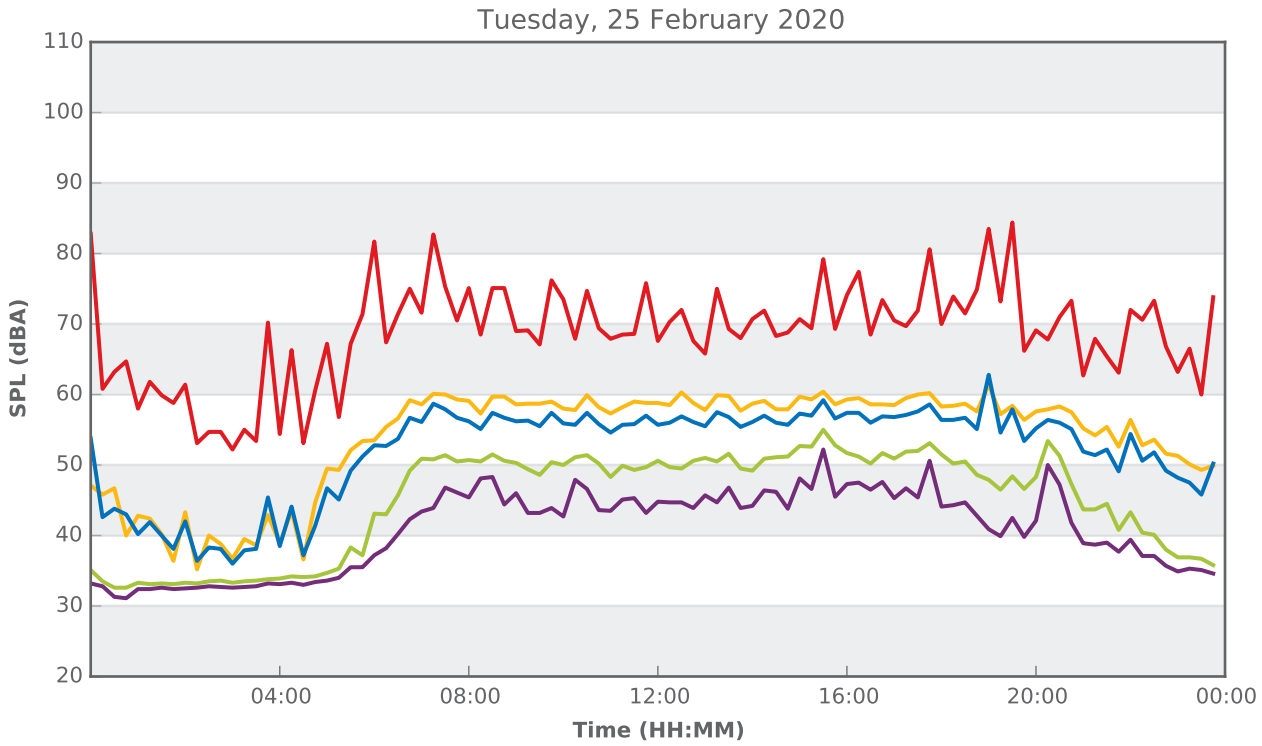
3 Tivoli Avenue, Rose Bay



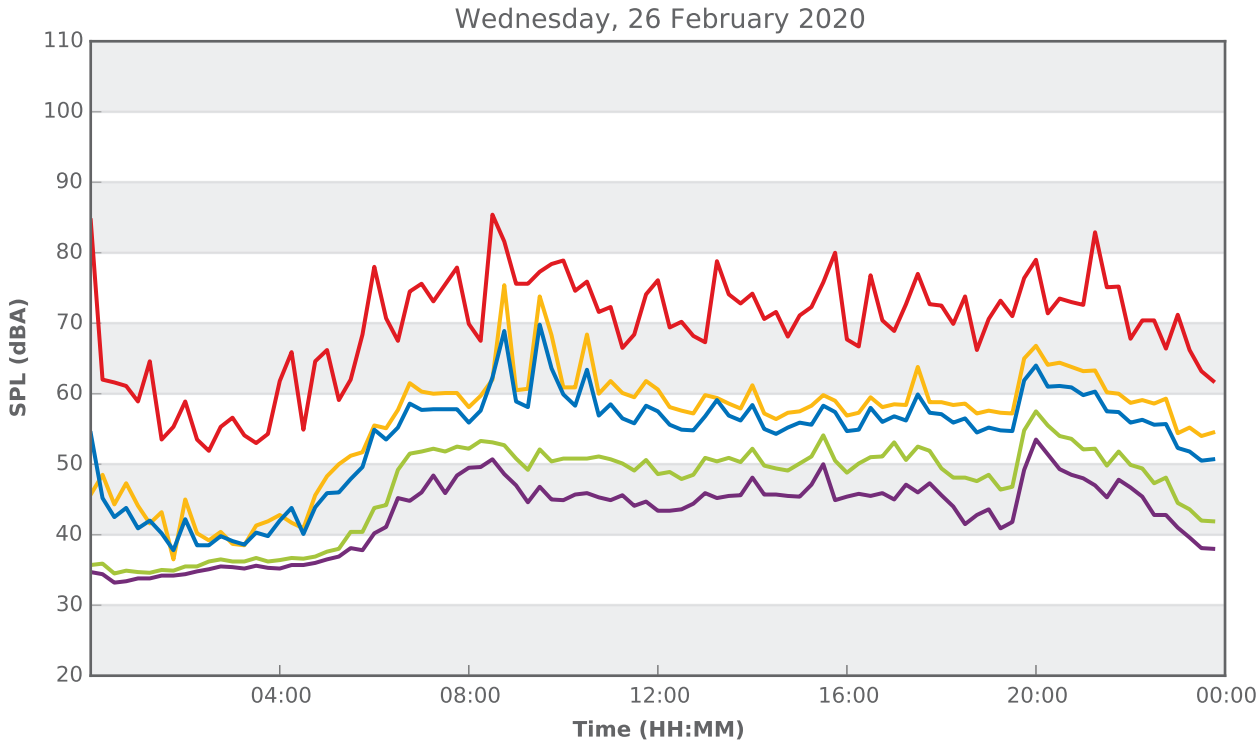


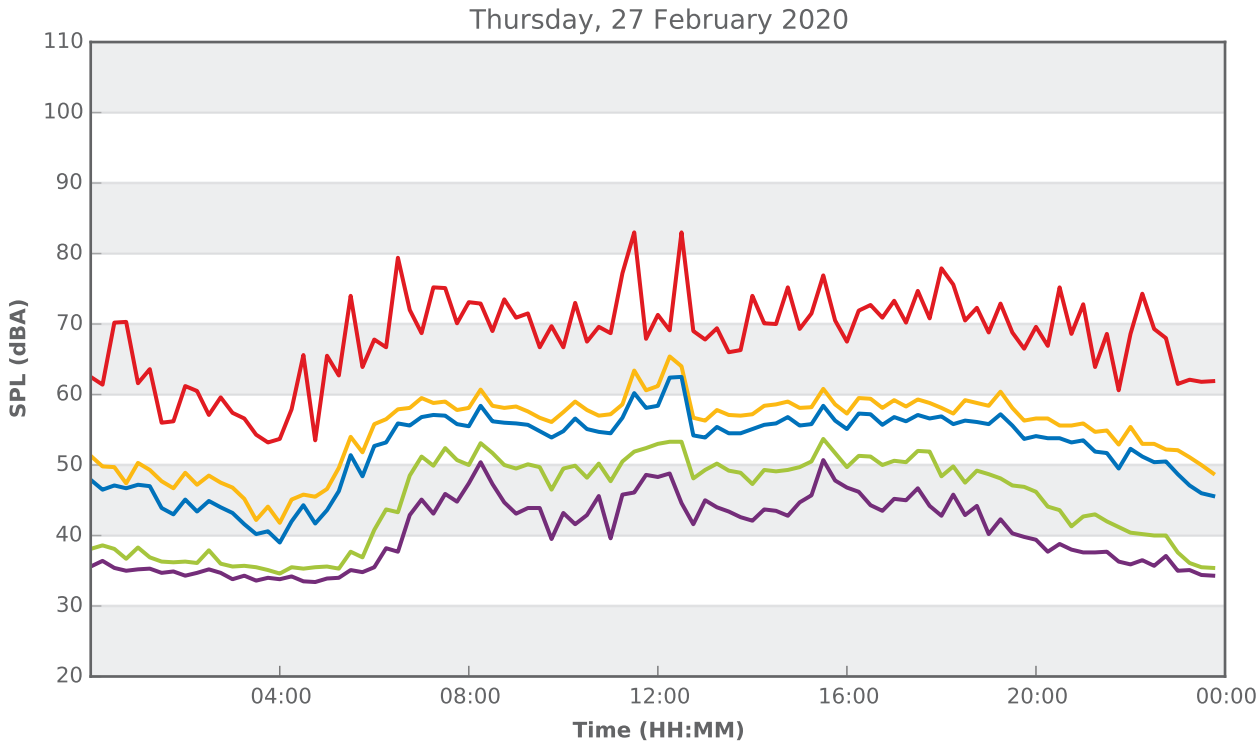
3 Tivoli Avenue, Rose Bay



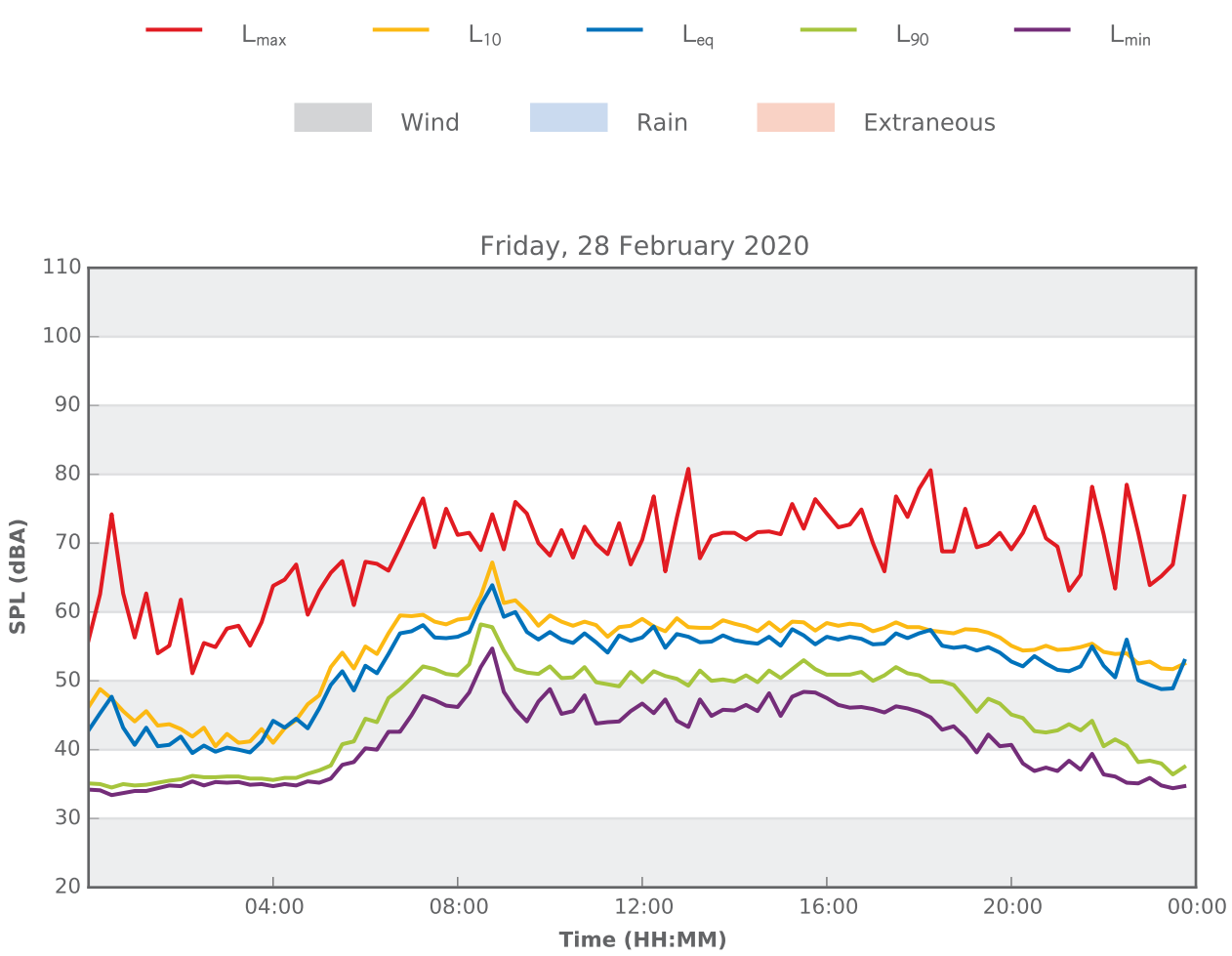


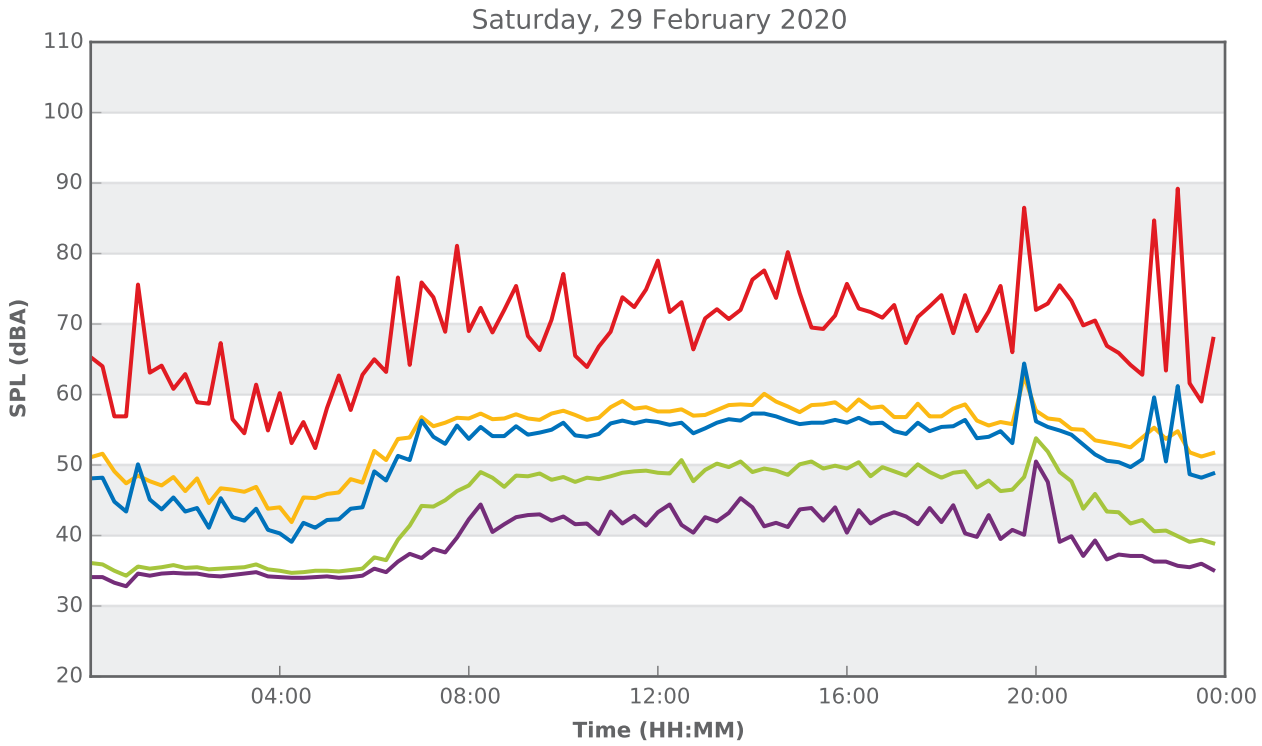
3 Tivoli Avenue, Rose Bay



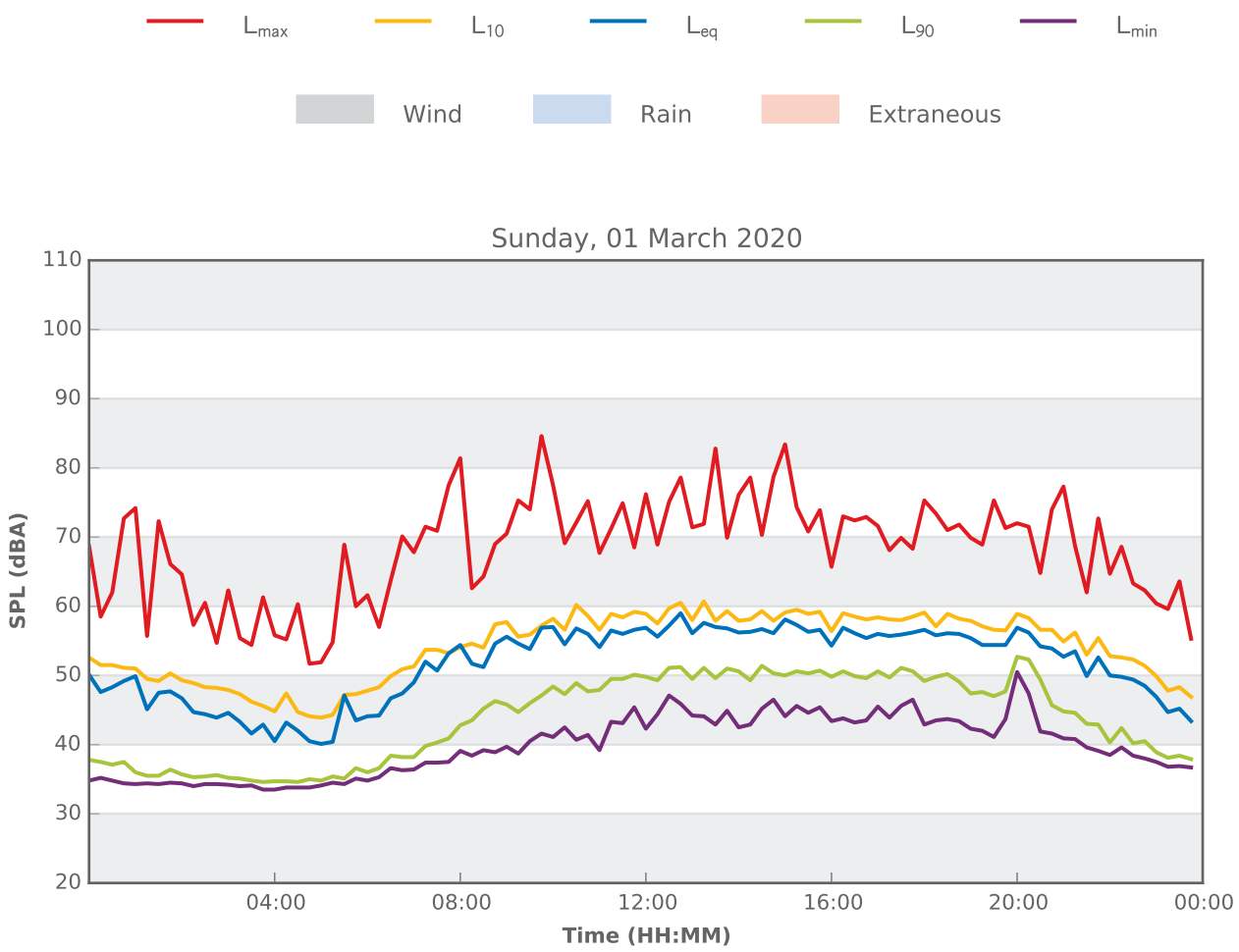


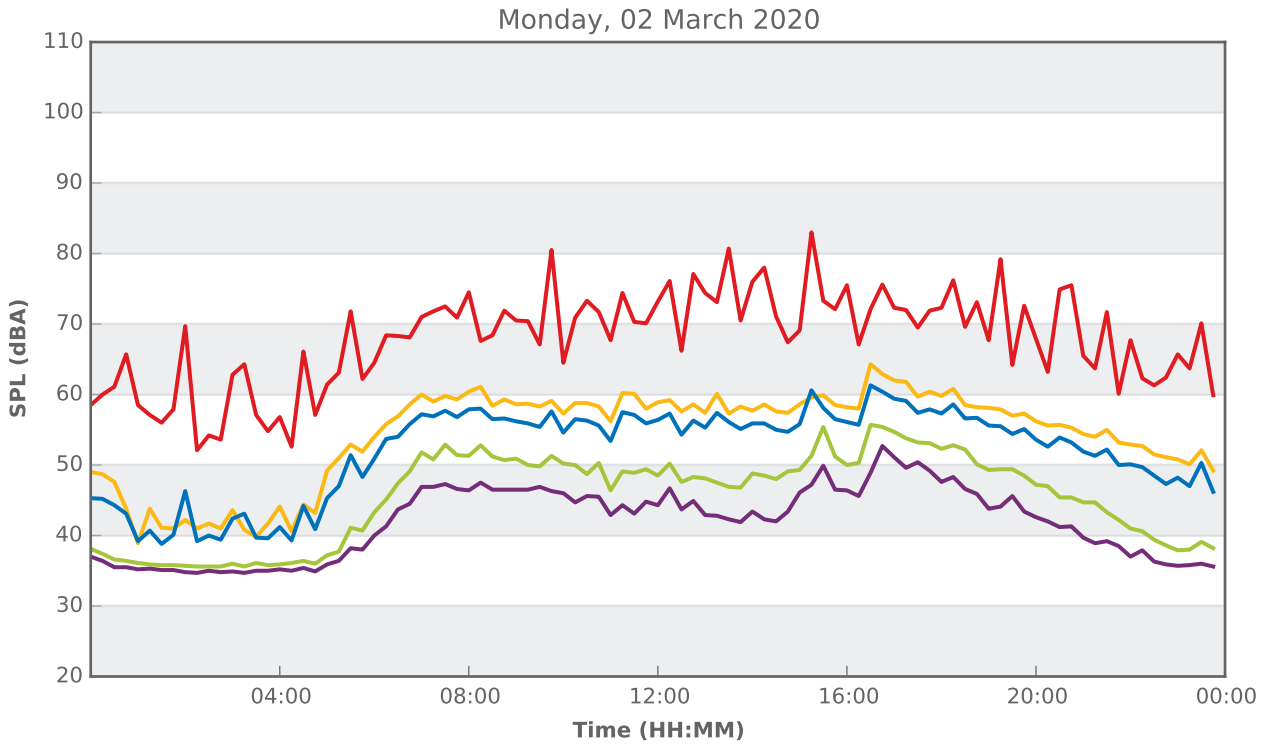
3 Tivoli Avenue, Rose Bay



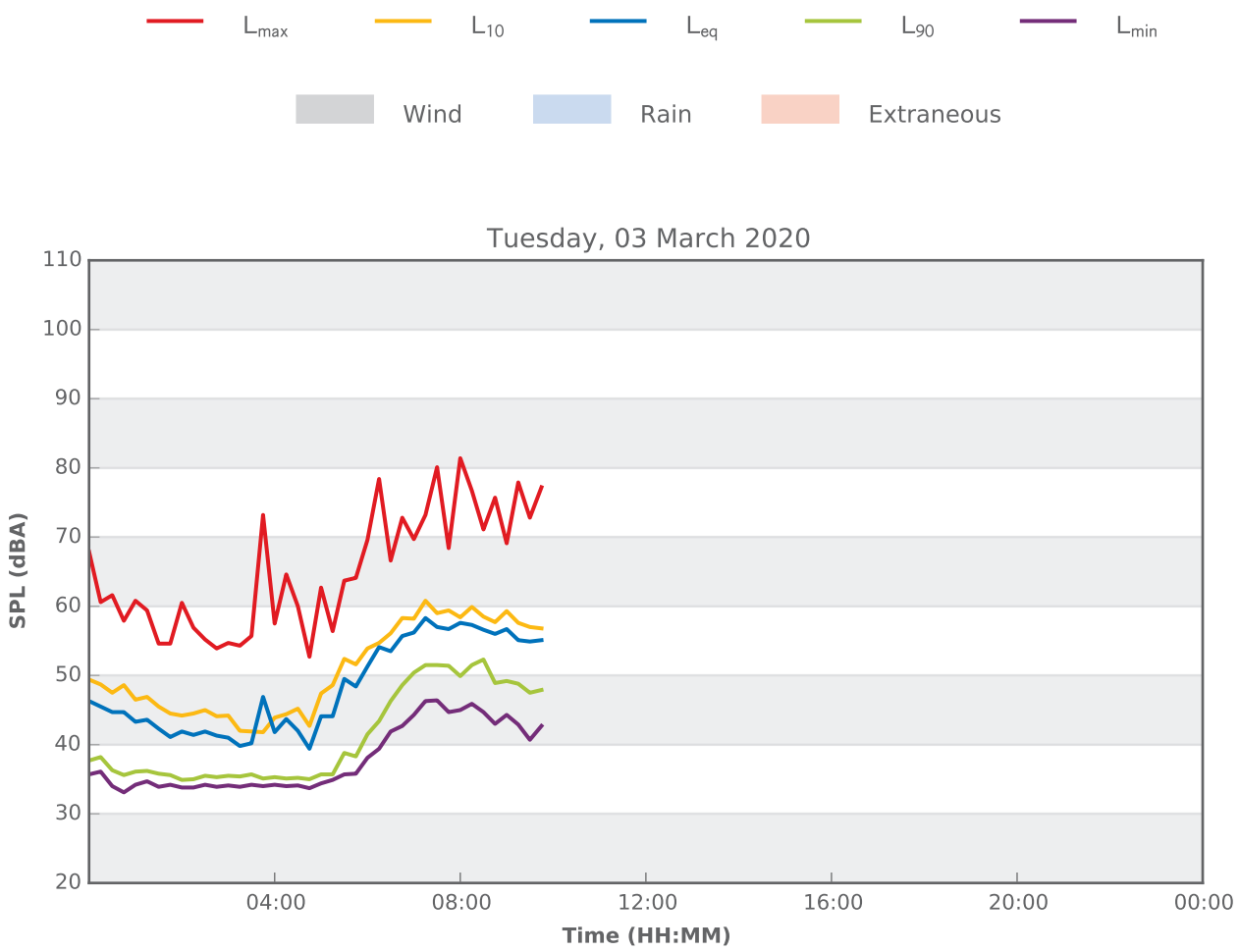


3 Tivoli Avenue, Rose Bay

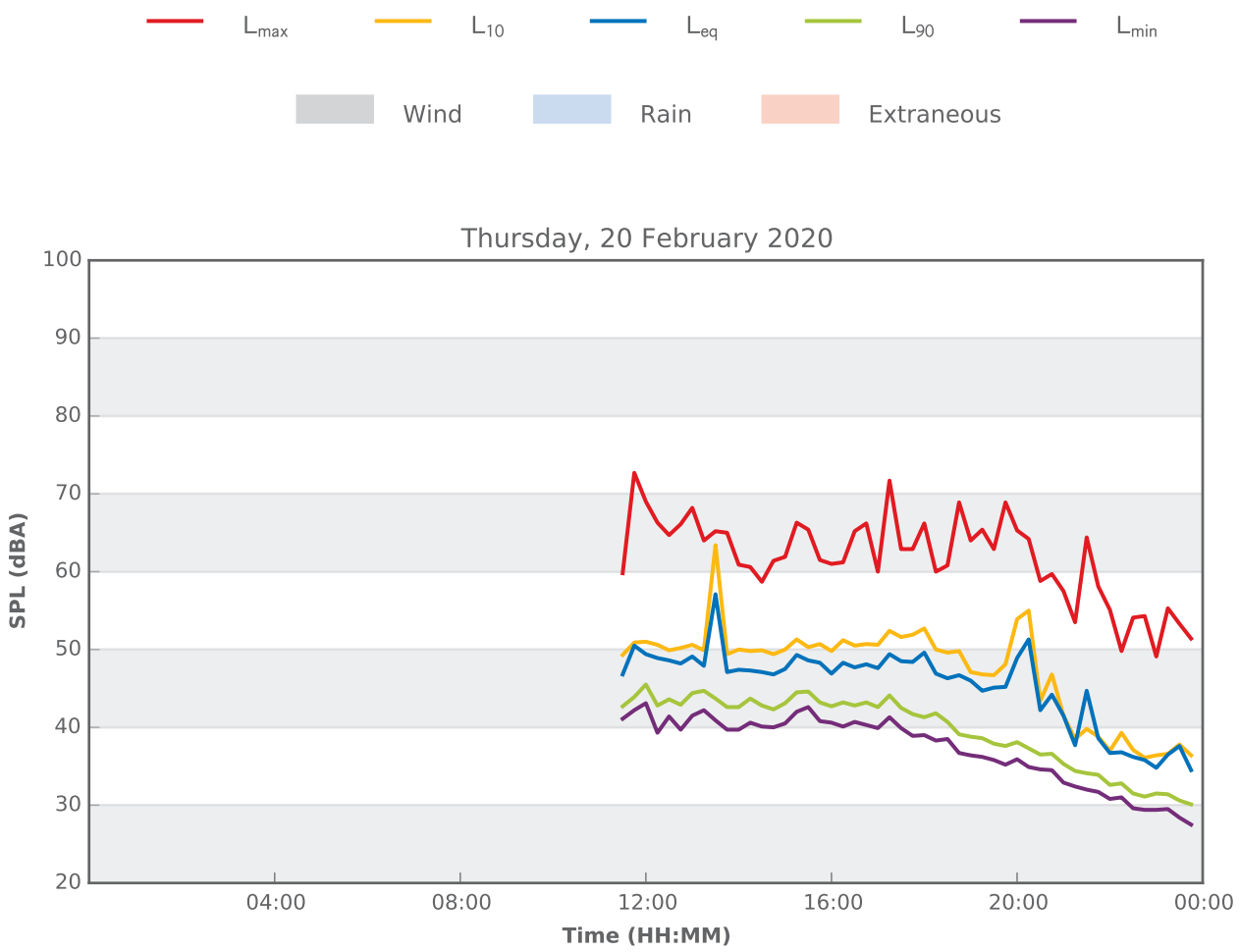


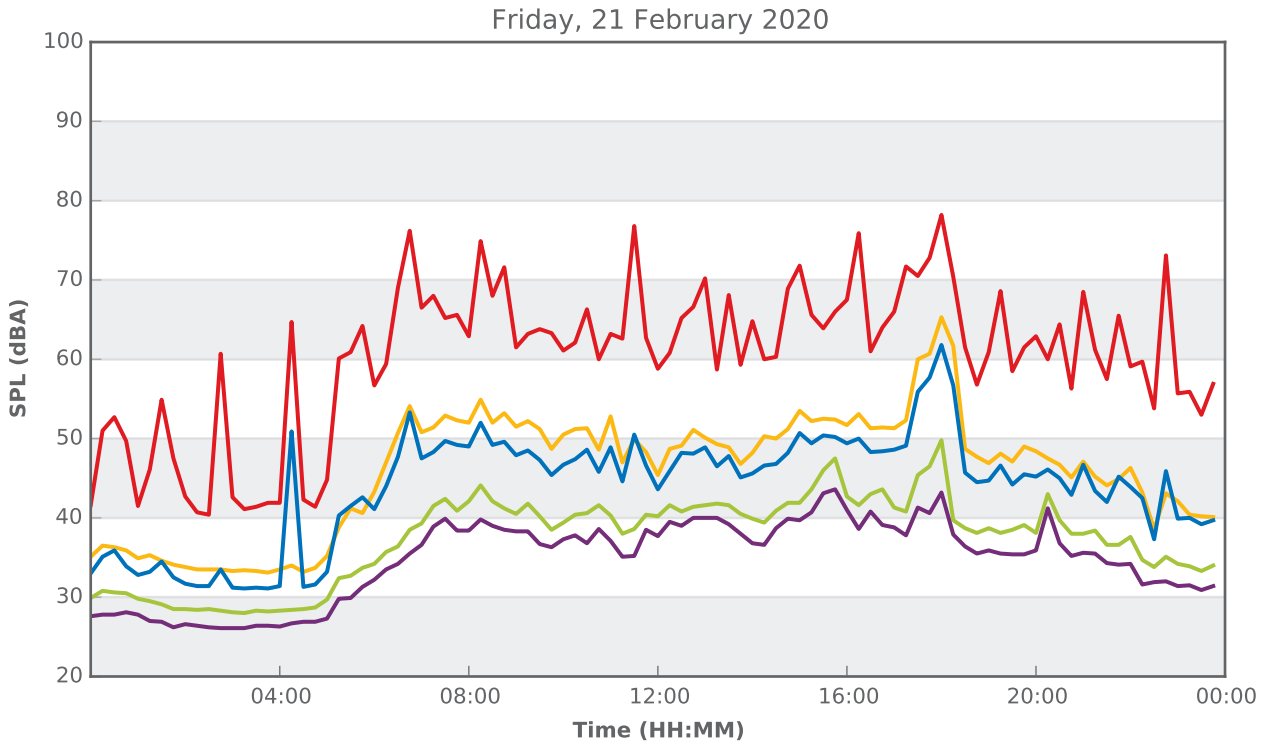


3 Tivoli Avenue, Rose Bay

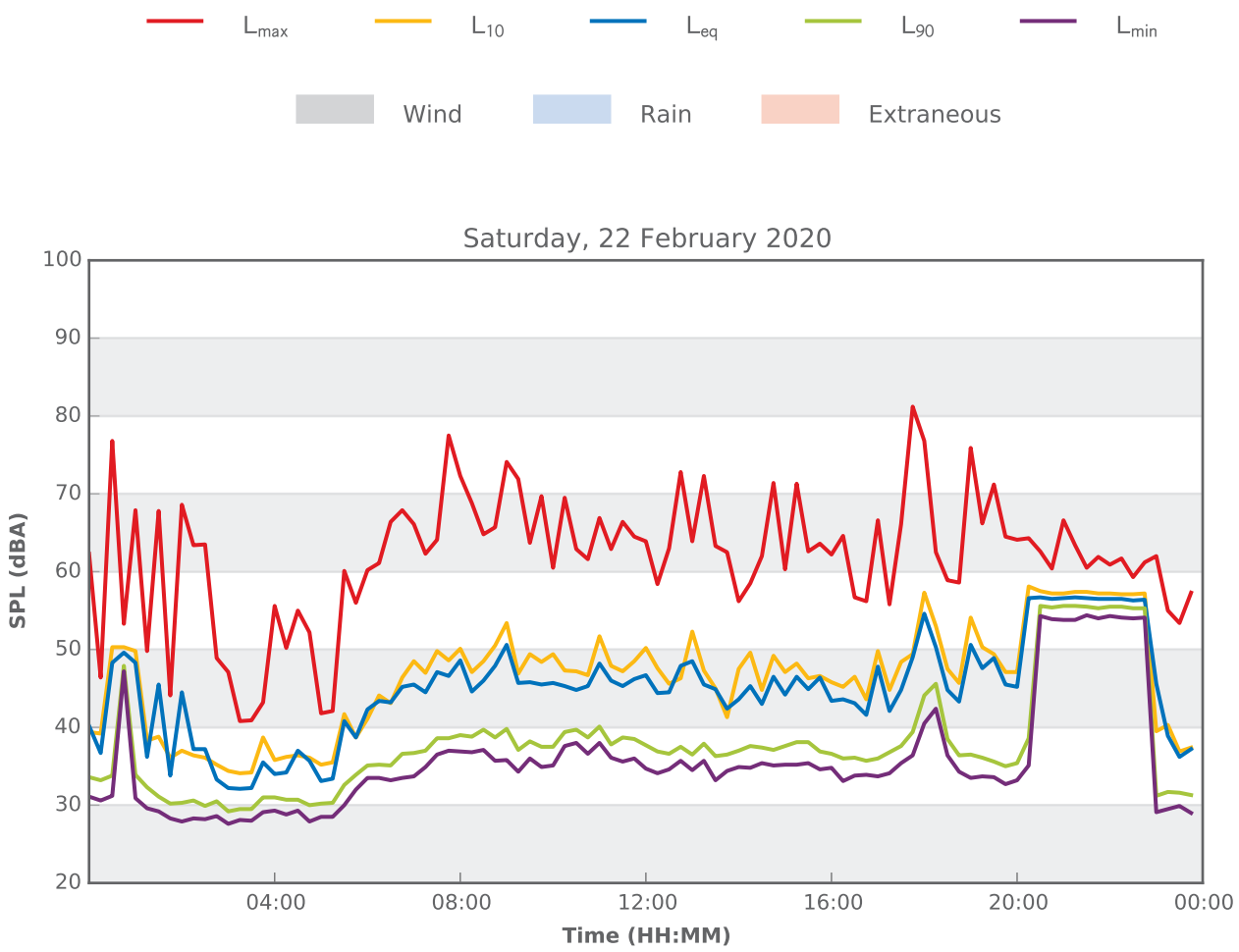


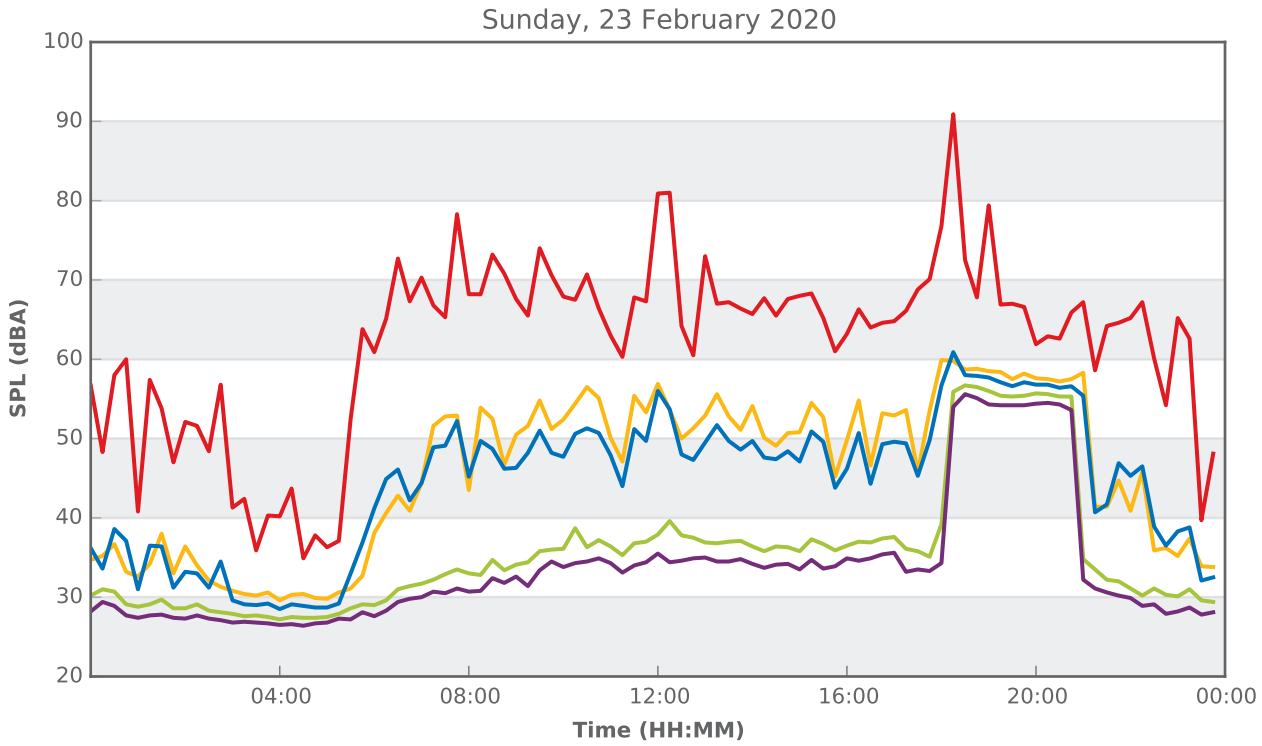
10 Tivoli Avenue, Rose Bay



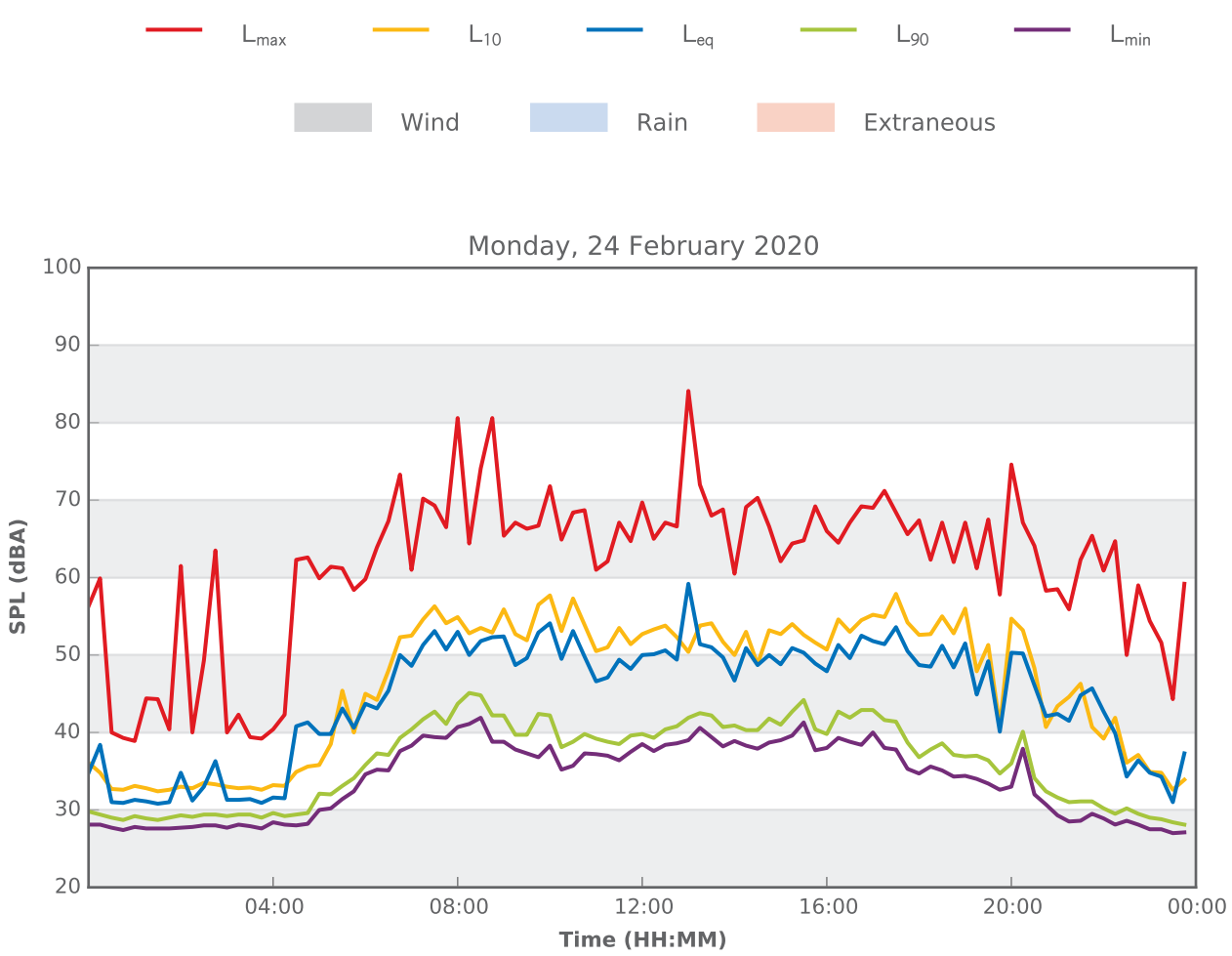


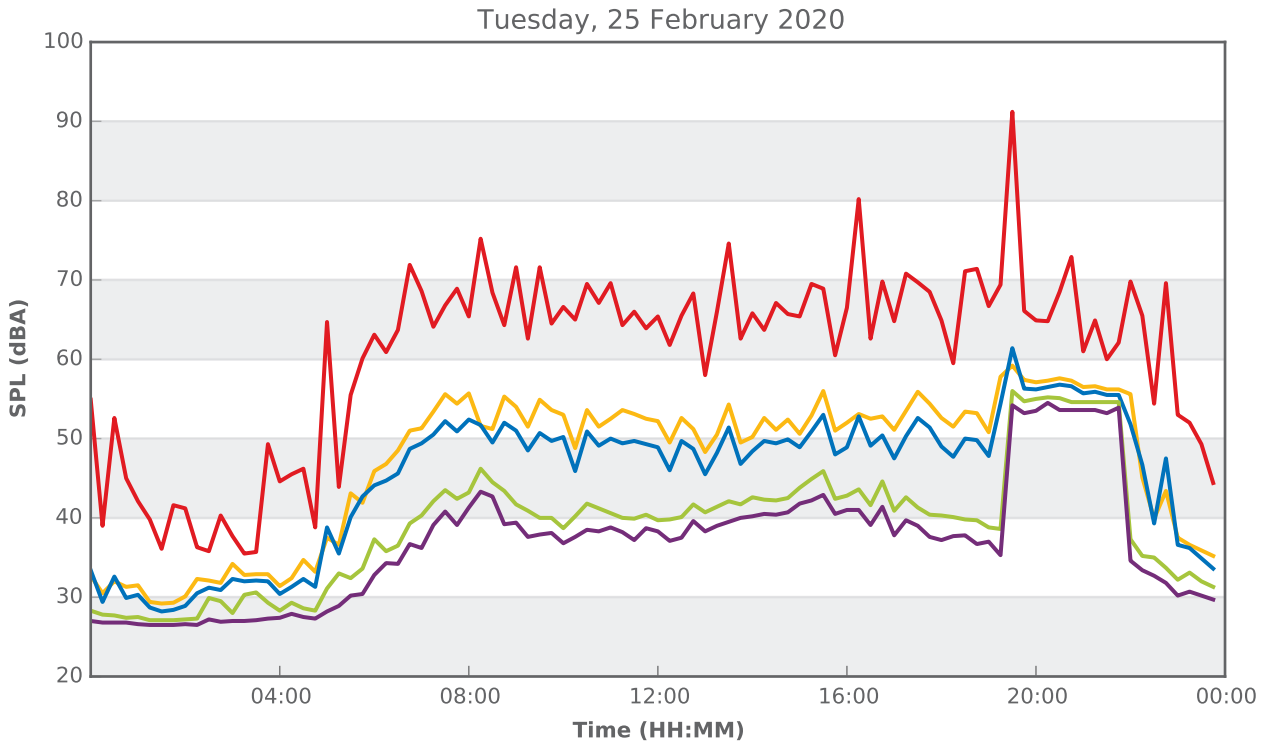
10 Tivoli Avenue, Rose Bay



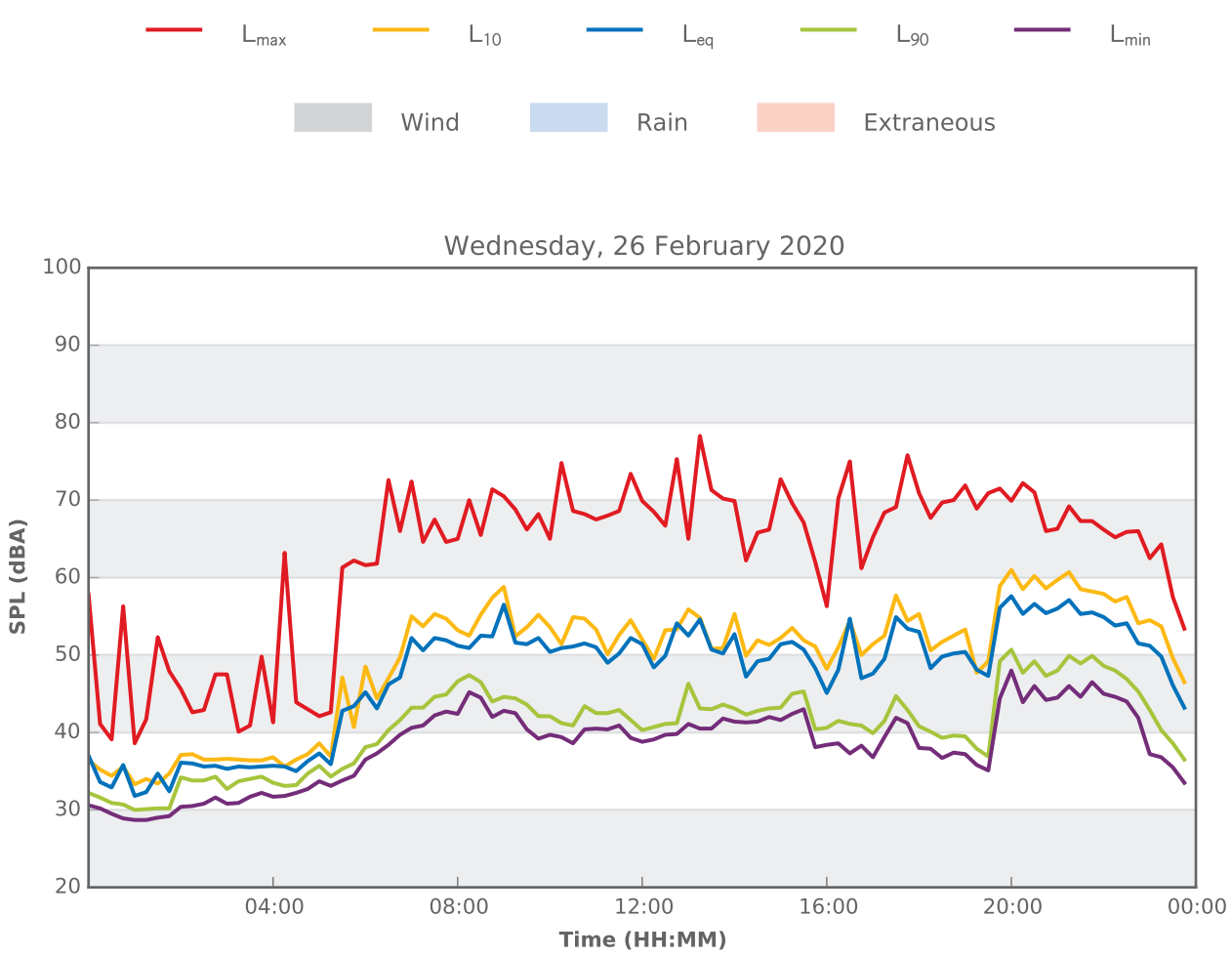


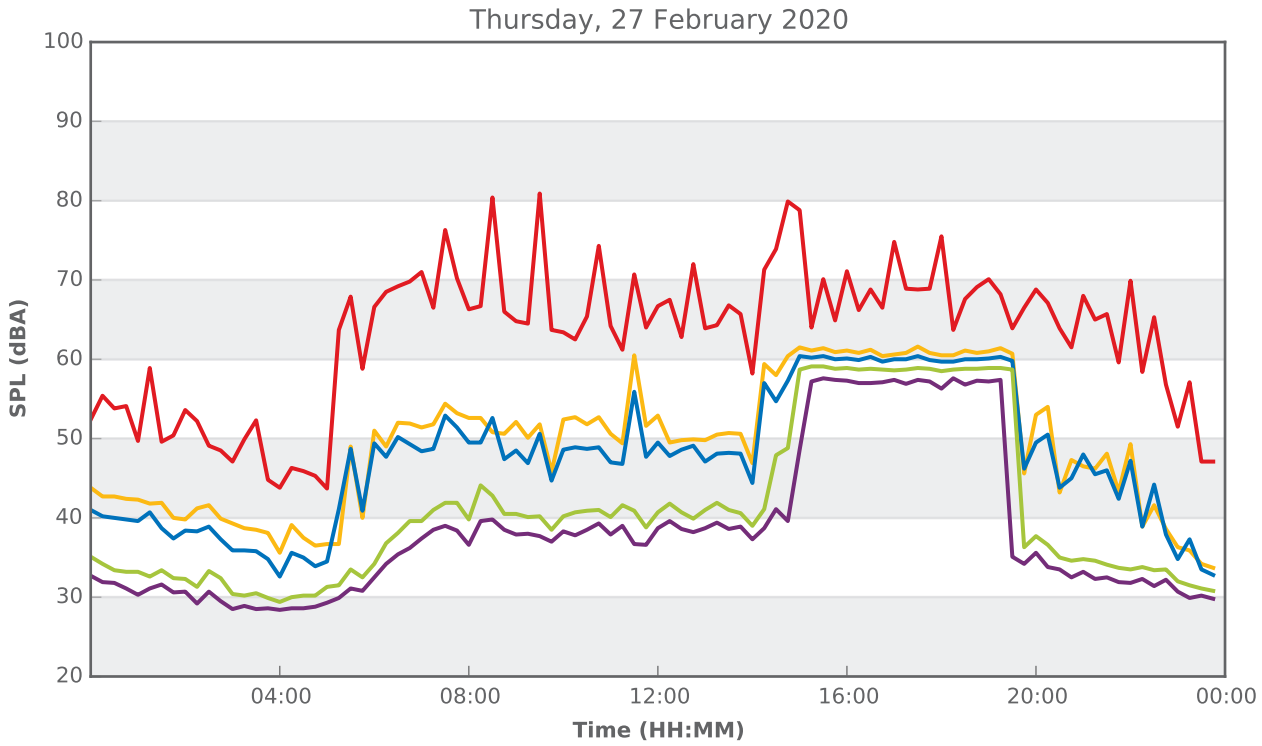
10 Tivoli Avenue, Rose Bay



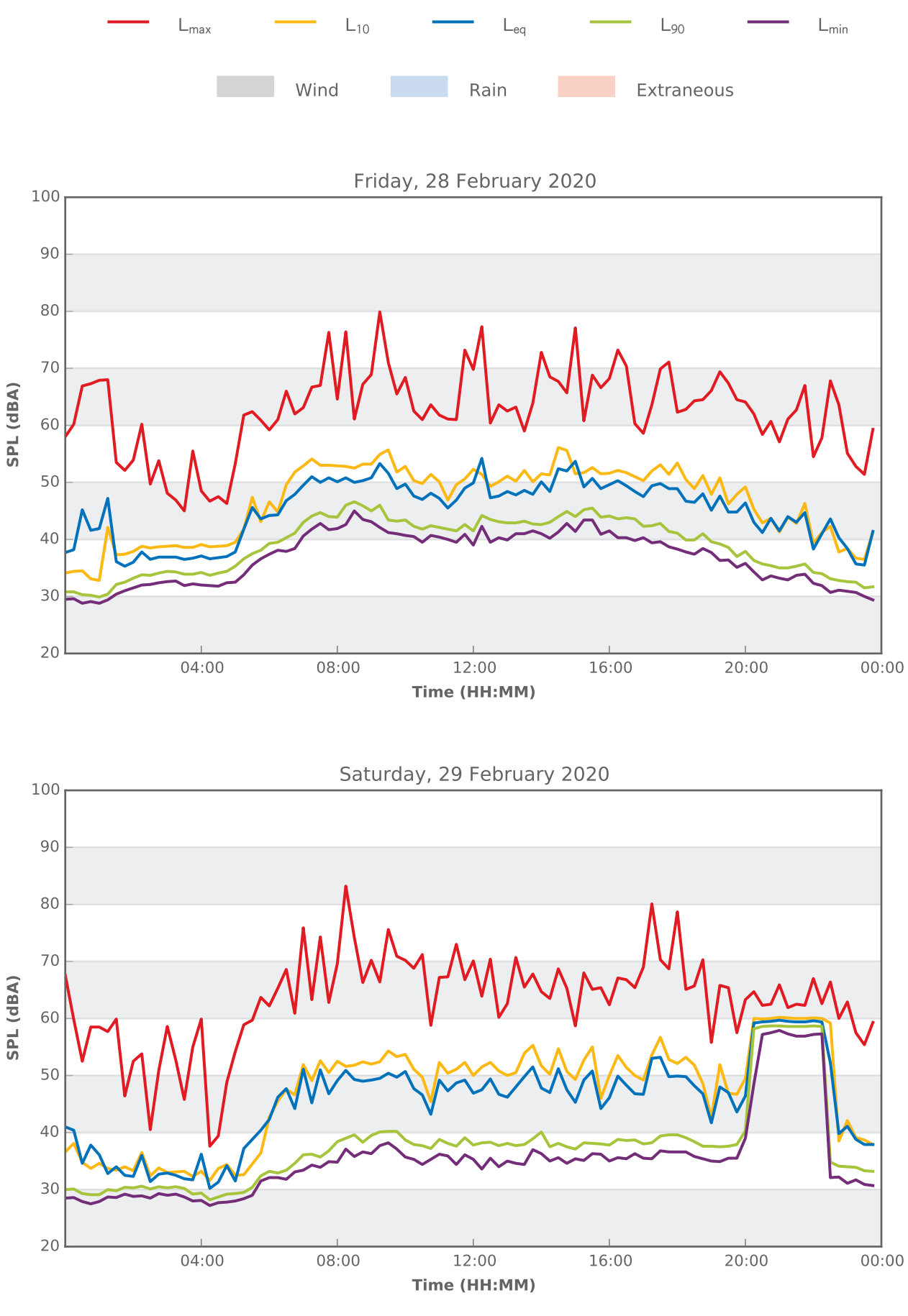


10 Tivoli Avenue, Rose Bay

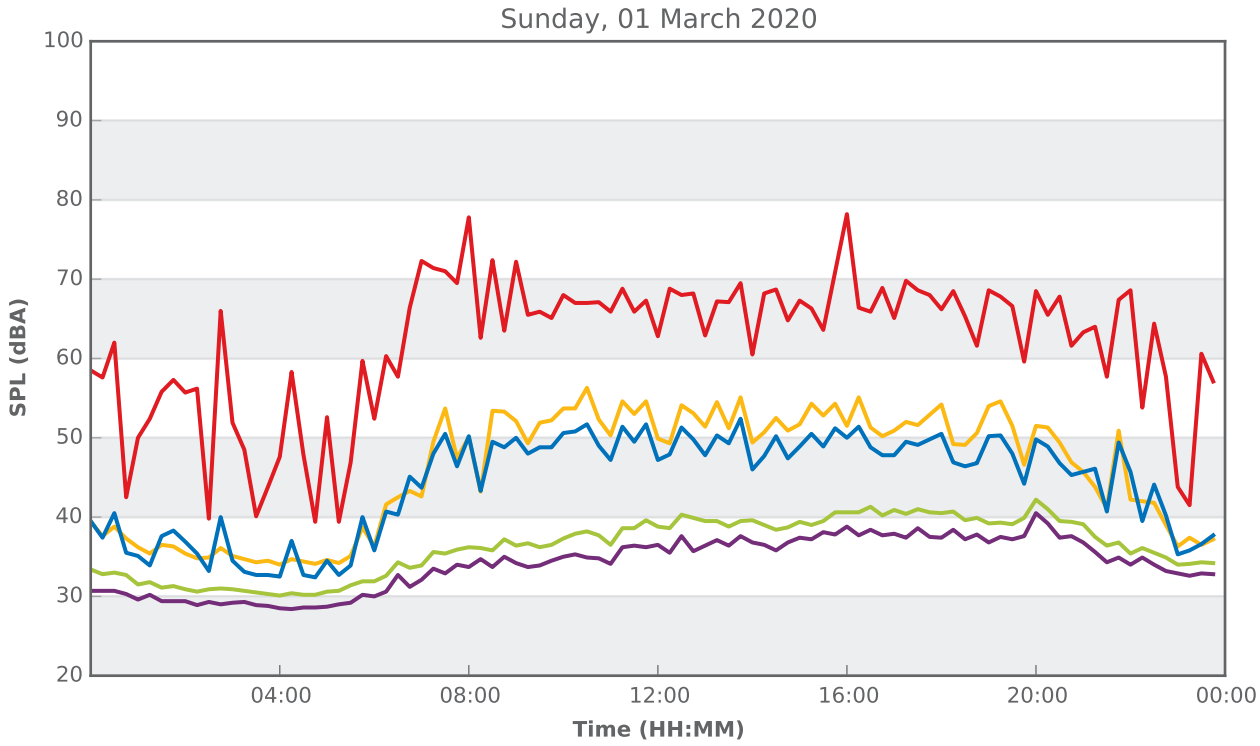


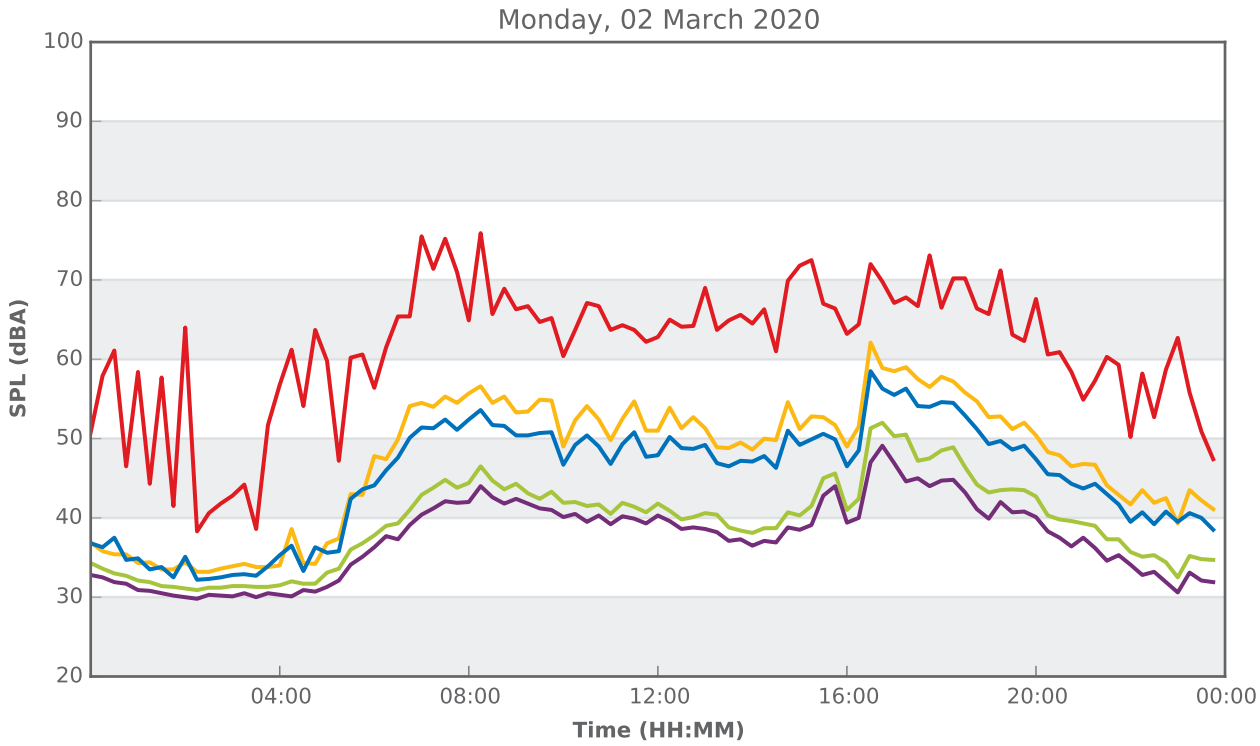


10 Tivoli Avenue, Rose Bay

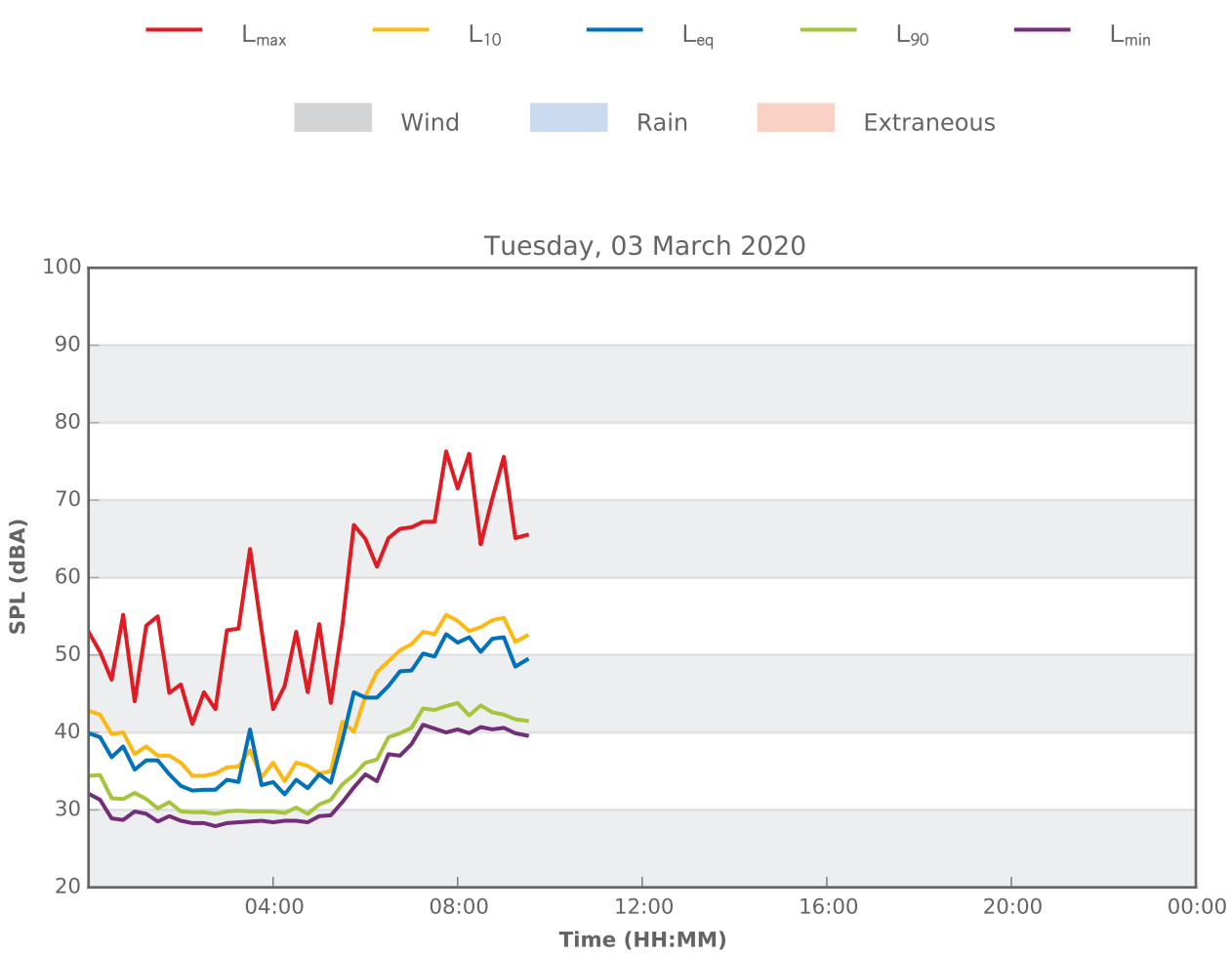


10 Tivoli Avenue, Rose Bay

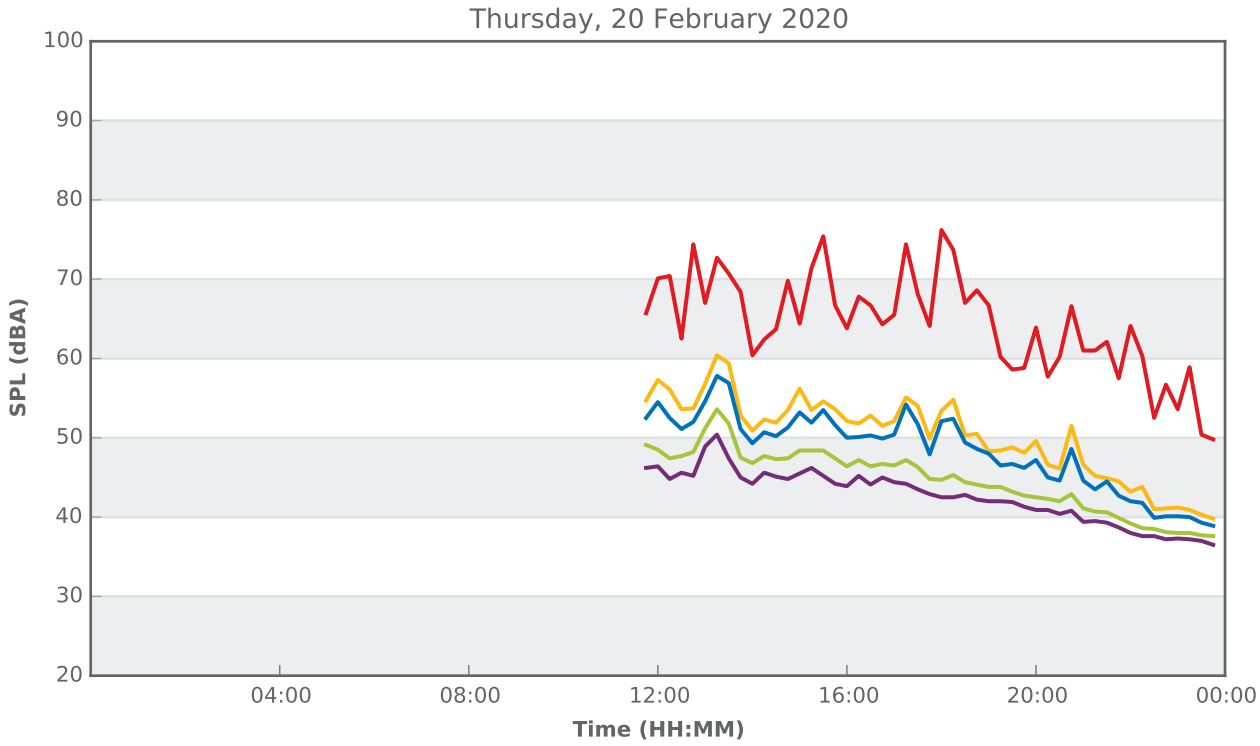


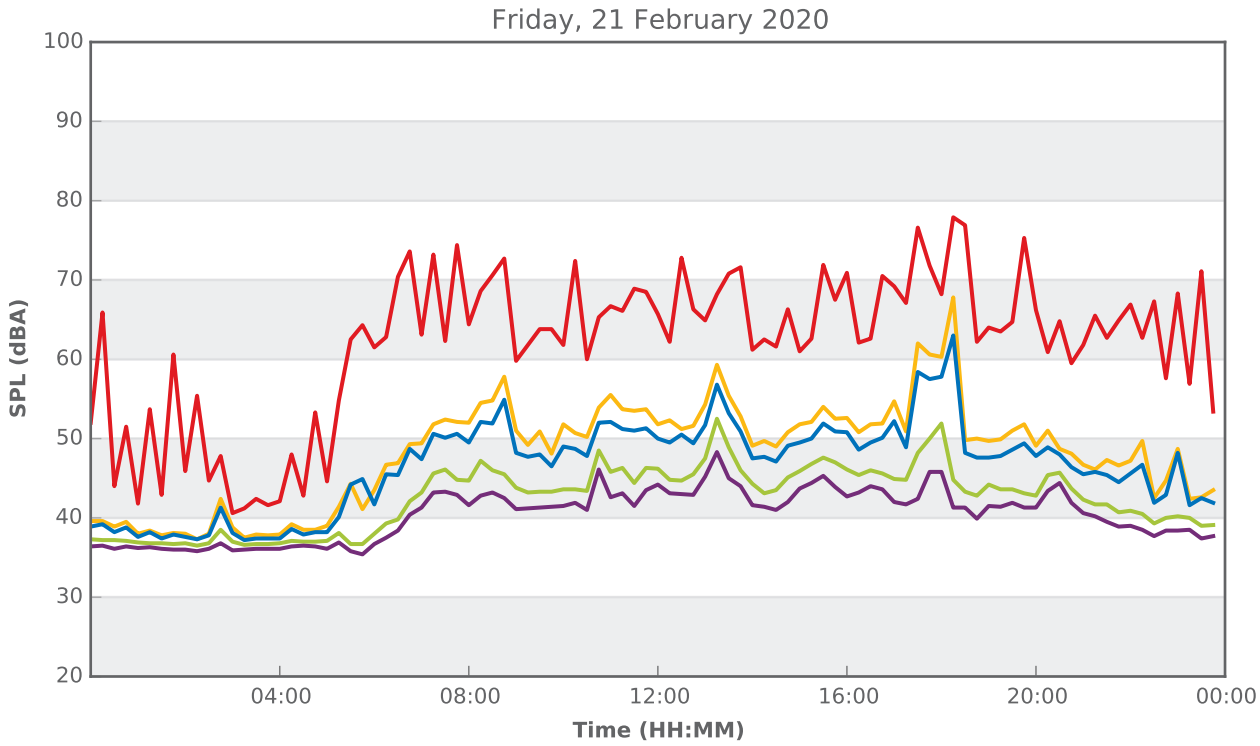


10 Tivoli Avenue, Rose Bay

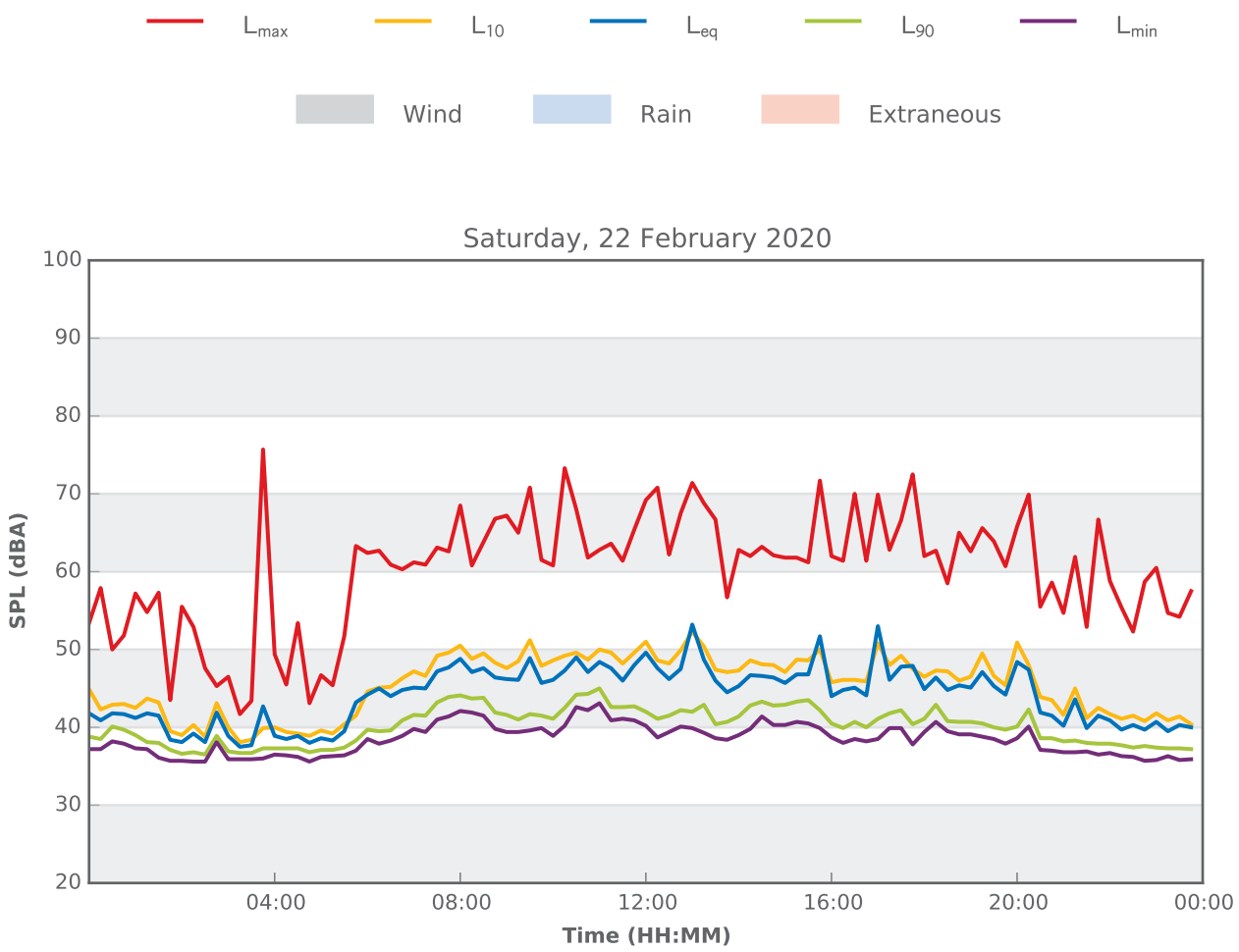


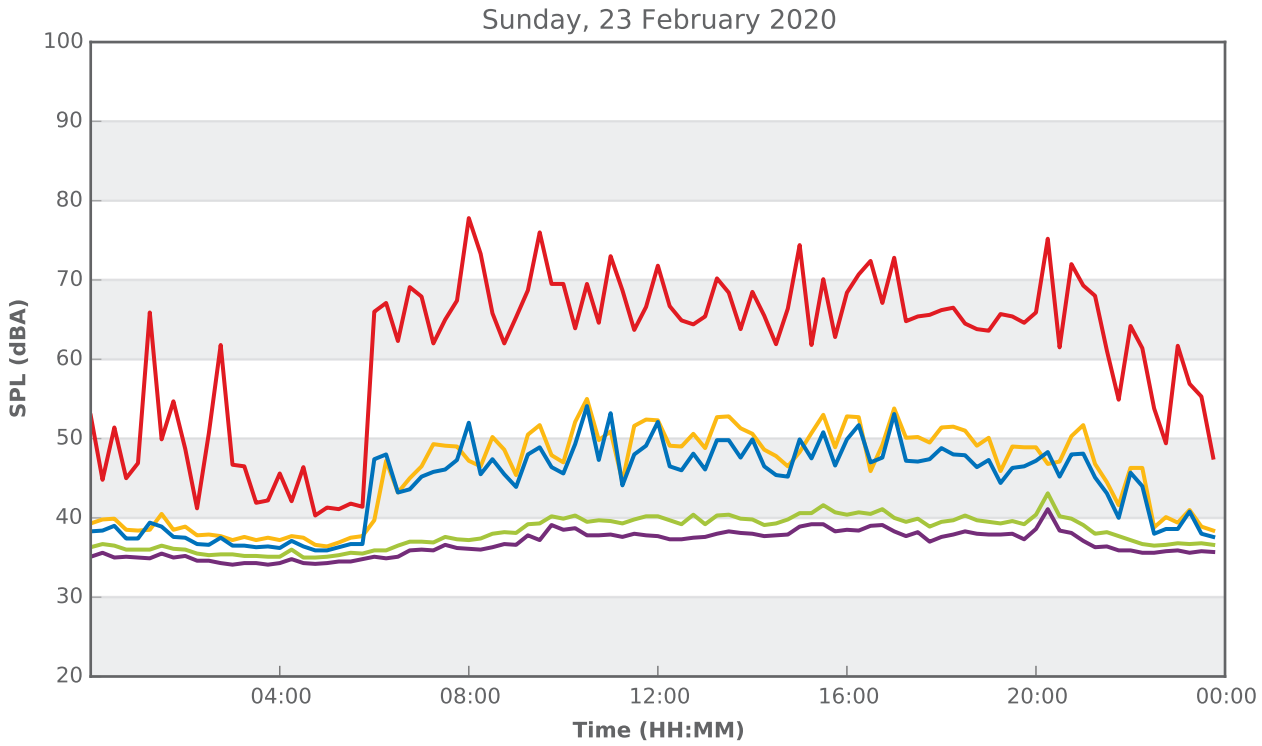
3 Bayview Hill Road, Vaucluse



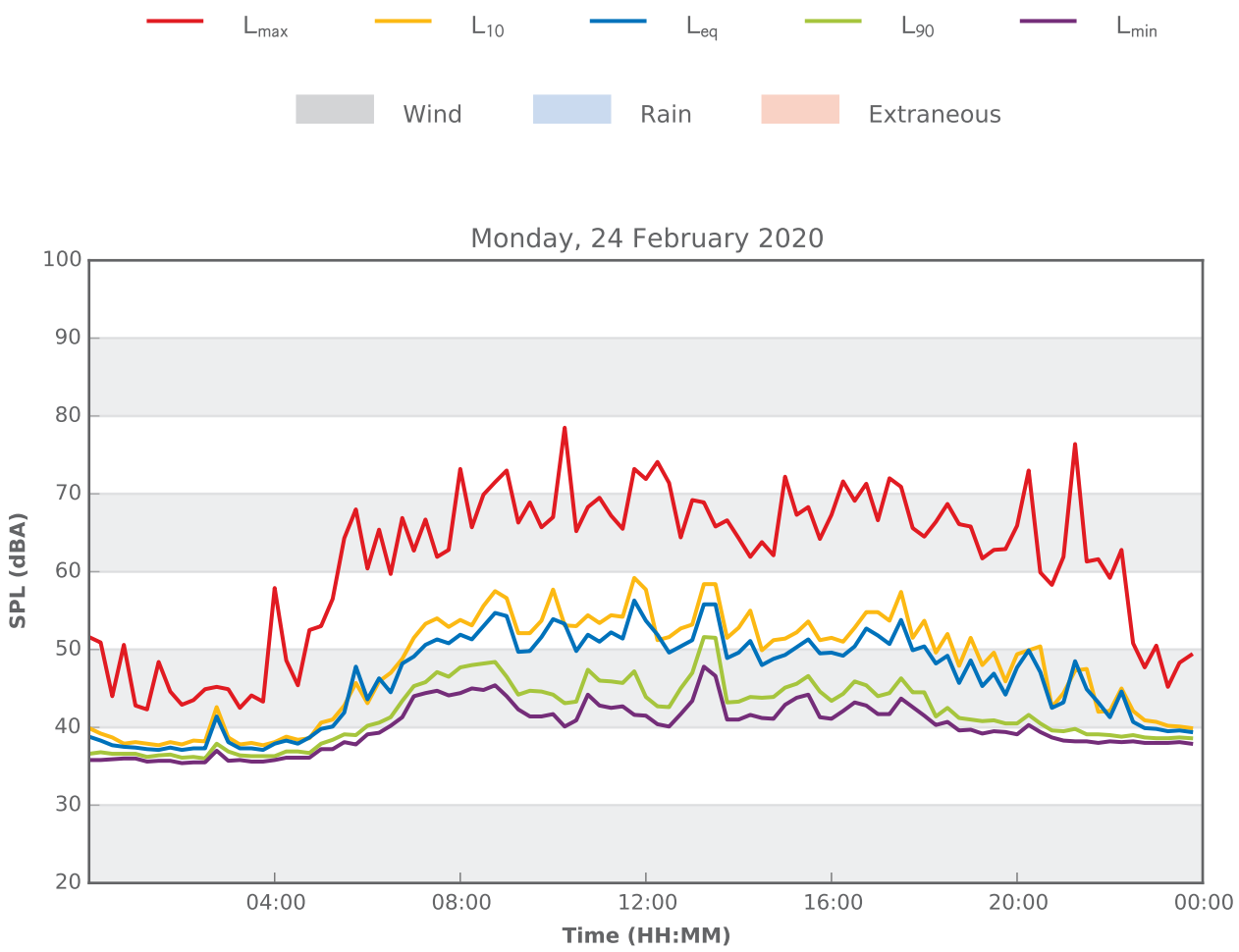


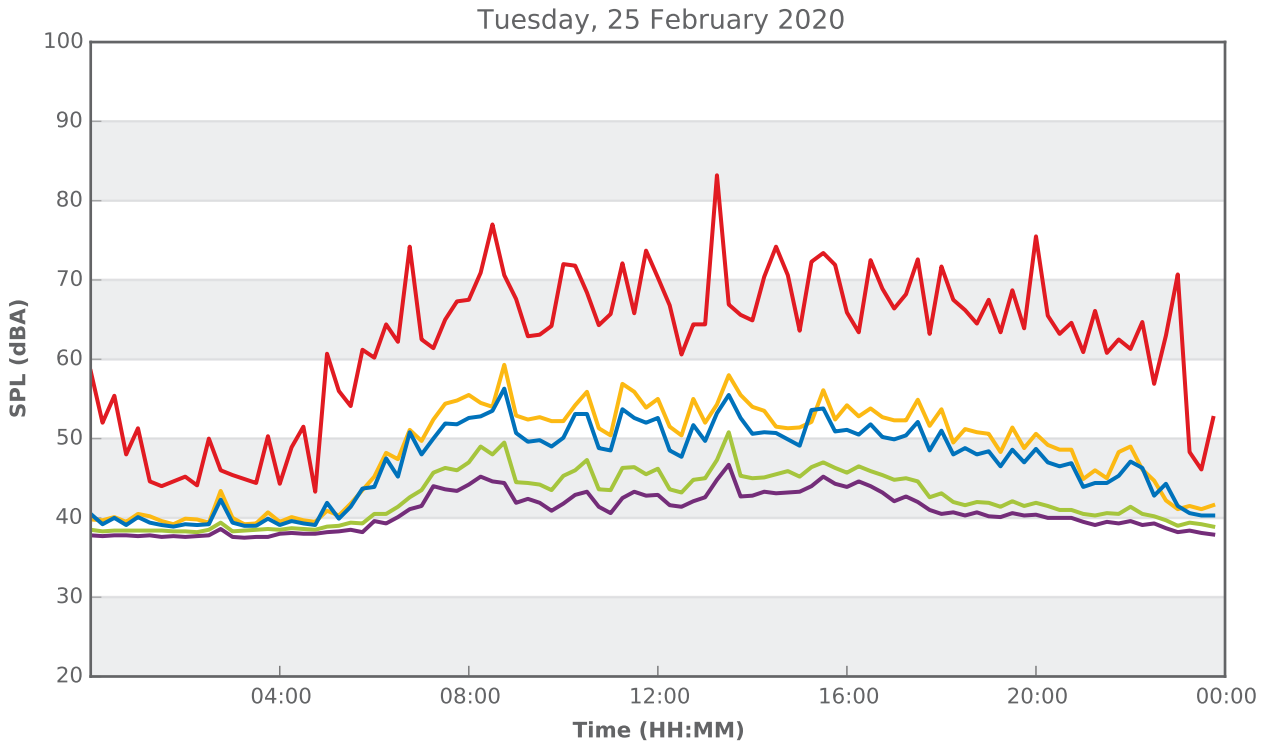
3 Bayview Hill Road, Vaucluse



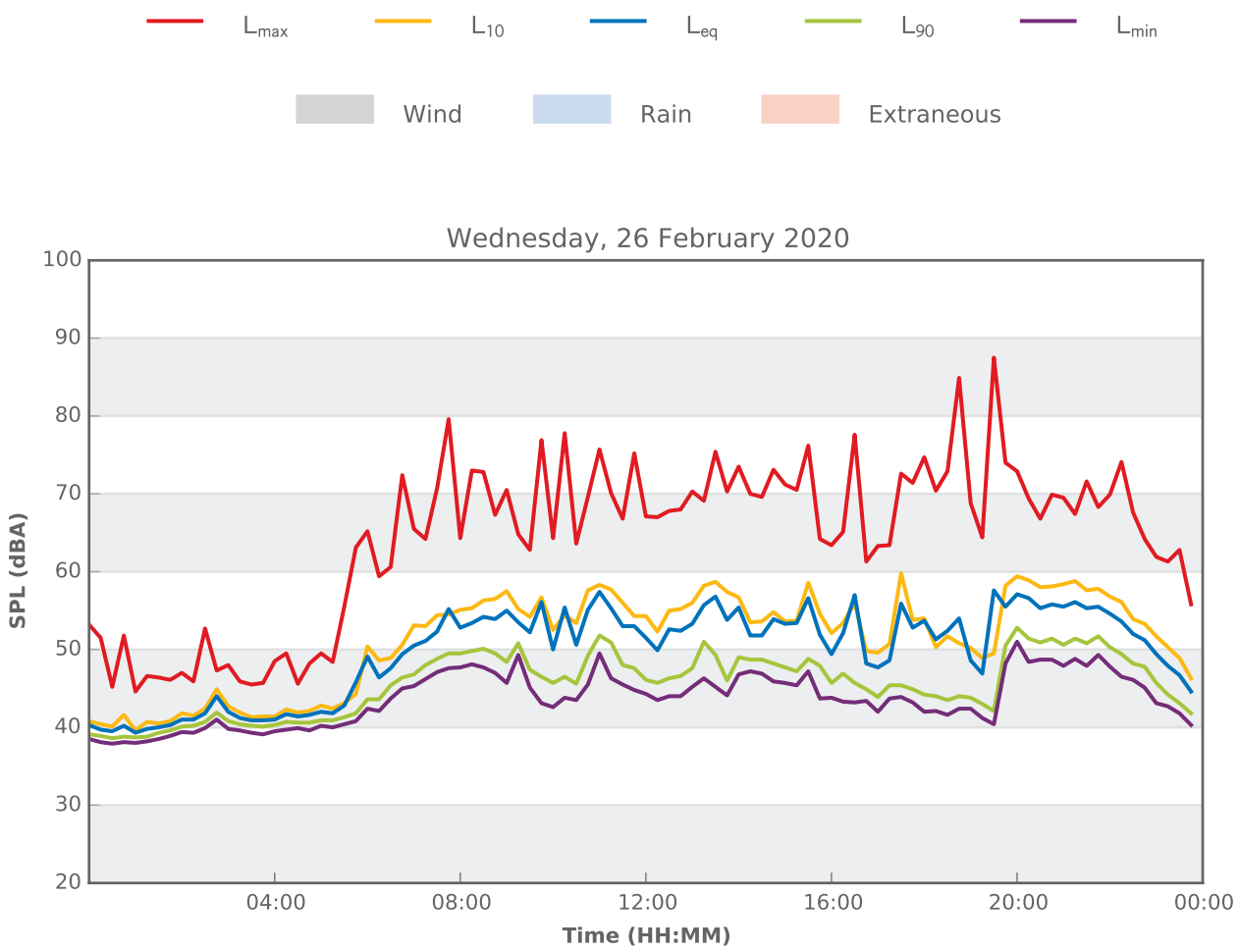


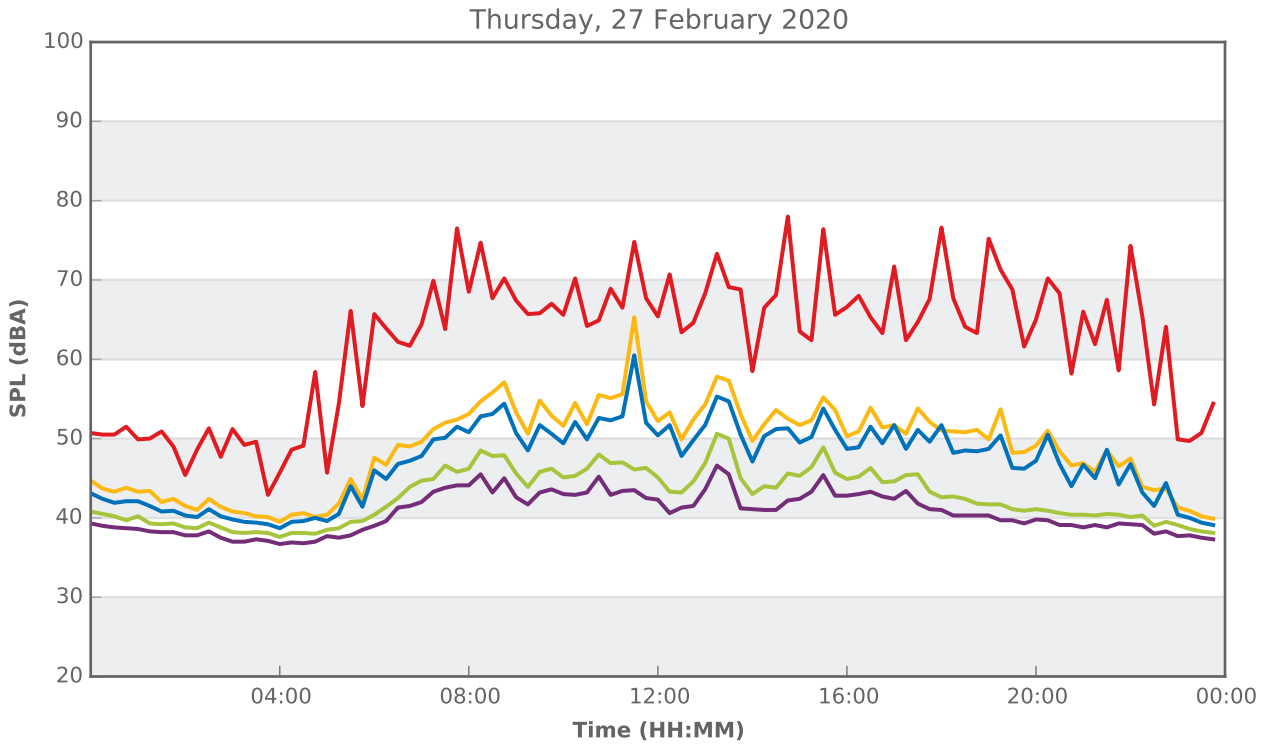
3 Bayview Hill Road, Vaucluse



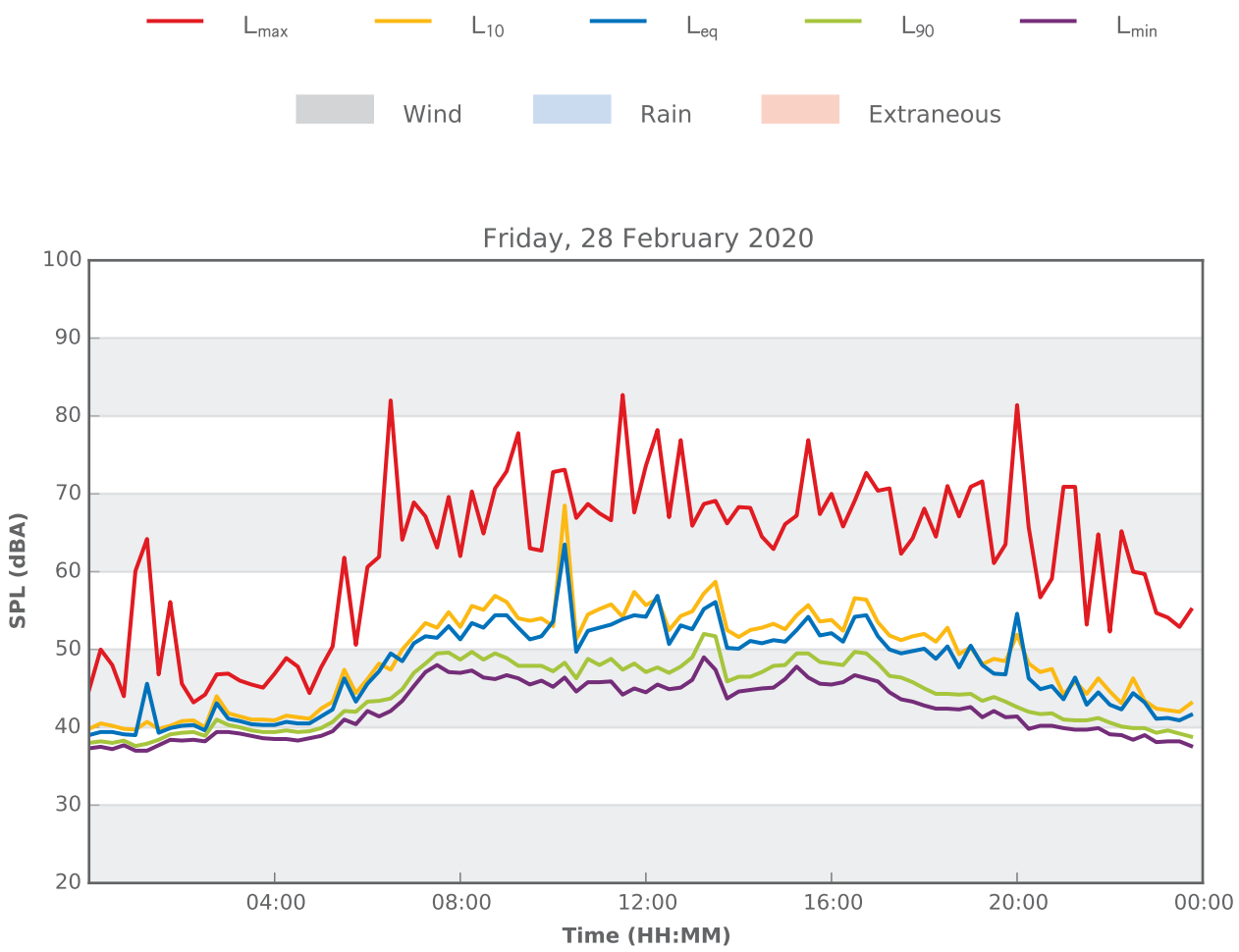


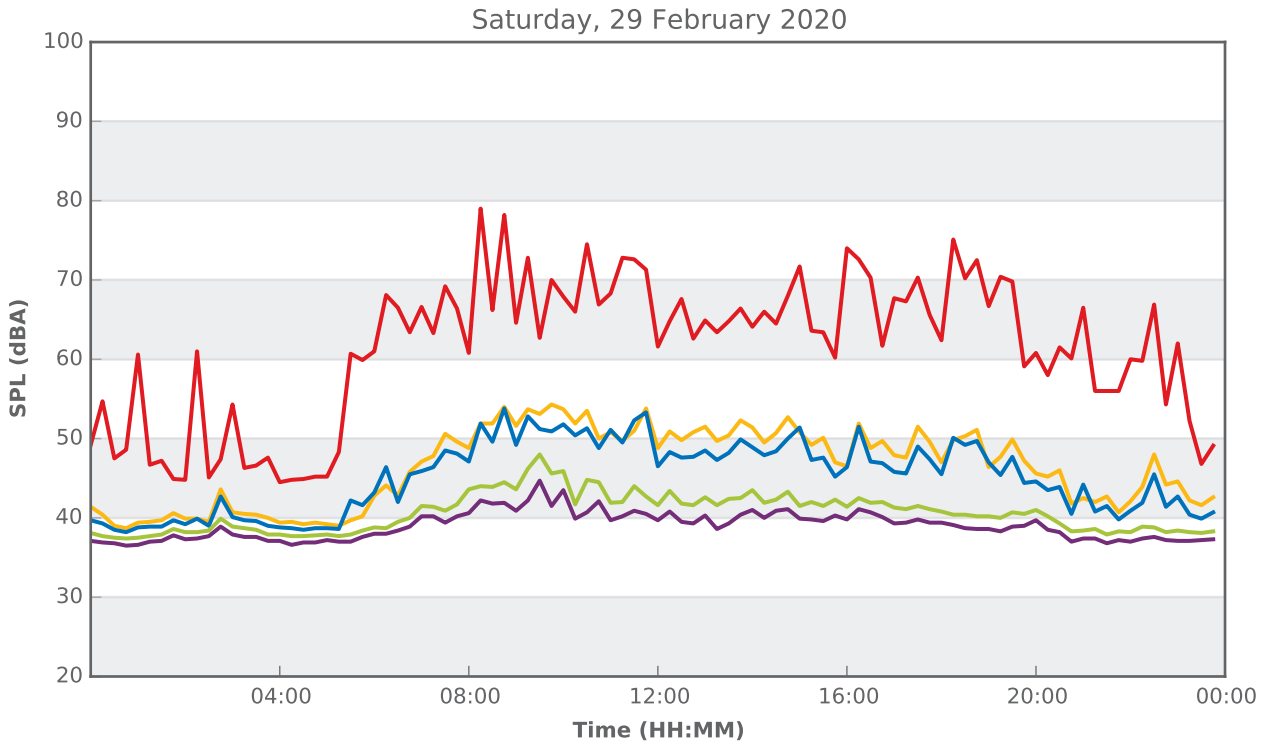
3 Bayview Hill Road, Vaucluse



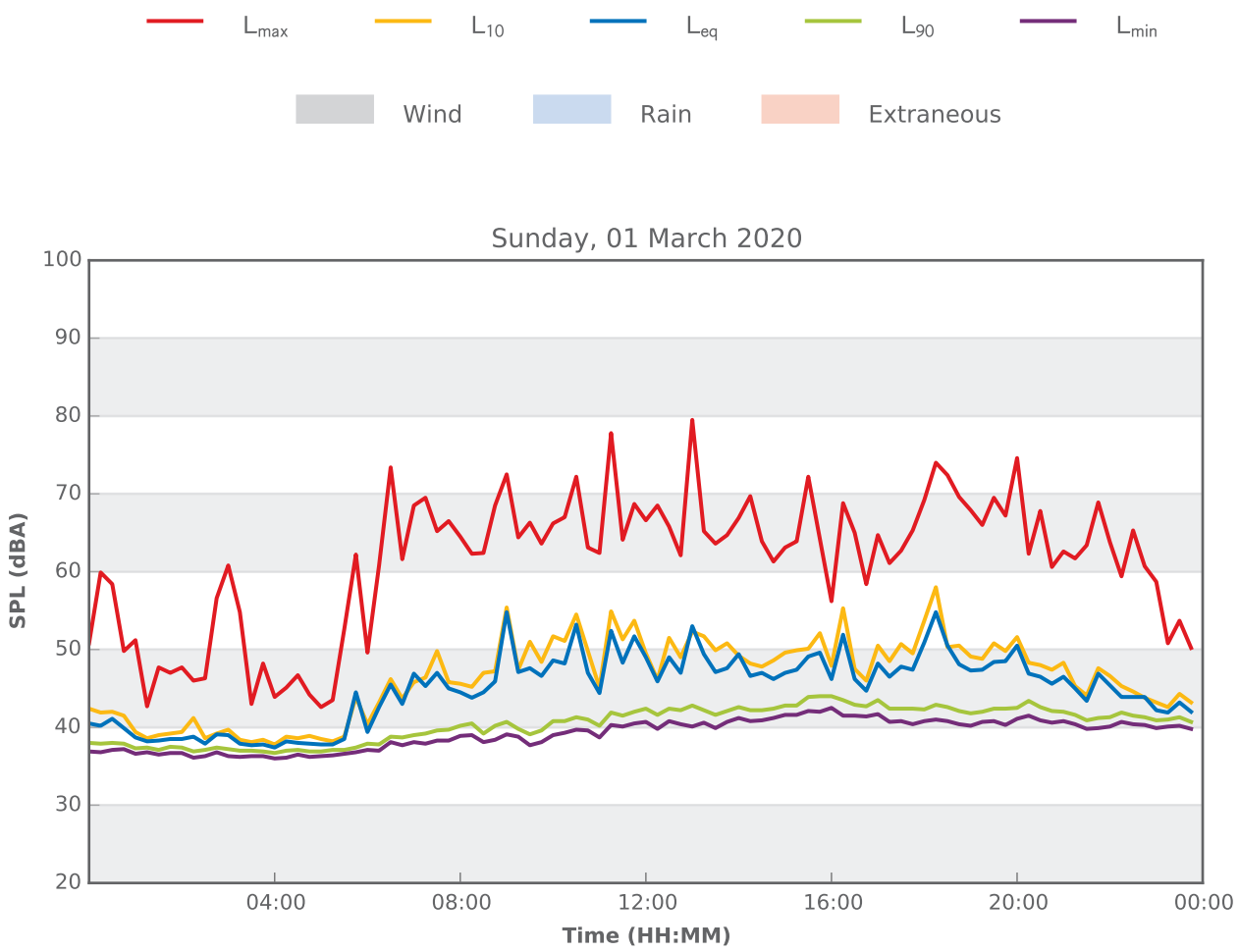


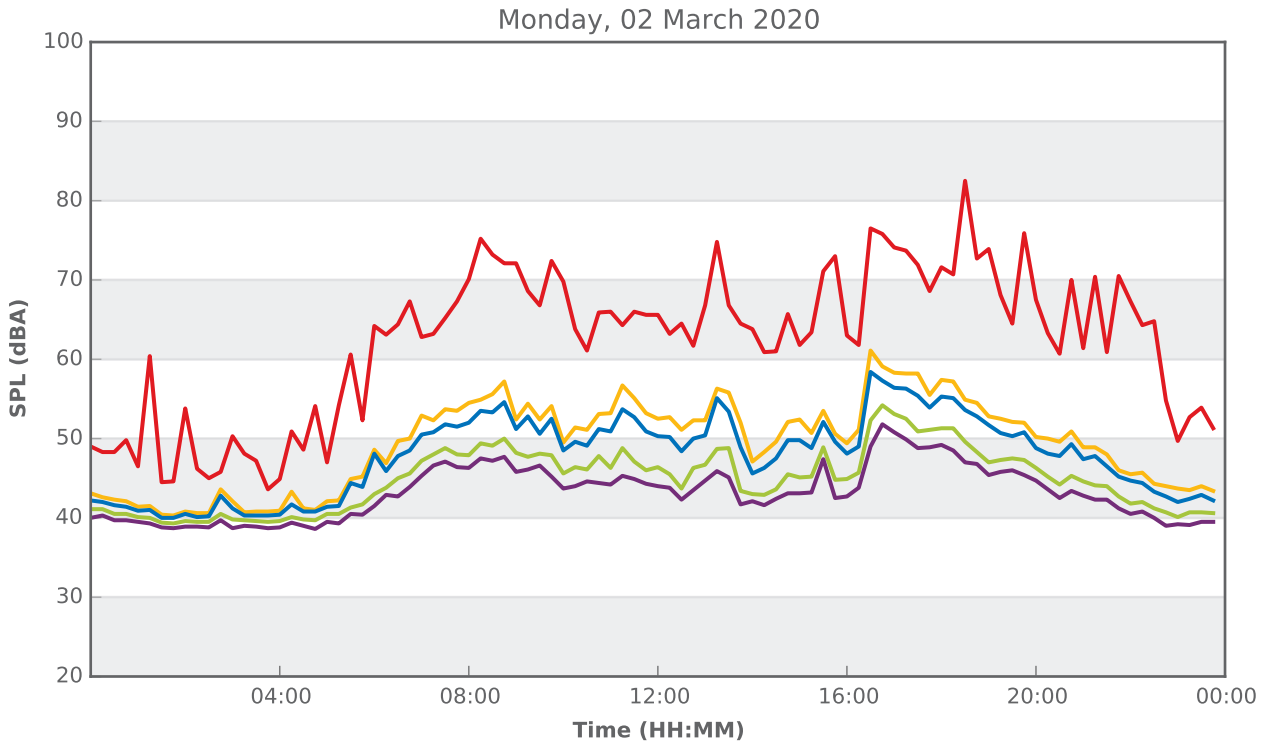
3 Bayview Hill Road, Vaucluse





3 Bayview Hill Road, Vaucluse





3 Bayview Hill Road, Vaucluse