BAPTISTCARE MACQUARIE PARK CONCEPT MASTER PLAN

Appendix B Acoustic Impact Assessment

State Significant

Development Application (SSDA)

Prepared for BaptistCare

2/11/2022

DOCUMENT CONTROL

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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 (LAmax) – 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.

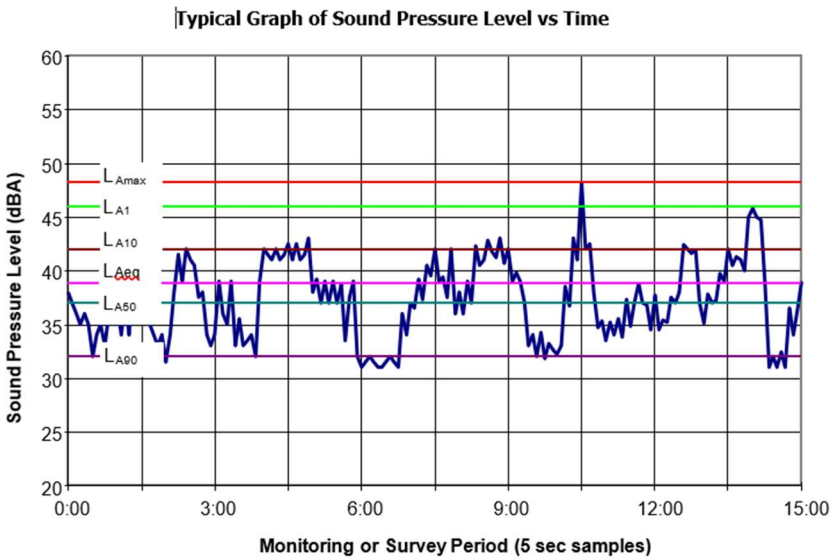
L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

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.



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Appendix A: Unattended Noise Monitoring Graphs

1 INTRODUCTION

This report has been prepared to accompany a State Significant Development Application (SSDA) for a Concept Master Plan for the site located at 157 Balaclava Road, Macquarie Park.

Specifically, consent is sought for the following in this Concept SSDA:

- A mixed use development comprising a maximum GFA of 190,000m2 dedicated to a range of land uses including:
  - Student Housing;
  - Seniors Housing;
  - Build to Rent;
  - Retail;
  - Residential;
  - Mixed uses including commercial and allied health; and
  - A school.
- Maximum building heights and GFA for each development block;
- Public domain landscape concept, including parks, streets and pedestrian connections;
- and
- Vehicular and intersection upgrades.

1.1 Objectives

This report has been prepared in response to the Secretary's Environmental Assessment Requirements (SEARS) dated 17 August, 2022 for SSD-46561712. Specifically, this report has been prepared to respond to those SEARS summarised in Table 1.

Table 1 – SEARs requirements

Item	Description of Requirement	Section Reference (this report)
5. Environment Amenity	Assess amenity impacts on the surrounding locality, including solar access, visual privacy, visual amenity, overshadowing, wind impacts and acoustic impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.	4.2-4.3, 6
15. Noise and Vibration	Identify the main noise and vibration generating sources and demonstrate how consideration for noise and vibration impacts has informed site layout and proposed land uses.	4.2, 7
	Provide an assessment prepared by an acoustic engineer demonstrating how the development would achieve compliance with the relevant NSW Environment Protection Authority (EPA) guidelines.	4.2, 7

The objectives to facilitate this noise and vibration assessment are as follows:

- Identify neighbouring land use, sensitive receivers, and terrain.
- Review any noise impact assessments previously undertaken in proximity to the development site.
- Establish existing acoustic environment by conducting ambient and background noise level measurements (a minimum of 7-day unattended noise monitoring at two locations with satisfactory weather conditions).
- Establish project-specific acoustic criteria in accordance with relevant NSW guidelines, policies and Standards.
- Conduct traffic noise assessment.
- Assess potential construction noise and vibration impacts.
- Assess potential operational noise impacts from the development.
- Provide in-principle recommendations on building facades – glazing requirements,
- Provide in-principal recommendations on construction and operational noise & vibration impacts, if required.

1.2 Referenced Documents

The following documentation have been referenced in this noise and vibration assessment:

- NSW Noise Policy for Industry (NPfI), NSW EPA, 2017,
- EPA's Interim Construction Noise Guideline (ICNG), 2009,
- Transport for NSW's (TfNSW) Construction Noise and Vibration Guideline (CNVG),
- NSW Road Noise Policy (RNP), DECCW, 2011; and
- AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors

2 PROJECT DESCRIPTION

2.1 The Site

The site is located at 157 Balaclava Road, Macquarie Park and is legally identified as Lot 60 in DP 1107965. The site is located near the corner of Herring Road and Epping Road within the City of Ryde Local Government Area (LGA). It is directly south of Macquarie University and in close proximity to Macquarie Shopping Centre. The surrounding area is characterised by a mix of commercial and education uses, as well as student accommodation and residential dwellings.

The site comprises a significant land holding with street frontages to Balaclava Road and Epping Road. It currently accommodates several low-medium density buildings that are connected via internal footpaths and lower order road networks. The total site area of the Baptist Care landholding is 63,871m^2.

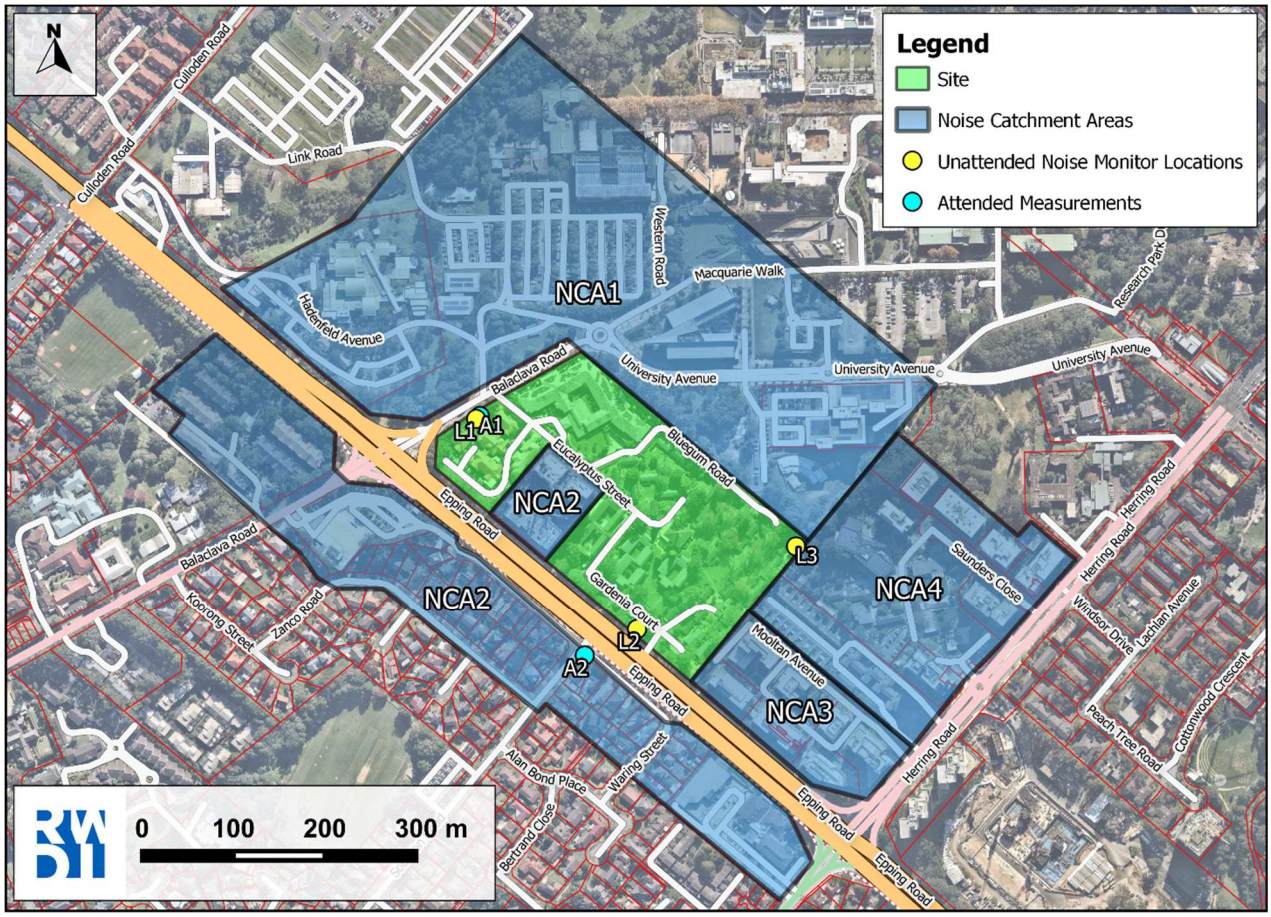


Figure 2-1 Site Location

2.2 Concept Master Plan Development

The Concept Master Plan seeks approval for all building envelopes and land uses. No physical works are proposed as part of this application. The site area is 63,871m^2 and has been divided into four proposed stages as indicated in **Figure 2-2**.

Stage 1 works includes the construction of Vertical Village building and the demolition of the existing Willandra Village and Cooinda Court. The proposed Vertical Village is a 13-storey aged care / retirement facility with an L-shaped form.

Stage 2 works includes the construction of educational facilities, Aged Care / Retirement building, Built to Rent facilities, and retail.

Stage 3 works includes the construction of mixed use / residential buildings.

Stage 4 works includes student accommodation and mixed used / residential buildings.

The Master Plan area breakdown is presented in **Figure 2-3**.

Figure 2-2 Indicative Staging Diagram
(Image Courtesy Appendix E – Urban Design Master Plan Design Report)

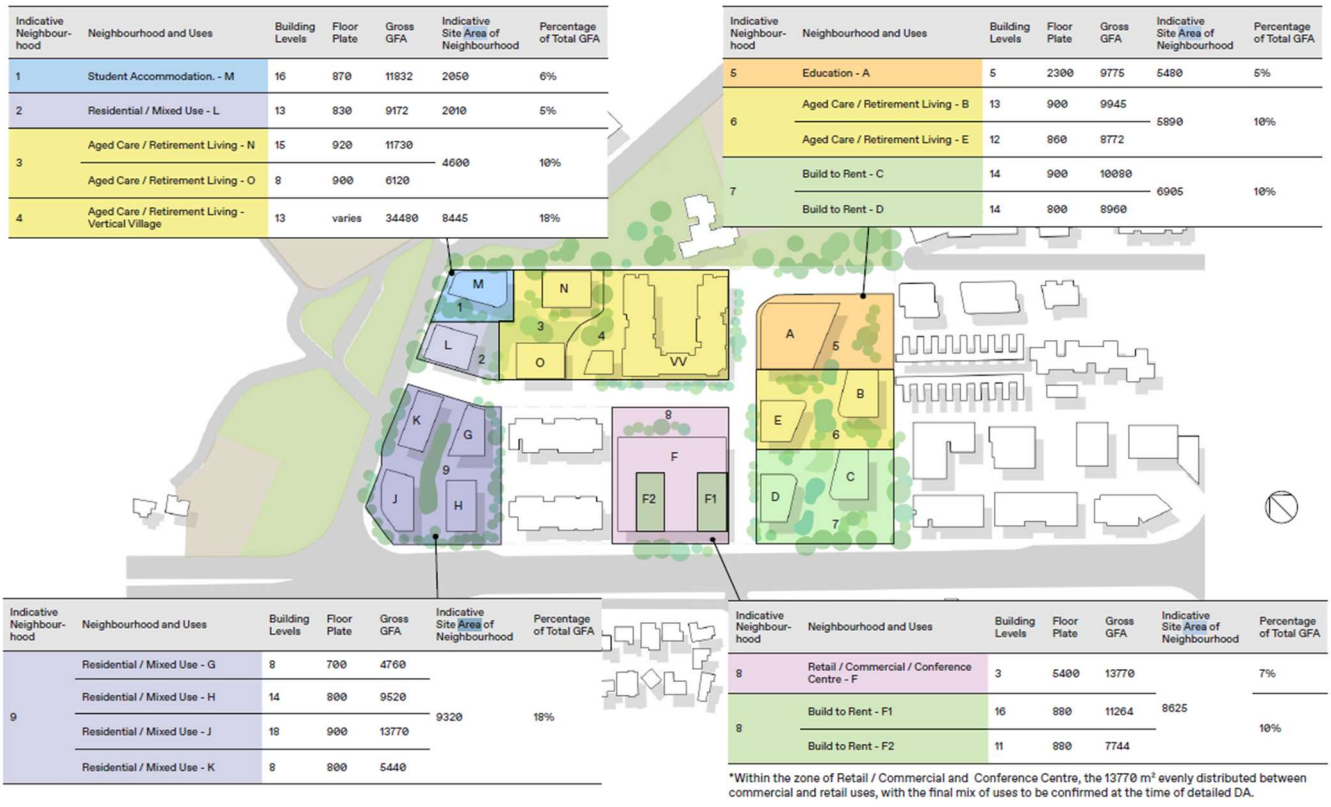


Figure 2-3 Masterplan Area Plan

(Image Courtesy Appendix E – Urban Design Master Plan Design Report) **Concurrent Developments**

2.3 Concurrent Developments

In addition to the Site, we understand that a concept development consent has been issued for the area immediately to the east of the Site (Morling College). This redevelopment will involve the construction of a new road through the College from Herring road. The new road is intended to connect to the Site and provide an access route from Herring Road.

3 NOISE CATCHMENT AREAS

The areas with noise-sensitive receivers around the site have been divided into four Noise Catchment Areas (NCAs). The NCAs group together sensitive receivers with similar existing noise environments. The NCAs and sensitive receivers in the area around the development are detailed in **Table 3-1** and are shown in **Figure 2.4**

Table 3-1 Noise Catchment Areas (Refer to Figure 2.4

NCA	Direction from Development	Description
NCA01	North	Receivers to the north of the site where the noise environment is currently influenced by: • road traffic noise along Epping Road, Balaclava Road, Hadenfield Avenue, University Avenue; • activity from the existing BaptistCare Retirement village; and • activity from Macquarie University
NCA02	Southwest	Receivers to the southwest of the site where the noise environment is currently influenced by: • road traffic noise on Epping Road; • activity from the existing BaptistCare Retirement village; and • construction activity located between Epping Road and Eucalyptus Street.
NCA03	Southeast	Receivers to the southeast of the site where the noise environment is currently influenced by: • road traffic noise on Epping Road and Herring Road; and • activity from the existing BaptistCare Retirement village
NCA04	Southeast	Receivers to the southeast of the site where the noise environment is currently influenced by: • road traffic noise on Herring Road; • activity from the existing BaptistCare Retirement village; and • activity from Macquarie University

3.1.1 Nearest Sensitive Receiver Types

The nearest sensitive receiver types in each noise catchment area are presented in **Figure 3-1** and detailed in **Table 3-2.**

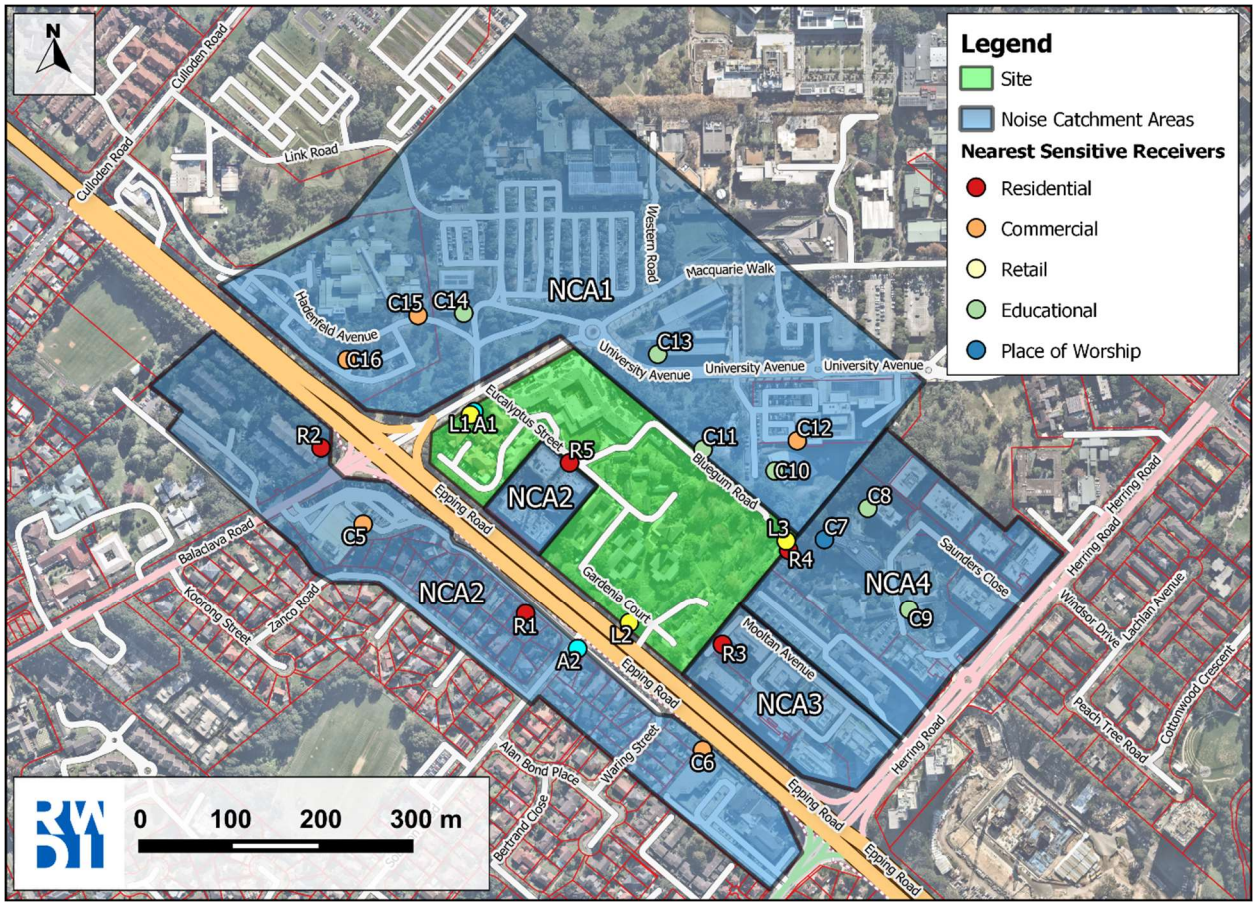


Figure 3-1 Nearest Sensitive Receivers

(Image Courtesy Nearmap)

Table 3-2 Nearest Sensitive Receivers

Reciever ID	Receiver Type	Receiver Description
R01	Residential	66A Waring Street / Epping Road, Macquarie Park
R02	Residential	118-190 Balaclava Road, Macquarie Park
R03	Residential	Residential apartments (8 storeys) – 7 Mooltan Avenue, Macquarie Park
R04	Residential	Morling College Accomodation (Rear) – 12 Herring Road, Macquarie Park
R05	Residential	159-161 Epping Rd currently under construction
C05	Commercial	Woolworths Marsfield, Corner of Balaclava Road & Epping Road
C06	Commercial	Dan Murphy's North Ryde, 108 Herring Road, North Ryde
C07	Place of Worship	Macquarie Baptist Church, 5 Saunders Close, Macquarie Park
C08	Educational	Morling Residential College
C09	Educational	Morling College
C10	Educational	Waratah College (Child Care Centre)
C11	Educational	Gumnut Cottage Long Daycare Centre
C12	Commercial	Cochlear Corporate Offices
C13	Educational	Macquarie University Facility
C14	Educational	Macquarie University Incubator
C15	Commercial	Infinity Smart Solutions Pty Ltd
C16	Commercial	Permaculture Demonstration Garden

4 EXISTING NOISE ENVIRONMENT

To characterise the existing noise environment of the project location, RWDI personnel attended site to conduct short-term attended and long-term unattended noise measurements as described in the sub-sections below.

The locations of the short-term attended and long-term unattended noise measurements are included in **Figure 2.1**

4.1 Unattended Noise Measurements

Three unattended noise monitors were installed on site as shown in yellow in **Figure 2-1**. The noise monitors were used for measuring the background noise levels (L_{A90}) at the identified NCAs. One of the three monitors was also used to measure existing traffic noise levels (L_{Aeq}) along Epping Road, and one was used to measure existing traffic noise levels (L_{Aeq}) along Balaclava Road.

The locations of the noise monitors were as follows:

- L1 along the northern boundary of the development site fronting Balaclava Road. The noise monitor will be representative of the noise environment for NCA01;
- L2 along the western boundary of the development site fronting Epping Road. The noise monitor will be representative of the noise environment for NCA02 and NCA03, and existing traffic noise levels on Epping Road; and
- L3 along the eastern boundary of the development site behind Morling College. The noise monitor will be representative of the NCA04.

All noise monitors were located in free field conditions, meaning that they are not located adjacent to sound reflective surfaces other than the ground below the monitors.

The unattended noise monitoring equipment used at locations L1, L2 and L3 consisted of Acoustic Research Laboratory (ARL) NGARA noise monitors. All noise monitors were programmed to measure A-weighted, statistical noise levels stored at 15-minute intervals on fast response mode. The noise monitors were calibrated at the beginning and end of the monitoring period, with no significant drift being observed.

The noise monitors were on site between Tuesday 2nd August and Friday 12th August 2022.

The measured background noise levels at the unattended noise monitoring locations are presented in **Table 4-1**. Refer to Appendix A for graphs of the unattended noise monitoring data. In accordance with the NPfI, weather-affected data (periods where average wind speeds have exceeded 5m/s and/or have been affected by rain) have been excluded in determining the ambient and background noise levels.

Table 4-1 Unattended Noise Measurements – Background (L_{A90}) Noise Levels

Noise Monitor Location	Time of Day [1]	Rating Background Level (RBL) $L_{A90, period}$ dBA
L1	Day	56
	Evening	52
	Night	50
L2	Day	51
	Evening	49
	Night	37
L3	Day	45
	Evening	43
	Night	37

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am

The L_{Aeq} traffic noise levels measured at noise monitoring locations L1 and L2 are presented in **Table 4-2**.

Table 4-2 Unattended Noise Measurements – Traffic (L_{Aeq}) Noise Levels

Noise Monitor Location	Time of Day [1]	Traffic Noise Level, dBA	
		$L_{Aeq, period}$	$L_{Aeq,1hour}$
L1 – Approximately 6m from Balaclava Road	Day	62.7	64.9
	Night	56.9	59.0
L2 – Approximately 16m from Epping Road	Day	65.2	68.9
	Night	60.7	63.7

Note 1: Day = 7am – 10pm; Night = 10pm – 7am

4.2 Attended Noise Measurements

Attended noise monitoring was conducted on Tuesday the 2nd of August 2022 between 11:30am and 1pm, and Friday the 12th of August 2022 between 10am and 1pm to measure existing background noise levels at the surrounding area (locations A1 and A2 in **Figure2-1**). Measured noise levels are presented in **Table 4-3**.

Table 4-3: Attended Noise Measurements

Monitoring Location	Date and Time	$L_{A90,15min}$ dBA	$L_{Aeq,15min}$ dBA	Sources
A1	2/08/2022 11:43 AM	55	61	Balaclava Road Noise (Cars): LAF 60-67 dBA (Usually 60-65 dBA) Balaclava Road Noise (Buses): LAF 68-74 dBA Construction (Hammering): LAF 57 dBA High Pitch Beeps: LAF 57 dBA
	12/08/2022 12:44 PM	57	65	Balaclava Road Noise (Cars): LAF 63-65 dBA Balaclava Road Noise (Buses): LAF ~70 dBA Construction on Balaclava Road (general): LAF 57-58 dBA Construction on Balaclava Road (hammering): LAF 70 dBA
A2	2/08/2022 12:35 PM	54	67	Road Noise (Cars on same side): LAF 67-70 dBA Road Noise (Cars on opposite side): LAF 65 dBA Road Noise (Trucks): LAF 74 dBA Construction (Hammering): LAF 50-54 dBA Speaker: LAF 56 dBA
	12/08/2022 10:12 AM	57	65	Road traffic noise from Epping road (dominant and constant) Surrounding birds Construction: LAF 55-56 dBA

5 OPERATIONAL NOISE ASSESSMENT

5.1 Operational Noise Level Criteria

5.1.1 Noise Policy for Industry

The NPfI provides a framework for assessing environmental noise impacts from industrial premises and industrial development proposals in New South Wales.

The NPfI recommends the development of project noise trigger levels, which provide a benchmark for assessing a proposal or site. The project noise trigger levels should not be interpreted as mandatory noise criteria but, rather, as noise levels that, if exceeded, would indicate a potential noise impact on the community.

The project noise trigger level is the lower value of the project intrusiveness noise level and the project amenity noise level. The project intrusiveness noise level assesses the likelihood of noise being intrusive above the ambient noise level and is applied to residential receivers only. The project amenity noise level ensures the total industrial noise from all sources in the area does not rise above a maximum acceptable level.

5.1.1.1 Project Intrusiveness Noise Levels

The intrusiveness noise level is the noise level 5 dBA above the background noise level for each time period (daytime, evening or night time) of interest at a residential receiver. The background noise level is derived from the measured L_{A90} noise levels.

The NPfI stipulates that project intrusiveness noise levels should not be set below 40 dBA during the daytime and 35 dBA in the evening and night- time. Additionally, the NPfI recommends that the project intrusiveness noise level for evening is set at no greater than that for the daytime, and that the project intrusiveness level for night-time is set at no greater than that for the evening and daytime.

Intrusiveness noise levels for the project are summarised in **Table 5-1**.

Table 5-1 Project Intrusiveness Noise Levels

Noise Catchment Area	Time of Day	Rating Background Level (RBL) $L_{A90, period}$ dBA	Project Intrusiveness Noise Level $L_{Aeq, 15min}$ dBA
NCA01 (Monitor L1)	Day	56	61
	Evening	52	57
	Night	50	55
NCA02 (Monitor L2)	Day	51	56
	Evening	49	54
	Night	37	42
NCA03 (Monitor L2)	Day	51	56
	Evening	49	54
	Night	37	42

Noise Catchment Area	Time of Day	Rating Background Level (RBL) $L_{A90,\ period}$ dBA	Project Intrusiveness Noise Level $L_{Aeq,\ 15min}$ dBA
NCA04 (Monitor L3)	Day	45	50
	Evening	43	48
	Night	37	42

5.1.1.2 Project Amenity Noise Levels

Project amenity noise levels aim to set a limit on continuing increases in noise levels from all industrial noise sources affecting a variety of receiver types; that is, the ambient noise level in an area from all industrial noise sources remains below recommended amenity noise levels.

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, or 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 noise 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 more, 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.

The project amenity noise levels are calculated from the recommended amenity noise levels presented in **Table 5-2**.

Table 5-2 Recommended Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day [a]	Recommended Amenity Noise Level $L_{Aeq,period}$ dBA
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day.
School classroom-internal (applies to all educational receivers)	All	Noisiest 1-hour period when in use	35
Hospital ward internal external	All	Noisiest 1-hour	35
Place of worship-internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	65
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dB(A) to recommended noise amenity area

a. Day = 7.00am – 6.00pm; Evening = 6.00pm – 10.00pm; Night = 10.00pm – 7:00am

Due to different averaging periods for the $L_{Aeq,15min}$ and $L_{Aeq,period}$ noise descriptors, the values of project intrusiveness and amenity noise levels cannot be compared directly when identifying noise trigger levels i.e. the most stringent values of each category. In order to make a comparison between descriptors, the NPfI assumes that the $L_{Aeq,15min}$ equivalent of an $L_{Aeq,period}$ noise level is equal to the $L_{Aeq,15min}$ level plus 3dB.

The most potentially affected residential receivers near the site are classified as being in a "urban" noise amenity area. The project amenity noise levels for the Project are presented in **Table 5-3**.

Table 5-3 Project Amenity Noise Levels

Receiver	Time of Day	Recommended Amenity Noise Level $L_{Aeq,period}$ dBA	Project Amenity Noise Level $L_{Aeq,15min}$ dBA
All nearby residences	Day	60	58
	Evening	50	48
	Night	45	43
Educational premises	When in use	35 (internal) 45 (external)[1]	33 (internal) 43 (external)[1]
Commercial premises	When in use	65	63
Place of worship	When in use	40 (internal) 50 (external)[1]	38 (internal) 48 (external)[1]
Passive Recreation (e.g. National Park)	When in use	50	48
Active Recreation (e.g. school playground, golf course).	When in use	55	53

Note 1: For internal noise criteria typical best practice is to convert the internal noise level to an outside level assuming windows are open. A 10 dB façade loss has been used to convert from internal to external noise levels, based on Development Near Rail Corridors And Busy Roads–Interim Guideline NSW Department of Planning 2008

5.1.1.3 Project Noise Trigger Levels

The project noise trigger levels (PNTLs) are defined as the lower of the project intrusiveness and the project amenity noise levels. These overall project noise trigger levels are summarised in **Table 5-4** below. All criteria are those to be applied to external areas.

Table 5-4 NPfI Overall Project Trigger Noise Level Criteria

Receiver (Res. Receivers)	Time of Day [1]	Intrusiveness Criteria $L_{Aeq,15min}$ dBA	Amenity Criteria $L_{Aeq,15min}$ dBA	PNTL $L_{Aeq,15min}$ dBA
NCA01	Day	61	58	**58**
	Evening	57	48	**48**
	Night	55	43	**43**
NCA02 (R01, R02, R05)	Day	56	58	**56**
	Evening	54	48	**48**
	Night	42	43	**42**
NCA03 (R03)	Day	56	58	**56**
	Evening	54	48	**48**
	Night	42	43	**42**
NCA04 (R04)	Day	50	58	**50**
	Evening	48	48	**48**

Receiver (Res. Receivers)	Time of Day [1]	Intrusiveness Criteria $L_{Aeq,15min}$ dBA	Amenity Criteria $L_{Aeq,15min}$ dBA	PNTL $L_{Aeq,15min}$ dBA
	Night	42	43	**42**
Educational (C08-C11, C13-14)	When in use	-	43	**43**
Commercial (C05-C06, C12, C15-16)	When in use	-	63	**63**
Place of Worship (C07)	When in use	-	48	**48**

Note 1: Day = 7am – 6pm; Evening = 6pm – 10pm; Night = 10pm – 7am

5.1.1.4 Sleep Disturbance

Guidance for assessing the potential for sleep disturbance impacts on nearby residences is provided in Section 2.5 of the *NPfI*, which states:

> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
> - L_{Amax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,
>
> *a detailed maximum noise level event assessment should be undertaken.*

Based on the above, the night-time sleep disturbance screening noise levels for the residential areas in the vicinity of the development are presented **Table 5-5**.

Table 5-5 Sleep Disturbance Criteria

NCA	Period	Measured RBL, L_{A90}, period	Sleep Disturbance Criteria, $L_{Aeq,15min}$	Sleep Disturbance Criteria, LA_{MAX}
NCA01	Night-time (10pm-7am)	50	**55**	**65**
NCA02		37	**42**	**52**
NCA03		37	**42**	**52**
NCA04		37	**42**	**52**

Note 1: Minimum RBL for 'Night-time' used for assessment.

Where the sleep disturbance screening noise level is predicted to be exceeded then a detailed maximum noise level event assessment should be undertaken. The detailed assessment should discuss the predicted level of the events, the exceedance of the screening level, existing maximum noise levels, and consider guidance from current literature regarding sleep disturbance, such as the *Road Noise Policy*.

5.1.2 Road Noise Policy

The Road Noise Policy (RNP) provides a framework for assessing environmental noise impacts on existing buildings from the development of new public roadways, and should be used to assess the impact of traffic noise from public roads within the site envelope on existing buildings. The recommended amenity levels for sensitive land uses are presented in Table 5-6. All non-residential criteria apply only during the use of the premises. Where criteria are specified as indoor, they may be converted to outdoor criteria using a 10 dB addition assuming partially open windows, as per Table 5-3.

Table 5-6 Road Traffic Noise Assessment Criteria for new roads

Existing sensitive land use	Assessment criteria – $L_{Aeq,1h}$ dB(A)	
	Day (7am-10pm)	Night (10pm-7am)
Residential affected by development of new local roads (R01-R05)	55	50
School Classrooms (C08-C09, C13-C14)	40 (internal)	
Childcare facilities (C10-C11)	Sleeping Rooms: 40 (internal) Indoor Play Areas: 40 (internal) Outdoor Play Areas: 55 (external)	
Places of worship (C07)	40 (internal)	
Retail (C05-C06)	55 (internal)	
Office Spaces (C12, C15-C16)	45 (internal)	

5.2 Assessment of Operational Noise

Noise modelling of the operational noise emissions was undertaken using the ISO9613 noise prediction algorithm in the Cadna/A modelling software. The noise model was constructed from a combination of aerial photography, existing ground topography, design ground topography and proposed design. The local terrain, receiver buildings and structures have been digitised in the noise model to develop a three-dimensional representation of the proposed site and surrounding environment.

The noise model includes a 2.6 metre retaining wall along the boundary shared between the Site and 159-161 Epping Rd as shown in **Figure 5-1**.

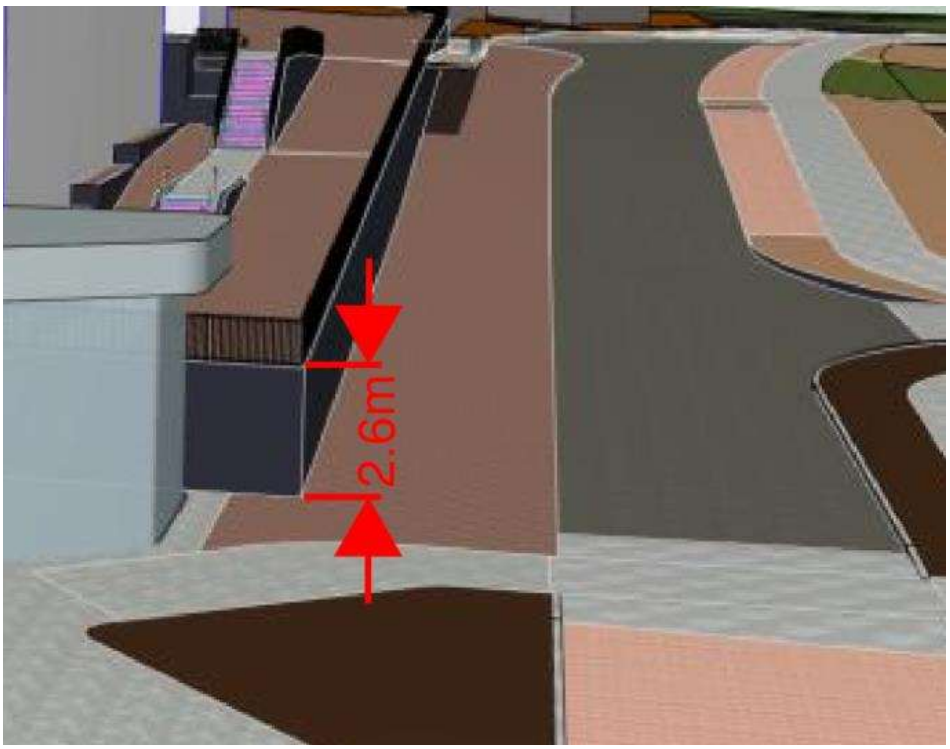


Figure 5-1: Retaining wall to south-west of new road

5.2.1 Mechanical Plant

At this stage, no detailed mechanical design has been completed. When designed, the mechanical systems must comply with the criteria outlined in section 5.1.1. A detailed mechanical noise assessment should be conducted at detailed DA stage, following development of the mechanical design for each building.

This section presents an 'in principle' mechanical noise intrusion assessment, based on the following assumptions:

- VRV, air cooled chillers, and cooling towers located on the roof of school, retail, and aged care buildings
- Kitchen exhaust discharge on the roof of retail spaces
- Mechanical services in residential and student accommodation buildings are localised systems without significant rooftop equipment
- Water cooled chillers are acoustically isolated within mechanically ventilated plantrooms
- Air cooled chillers are located on top of nominated rooves
- VRVs have a negligible acoustic impact compared to other mechanical system noise sources

The major plant, their indicative locations, sound power levels (SWLs) are listed below.

Table 5-7 Major Mechanical Plant Items With Indicative Locations and SWLs

Plant Item	Indicative Location	Assumed Individual SWL, dBA
Cooling Towers	1 per rooftop of building types listed above (total building GFA < 10000) 2 per rooftop of building types listed above (total building GFA >10000)	95
Kitchen Exhaust Fans (KEFs)	1 per rooftop of building types listed above	90

5.2.1.1 Predicted Noise Levels

Based on the assumptions presented above, the predicted noise levels at the surrounding receivers from mechanical plant are presented in **Table 5-8**. Where project noise trigger levels vary with time of day (refer to **Table 5-4**), noise emissions will be assessed against the most stringent requirements.

Table 5-8 Predicted Noise Levels from Mechanical Plant

Receiver ID	Predicted Noise Level $L_{Aeq, 15min}$	NPfI Noise Criteria $L_{Aeq, 15min}$	Complies
R01	43	42	**No (+1)**
R02	27	42	Yes
R03	31	42	Yes
R04	40	42	Yes
R05	43	42	**No (+1)**
C05	33	43	Yes
C06	28	43	Yes
C07	39	48	Yes
C08	33	43	Yes
C09	34	43	Yes
C10	42	43	Yes
C11	42	43	Yes
C12	32	63	Yes
C13	38	43	Yes
C14	29	43	Yes
C15	31	63	Yes
C16	34	63	Yes

The worst case noise impact of this preliminary mechanical review is a 1 dB exceedance predicted at R01 and R05. This exceedance is marginal, and indicates that design of a mechanical system compliant with the nominated NPfI project noise trigger criteria is feasible, taking into account options for equipment selection and acoustic attenuation. A detailed mechanical noise assessment should be conducted at detailed DA stage, following development of the mechanical design for each building.

5.2.2 Vehicle Noise

The anticipated peak hour trip generation of the site is approximately 448 vehicle movements, during the AM peak hour. These vehicle movements are assumed to be distributed uniformly across all roads within the site. No details are currently available concerning non peak hour traffic movements, other than aggregate daily values.

Modelling of noise emissions from vehicle movements along the internal roads of the site have been based on the SWL noise emissions in **Table 5-9** (based on measurements the CORTN algorithm for road traffic modelling):

Table 5-9 SWL from Cars travelling 40km/h

Noise Source	Sound Power Level, L_{Aeq}/m
448 vehicles	61.8 dBA/m

We note that noise emissions from cars manoeuvring within any basement level carparks will be negligible and will have no appreciable contribution to noise impacts on surrounding receivers.

5.2.2.1 Predicted Noise Levels

Noise emissions from vehicles have been assessed against the requirements of the RNP for existing buildings affected by new roads (refer to **Table 5-6**). The predicted noise levels at the surrounding receivers are presented in **Table 5-10**. Since peak vehicle movements are predicted to occur during daytime, comparison to the daytime criteria has been made.

For childcare receivers C10 and C11, it has been assuming that sleeping hours for children do not coincide with the AM peak hour, and the “indoor play” criteria has been applied as the most stringent.

Table 5-10 Predicted Noise Levels from Vehicle Movements

Receiver ID	Predicted Noise Level $L_{Aeq, 15min}$	RNP Noise Criteria [1] $L_{Aeq, 15min}$	Complies
R01	43	55	Yes
R02	28	55	Yes
R03	35	55	Yes
R04	52	55	Yes
R05	57	55	**No (+2 dB)**
C05	33	65	Yes

Receiver ID	Predicted Noise Level $L_{Aeq, 15min}$	RNP Noise Criteria [1] $L_{Aeq, 15min}$	Complies
C06	30	65	Yes
C07	46	50	Yes
C08	37	50	Yes
C09	37	50	Yes
C10	47	50	Yes
C11	50	50	Yes
C12	32	55	Yes
C13	38	50	Yes
C14	32	50	Yes
C15	33	55	Yes
C16	34	55	Yes

Note 1: Day-time criteria

Our analysis indicates that noise emissions from peak-hour vehicle movements along the new roads will comply with the RNP daytime criteria, except at R05, where criteria will be exceeded by 2 dB along the elevated walkway at about 5m from the railings shown in Figure 1. This minor exceedance for a portion of the walkway, under peak-hour traffic flow, is considered negligible and hence no mitigation is proposed.

5.2.3 Retail Noise

The commercial sections of mixed use buildings are likely to be "shop top housing" with a ground floor retail component for speciality shops and services. No significant noise generating sources are expected to be associated with these services, other than mechanical services discussed in the previous section. Should a licensed premise or amplified music be sought to be used, a separate assessment of the potential noise impacts should be conducted.

5.2.4 Educational Facilities

The school located at the western corner of the site is anticipated to be a school with a student capacity of up to 1000 students. Two outdoor areas will be included within the school grounds; one on the roof of the school and one on the ground to the east of the school building. The locations of the play areas are shown in **Figure 5-2**. Based on advice from Project Architects BVN, the anticipated maximum capacity of the areas during periods of active play, and hence maximum noise, is 130 children in the rooftop play area, and 150 children in the ground floor play area.

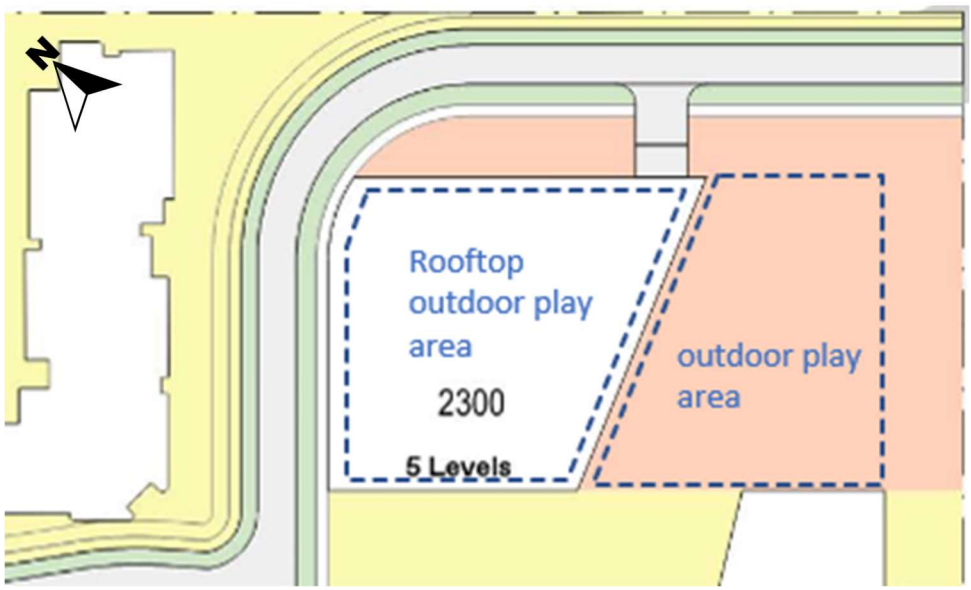


Figure 5-2 School Outdoor Play Areas

Modelling of noise emissions from school children playing have been based on the SWL noise emissions in **Table 5-9** (based on measurements conducted by RWDI):

Table 5-11 SWL from Children

Noise Source	Sound Power Level per child, L_{Aeq}, dBA	Number in active play area	Total Sound Power Level, L_{Aeq}, dBA
Child (active play)	79	130	100
		150	101

5.2.4.1 Predicted Noise Levels

Based on the assumptions presented above the predicted noise levels at the surrounding receivers from playground noise are presented in **Table 5-12.** Noise emissions have been compared with the daytime project noise trigger levels of the NPfI (refer to **Table 5-4**), even though the NPfI does not formally assess noise impacts from non-mechanical sources. It is assumed there will be no activity of on the school grounds outside daytime hours. Predicted emissions considering 500 children in each location are presented in Error! Reference source not found..

Table 5-12 Predicted Noise Levels from Playground Noise

Receiver ID	Predicted Noise Level $L_{Aeq, 15min}$	NPfI Noise Criteria $L_{Aeq, 15min}$	Complies
R01	19	56	Yes
R02	13	56	Yes
R03	33	56	Yes
R04	50	50	Yes

Receiver ID	Predicted Noise Level $L_{Aeq, 15min}$	NPfI Noise Criteria $L_{Aeq, 15min}$	Complies
R05	32	56	Yes
C05	14	63	Yes
C06	20	63	Yes
C07	38	48	Yes
C08	29	43	Yes
C09	25	43	Yes
C10	40	43	Yes
C11	36	43	Yes
C12	26	63	Yes
C13	25	43	Yes
C14	15	43	Yes
C15	14	63	Yes
C16	13	63	Yes

Compared to predictions for mechanical and vehicle noise (section 5.2.2), noise levels from children playing are expected to be negligible at all receivers except R04, where it is likely to be audible. Receiver R04 is part of the adjacent site undergoing concurrent development and subject to a separate assessment and DA. Further assessment of the acceptability of noise impacts at this receiver should be conducted once further details of R04, are available.

5.2.5 Sleep Disturbance

Operational noise emissions associated with the site that occur during the night-time period (10pm-7am) should be assessed for potential sleep disturbance at the nearest noise sensitive receivers. Currently, potential sources of sleep disturbance are limited to vehicle activities on the internal roads. The only external receiver adjacent to a road within the site is R05. No other residential receivers are expected to be exposed to sources with the potential for sleep disturbance. Sleep disturbance impacts at R04 have the potential to occur, however these worst case impacts will occur when vehicles are directly in front of the receiver, on the Morling College connection (as they will be closer to the receiver than when they are within the Site). As the receivers are being built in conjunction with the Morling College connection, sleep disturbance impacts as a result of Site are not anticipated.

The L_{Amax} sound power levels of typical activities that may occur on site with the potential to cause sleep disturbance is presented in **Table 5-13**.

Table 5-13 Sleep Disturbance – L_{Amax} Sound Power Levels

Noise Source	L_{Amax} SWL (dBA)
SWL Car travelling at 30-40km/hr	94

The shortest distance between the internal road and the façade of R05 is approximately 15 metres. Considering a car source at this worst case location the potential L_{Amax} noise levels are summarised in **Table 5-14**.

Table 5-14 Summary of Predicted Sleep Disturbance Noise Levels

Reciever ID	Predicted Noise Level L_{AMax}	NPfI Noise Criteria L_{AMax}	Complies
R01	NA	52	Yes
R02	NA	52	Yes
R03	NA	52	Yes
R04	NA	52	Yes
R05	62	52	**No (+10)**

The above assessment indicates that predicted night-time L_{AFmax} noise levels from the site exceed NPfI night-time sleep disturbance criteria during passbys, and as a result a maximum noise level event assessment should be undertaken according to the RNP. The RNP specifies that "maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep". Assuming a minimum façade transmission loss of 10 dB, as recommended by standard practise in the NSW Infrastructure SEPP for premises with open windows, internal noise levels indicate that significant sleep disturbance impacts are unlikely.

5.3 Operational Noise Recommendations

Based on the preliminary review of noise emissions from the development, indicative recommendations are provided in the following sub-sections in order for the development to comply with the nominated noise emission requirements. A review should be conducted at development application stage to ensure that noise emissions from the development are adequately mitigated.

5.3.1 Vehicle Noise

- Maximum speed limit of 40 km/h along internal roads
- Any speed bumps, drainage grates or expansion joint covering plates should be firmly down such that they do not generate any rattling noises when driven over by vehicles.

5.3.2 Mechanical Plant

- An acoustic review of mechanical plant should be undertaken at detailed design stage once plant selections and locations have been finalised. Noise from the mechanical plant should be designed to comply with the mechanical services noise trigger levels of the NPfI presented in **Table 5-4**.

5.4 Noise Impacts on Sensitive Spaces Within Development

Consideration should also be given to the impacts of noise-generating uses in the development on noise-sensitive uses within the site (primarily residential, student accommodation, and aged care). As some noise-generating uses are in relatively close proximity to residential facades/residential outdoor living spaces, the

design should account for adequate acoustic separation and sound isolation to mitigate excess noise impact at all noise-sensitive receptors.

In this section, the potential noise impact of noise-generating uses to on-site noise-sensitive uses are discussed at a high-level, since noise mitigation could be applied at the source and receptor to ensure the applicable criteria are met. Details of noise mitigation will need to be developed during the project detailed design.

The primary sources of noise generation identified for the proposed development are as follows:

- School children attending the school;
- Rooftop mechanical plant, including noise from any outdoor/uncovered units and ventilation openings.

5.4.1 Mechanical Plant

As discussed in section 5.3.2, selections of specific mechanical equipment and the location of the equipment have not been finalised. Given this, it is not possible to carry out a detailed assessment of noise emissions of mechanical plant at this early stage.

Detailed acoustic assessment of the mechanical equipment will be undertaken at during DA stage for each building.

Mitigation measures that are commonly employed to control noise emissions from mechanical equipment include:

- Locating mechanical equipment as far as practicable from noise sensitive receivers;
- Using in-duct treatments such as internally lined ductwork or silencers;
- Building barriers or enclosures around equipment;
- Using acoustic louvers.

5.4.2 School

The rooftop playground of the school could potentially have considerable impacts on the residential facades overlooking the school. Façade design of these sections should consider cumulative noise impacts including student activity, so that overall noise emissions will meet the nominated acoustic criteria at off-site receptors (see **Table 5-4**).

5.4.3 Vehicle Noise

Internal roads have potential for noise impacts to spaces in proximity to roads, in particular balconies. Location of balconies and design of façade glazing should be designed with consideration of noise levels from internal roads, to ensure acoustic amenity.

6 EXTERNAL NOISE INTRUSION ASSESSMENT

The most significant source of external noise intrusion on the development will be road noise from surrounding busy roads, mainly Epping Road and Balaclava Road.

6.1 External Noise Intrusion Criteria

The internal noise levels within the proposed residential buildings are recommended to comply with internal noise levels presented in AS/NZS 2107-2016, *Acoustics - Recommended design sound levels and reverberation times for building interiors).* The recommended noise levels are presented in **Table 6-1**.

Table 6-1 Guidelines for Internal Noise Levels (based on AS/NZS 2107:2016)

Type of premise	Space	Time of Day	Internal Noise Level L_{Aeq} (dBA)
Residential, Student Accommodation, Aged care	Sleeping areas	Night	35 to 40
	Living Areas	All	35 to 45
	Common areas (foyer, lift lobby)	All	45 to 50
Student Accommodation	Common Rooms	Night	40 to 45
	Cafeteria	When in use	45 to 50
	Kitchen and Service Areas	When in use	45 to 55
Schools	School Classroom	When in use	35 to 45
	Assembly Hall (>250 students)	When in use	30 to 35
	Libraries	When in use	40 to 50

6.2 Recommendations for Building Envelope

Based on the measured noise levels presented in **Table 4-2**, noise isolation calculations were performed to determine the internal noise levels within the development as a result of noise transmission through the building façade elements (glazing, external walls and roof/ceiling). This modelling considered the transmission loss performance of the façade elements, the estimated surface area of each façade element exposed to external noise and the absorption characteristics of the internal spaces due to room finishes.

Based on our analysis, the indicative weighted sound reduction index (R_w) performance recommendations for the building façade elements have been presented in the sub-sections below. These recommendations should be reviewed at DA and detailed design stage once room layouts and glazing areas have progressed sufficiently.

6.2.1 Glazing and Glazed Doors

The indicative minimum glazing performance recommendations based on the preliminary design for the development are presented in **Table 6-2** below. For all spaces which are not specified, standard R_w 22 glazing is acceptable for any windows within the façade.

Glazing suppliers are to provide acoustic laboratory test reports confirming that the acoustic performance of their window systems (combined performance of the glass and window frame) meet the R_w requirements.

Table 6-2 Recommended Minimum Acoustic Performance for Glazing

Room Type	Façade	Minimum Glazing Performance
Bedrooms	Facing Epping Road	R_w 34
	Facing Balaclava Road	R_w 28
Living Areas	Facing Epping Road	R_w 30
	Facing Balaclava Road	R_w 28

Sample glazing assemblies for each of the R_w ratings are noted below.

R_w 22 Glazing
- Standard glazing (no acoustic seals required)

R_w 28 Glazing
- 6mm float glazing with continuous rubber acoustic seals (similar to Schlegel Q-lon seals)

R_w 30 Glazing
- 6.38mm laminated glazing with continuous rubber acoustic seals (similar to Schlegel Q-lon seals)

R_w 34 Glazing
- 10.38mm laminated glazing with continuous rubber acoustic seals (similar to Schlegel Q-lon seals)

6.2.2 External Walls

Any proposed concrete or masonry external walls will provide adequate acoustic isolation to meet the internal noise requirements. No additional acoustic treatment is expected to be required for these external walls.

Any lightweight external walls should be reviewed at detailed design stage to determine the appropriate construction to meet in the internal noise requirements.

Any penetrations in the external walls (e.g. for services) should be adequately sealed so as not to reduce the acoustic performance of the external walls.

6.2.3 Roof/Ceiling

Any concrete roof will provide adequate acoustic isolation to meet the internal noise requirements. No additional acoustic treatment is expected to be required for the roof/ceiling to mitigate external noise intrusion.

Any lightweight roof constructions should be reviewed at detailed design stage to determine the appropriate construction to meet the internal noise requirements.

6.2.4 Ventilation

In order to meet the internal noise recommendations of AS 2021:2015, the windows and doors on the north, south and eastern façades of the development will need to remain closed. This does not mean that the windows and doors cannot be opened for natural ventilation, however an alternative means of ventilation must also be provided for the space (e.g. mechanical ventilation). This arrangement should not compromise the sound isolation performance of the external façade.

7 TRAFFIC NOISE GENERATION TO EXISTING ROADS

Guidance for the assessment of traffic noise generated on public roads by new developments is set out in the EPA's Road Noise Policy 2011 (RNP).

Table 3 of the RNP is reproduced in **Table 7-1** and presents the relevant baseline criteria for traffic noise impacts from various road categories on residential uses. For the purpose of this assessment, Balaclava road is classified as a local road, and Epping road as a sub-arterial road.

Table 7-1 Road Traffic Noise Assessment Baseline Criteria for Residential Land Uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads 3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
Local roads	4. Existing residences affected by noise from **new** local road corridors 5. Existing residences affected by noise from **redevelopment** of existing local roads 6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)

Where existing road traffic noise exceeds the relevant base line criteria stipulated in **Table 7-1,** the RNP requires additional analysis to evaluate whether traffic noise levels at residences would increase by more than 2dBA as a result of increased flows associated with the development. If the increase in overall traffic noise levels is less than 2dBA, this would typically be considered as a barely perceptible increase in noise level and is unlikely to result in any adverse impacts on residential receivers.

7.1 Traffic Noise Generation Assessment

The site will be accessible by road at three entry/exit points, as shown in **Figure 7-1**. The road through Morling College does not currently exist however has been identified by Ryde Council as part of their future public road network, and the Master Plan is proposing this road network will be delivered as part of this project as well as the separate redevelopment of Morling College.

The anticipated peak hour trip generation of the site is approximately 448 vehicle movements, assumed to be distributed evenly between the Balaclava Road, Epping Road, and Morling College Road site entrances.

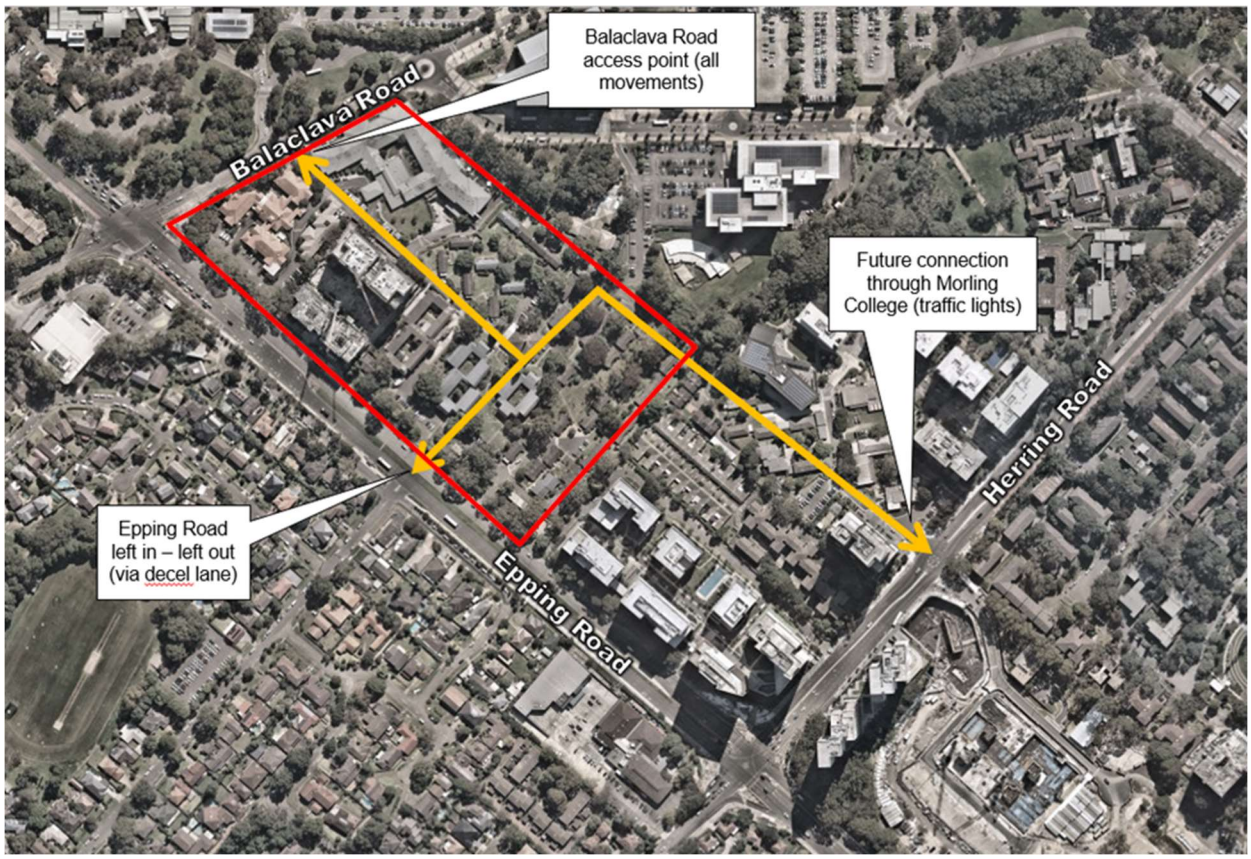


Figure 7-1: Access to Site (existing and new roads)

Existing traffic volumes for existing roads, used for the purpose of this assessment are presented in **Table 7-2**. As per information from the traffic consultant (JMT), Traffic flows on the Morling College connection are expected to be approximately 500 vehicles per hour in both the AM and PM peak hours, including the contribution of the Site.

Table 7-2 Existing Peak Hour Traffic Volumes

Roadway	AM Peak Hour (8am – 9am)	PM Peak Hour (5pm – 6pm)
Balaclava Road	840	1001
Epping Road	3378	3165

Measured traffic noise levels, reported in Section 3.1, already exceed the criteria presented in **Table 7-1**. The new peak hour traffic volumes, and the associated noise level increase from the additional vehicles, are presented in **Table 7-2**.

Table 7-3 Predicted Traffic Noise Level Increases

Roadway	Future Traffic Volumes		dB increase	
	AM Peak Hour (8am – 9am)	PM Peak Hour (5pm – 6pm)	AM Peak Hour (8am – 9am)	PM Peak Hour (5pm – 6pm)
Balaclava Road	1074	1235	0.7	0.6
Epping Road	3612	3399	0.2	0.2

Predicted traffic noise increases on the existing roads are expected to be less than 2 dB in all cases, and so no further analysis is required. The traffic noise impacts to receivers around the Morling College entrance are assumed to be acceptable, as the new connecting road is being developed in conjunction with construction of its surrounding receivers.

8 VIBRATION

No vibration intensive equipment is anticipated to be installed on site, and no surrounding receivers have an elevated sensitivity to vibration. No vibration impacts are anticipated as a result of the development.

9 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

The following section outlines preliminary advice and criteria which would be applicable to the development during construction stages. There is no proposed construction or demolition works associated with the Master Plan; these stages will be part of subsequent detailed SSDAs.

9.1 Acoustic Criteria / Management Levels

9.1.1 Noise – Interim Construction Noise Guideline (EPA, 2009)

The NSW EPA *Interim Construction Noise Guideline (ICNG)* requires project-specific Noise Management Levels (NMLs) to be established for noise affected receivers. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices are investigated to minimise noise emissions.

Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts would be managed via site specific construction noise management plans, to be prepared in the detailed design phase.

Table 9-1 details the *ICNG* noise management levels for residential premises.

Table 9-1 Interim Construction Noise Guideline Criteria for Residences

Time of Day	NML	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+10 dBA	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 meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences; 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of Day	NML	How to Apply
Outside Recommended Standard Hours	Noise Affected RBL+5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA 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*.

For commercial premises, the ICNG specifies that *the external noise levels... at the most-affected occupied point of the premises:*

- *industrial premises: external* $L_{Aeq,15min}$ *75 dB(A)*
- *offices, retail outlets: external* $L_{Aeq,15min}$ *70 dB(A)*

Based on the above, **Table 9-2** presents the applicable noise management levels for construction activities at surrounding receivers.

Table 9-2 Site-Specific Construction Noise Management Levels

Location	Construction Noise Management Level (NMLs) $L_{Aeq,15min}$				Highly Noise Affected Noise Level – $L_{Aeq,15min}$
	Day Standard Hours[1]	Day OOH	Evening OOH[2]	Night OOH[3]	
NCA01	66	61	57	55	75
NCA02	61	56	54	42	
NCA03	61	56	54	42	
NCA04	55	50	48	42	
Commercial	70	70	70	70	NA

Note 1: Standard Hours (7am – 6pm Monday to Friday, 8am – 1pm Saturday with no work on Sundays or Public Holidays)
Note 2: Evening Out-of-Hours (6pm – 10pm)
Note 3: Night Out-of-Hours (10pm – 7am)

9.1.2 Vibration – Construction Noise & Vibration Strategy

Minimum working distances for typical vibration intensive construction equipment are provided in the TfNSW's (formerly RMS) Construction Noise and Vibration Guideline (CNVG).

The minimum working distances presented in Section 7.1 of the CNVG are for both cosmetic damage (from BS 7358) and human comfort (from the NSW EPA Vibration Guideline) and are based on empirical data which suggests that where vibration intensive works are conducted outside the minimum distances, adverse vibration impacts are unlikely.

The recommended minimum working distances for vibration intensive activities from the CNVG are presented in **Table 9-3**.

Table 9-3 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Approx. Size / Weight / Model	Minimum Distance	
		Cosmetic Damage (BS 7385)	Human Response (NSW EPA Guideline)
Vibratory Roller	1-2 tonne	5 m	15 m to 20 m
	2-4 tonne	6 m	20 m
	4-6 tonne	12 m	40 m
	7-13 tonne	15 m	100 m
	13-18 tonne	20 m	100 m
	> 18 tonne	25 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	1600 kg (18 to 34t excavator)	22 m	73 m
Pile Driver – Vibratory	Sheet Piles	2 m to 20 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	4 m
Piling Rig – Hammer	12 t down force	15 m	50 m
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

9.2 Proposed Construction Activities

9.2.1 Construction Hours

Where possible, works should be completed during the standard daytime construction hours of Monday to Friday 7.00am to 6.00pm and Saturday 8.00am to 1.00pm. Where Out-of-Hours Works (OOHWs) are required (for emergency works/delivery, etc) it is likely that they would require separate approval.

9.3 Construction Noise Assessment

Noise modelling of the construction noise emissions was undertaken using the ISO9613 noise prediction algorithm in the Cadna/A modelling software.

The noise model was constructed from a combination of aerial photography, existing ground topography, design ground topography and proposed design. The local terrain, receiver buildings and structures have been digitised in the noise model to develop a three-dimensional representation of the construction works and surrounding environment.

9.3.1 Proposed Works

This report provides a preliminary assessment of the potential construction noise and vibration impacts associated with the proposed development. The following in principle construction phases have been considered:

- Demolition and clearing works
- Excavation and piling
- Building construction

These phases are anticipated to be repeated during each of the four project stages outlined **Figure 9-1**. It has been assumed that demolition phase for each stage will occur sequentially but without overlap, followed by excavation and then construction phases sequentially for each stage.

Figure 9-1 Indicative Staging

Sound power levels (SWLs) for the typical operation of construction equipment applied in the modelling are listed in **Table 9-4** and **Table 9-5** and are based on measurements conducted by RWDI. To assess construction noise levels against the NMLs, the noise levels have been converted to equivalent $L_{Aeq,15min}$ noise emissions based on the expected period of operation of the individual pieces of construction plant.

Table 9-4 Construction Noise Sources Stages 1, 3, and 4

Phase	Equipment	Operating mins in 15-min period	Quantity	Sound Power Level (dB)		
				Individual Item (SWL)	L_{Aeq} Activity	L_{Amax} Activity
Demolition and Clearing	Excavator (30 t)	15	2	110	**113**	114
	Truck & Dog (30 t)	15	1	108	**108**	
Excavation and Piling	Dozer (D10)	10	2	116	**117**	122
	Truck & Dog (30 t)	15	2	108	**111**	
	Excavator (40 t)	15	2	115	**118**	
	Piling Rig	5	1	116	**111**	
	Concrete Truck	15	1	109	**109**	
Construction	Concrete Truck / Agitator	15	2	106	**109**	117
	Concrete Pump	15	1	109	**109**	
	Truck (20 t)	15	1	103	**103**	
	Mobile Crane	10	1	113	**113**	
	Hand Tools	7.5	5	105	**109**	
	Elevated Work Platform	10	2	97	**98**	

Table 9-5 Construction Noise Sources Stage 2

Phase	Equipment	Operating mins in 15-min period	Quantity	Sound Power Level (dB)		
				Individual Item (SWL)	L_{Aeq} Activity	L_{Amax} Activity
Demolition and Clearing	Excavator (30 t)	15	4	110	**116**	114
	Truck & Dog (30 t)	15	2	108	**111**	
Excavation and Piling	Dozer (D10)	10	4	116	**120**	122
	Truck & Dog (30 t)	15	4	108	**114**	
	Excavator (40 t)	15	4	115	**121**	
	Piling Rig	5	2	116	**114**	
	Concrete Truck	15	2	109	**112**	
Construction	Concrete Truck / Agitator	15	4	106	**112**	117

Phase	Equipment	Operating mins in 15-min period	Quantity	Sound Power Level (dB)		
				Individual Item (SWL)	L_{Aeq} Activity	L_{Amax} Activity
	Concrete Pump	15	2	109	**112**	
	Truck (20 t)	15	2	103	**106**	
	Mobile Crane	10	2	113	**114**	
	Hand Tools	7.5	10	105	**112**	
	Elevated Work Platform	10	4	97	**101**	

Consistent with the requirements of the *ICNG*, and to inform the scheduling of construction activity and management of noise during the detailed design phase, the construction noise impacts are based on an expected typical worst-case scenario. The *ICNG* recommends that the realistic worst-case or conservative noise levels from the source should be predicted for assessment locations representing the most noise exposed residences or other sensitive land uses. For each receiver area the noise levels are predicted at the most noise-exposed location, which would usually be the closest receiver.

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted at the most-exposed receiver as the noise levels presented in this report are based on a realistic worst-case assessment.

9.3.2 Predicted Construction Noise Impacts

Preliminary noise impacts of site construction activities have been quantitatively assessed for the NCAs surrounding the site. The activities and staging considered are described in section 9.3.1.

The typical $L_{Aeq,15min}$ noise levels at the surrounding NCAs are provided in **Table 9-6** through **Table 9-9**. Each of the construction activities are representative of the 'noisiest' construction periods where there may be simultaneous operation of noise intensive construction plant on site.

Table 9-6 Predicted Construction Noise Impacts – Stage 1

Phase	NCA	Noise Level – $L_{Aeq,15min}$ dBA					
		Maximum Predicted Noise Level	Noise Affected Noise Management Levels (NMLs)				Highly Noise Affected NML
			Day [1] Standard	Day OOH	Eve OOH [2]	Night OOH [3]	
Demolition and Clearing	NCA01	67	45	40	40	35	75
	NCA02	60	46	41	41	37	
	NCA03	51	46	41	38	35	
	NCA04	53	55	50	48	42	

Phase	NCA	Noise Level – $L_{Aeq,15min}$ dBA					
		Maximum Predicted Noise Level	Noise Affected Noise Management Levels (NMLs)				Highly Noise Affected NML
			Day [1] Standard	Day OOH	Eve OOH [2]	Night OOH [3]	
Excavation and Piling	NCA01	75	45	40	40	35	
	NCA02	67	46	41	41	37	
	NCA03	59	46	41	38	35	
	NCA04	61	55	50	48	42	
Construction	NCA01	69	45	40	40	35	
	NCA02	62	46	41	41	37	
	NCA03	53	46	41	38	35	
	NCA04	55	55	50	48	42	

Table 9-7 Predicted Construction Noise Impacts – Stage 2

Phase	NCA	Noise Level – $L_{Aeq,15min}$ dBA					
		Maximum Predicted Noise Level	Noise Affected Noise Management Levels (NMLs)				Highly Noise Affected NML
			Day [1] Standard	Day OOH	Eve OOH [2]	Night OOH [3]	
Demolition and Clearing	NCA01	57	45	40	40	35	75
	NCA02	59	46	41	41	37	
	NCA03	58	46	41	38	35	
	NCA04	63	55	50	48	42	
Excavation and Piling	NCA01	64	45	40	40	35	
	NCA02	63	46	41	41	37	
	NCA03	66	46	41	38	35	
	NCA04	70	55	50	48	42	
Construction	NCA01	58	45	40	40	35	
	NCA02	57	46	41	41	37	
	NCA03	60	46	41	38	35	
	NCA04	64	55	50	48	42	

Table 9-8 Predicted Construction Noise Impacts – Stage 3

Phase	NCA	Noise Level – $L_{Aeq,15min}$ dBA					
		Maximum Predicted Noise Level	Noise Affected Noise Management Levels (NMLs)				Highly Noise Affected NML
			Day [1] Standard	Day OOH	Eve OOH [2]	Night OOH [3]	
Demolition and Clearing	NCA01	48	45	40	40	35	75
	NCA02	61	46	41	41	37	
	NCA03	34	46	41	38	35	
	NCA04	53	55	50	48	42	
Excavation and Piling	NCA01	50	45	40	40	35	
	NCA02	68	46	41	41	37	
	NCA03	34	46	41	38	35	
	NCA04	34	55	50	48	42	
Construction	NCA01	44	45	40	40	35	
	NCA02	63	46	41	41	37	
	NCA03	29	46	41	38	35	
	NCA04	28	55	50	48	42	

Table 9-9 Predicted Construction Noise Impacts – Stage 4

Phase	NCA	Noise Level – $L_{Aeq,15min}$ dBA					
		Maximum Predicted Noise Level	Noise Affected Noise Management Levels (NMLs)				Highly Noise Affected NML
			Day [1] Standard	Day OOH	Eve OOH [2]	Night OOH [3]	
Demolition and Clearing	NCA01	54	45	40	40	35	75
	NCA02	62	46	41	41	37	
	NCA03	34	46	41	38	35	
	NCA04	53	55	50	48	42	
Excavation and Piling	NCA01	61	45	40	40	35	
	NCA02	67	46	41	41	37	
	NCA03	36	46	41	38	35	

Phase	NCA	Noise Level – $L_{Aeq,15min}$ dBA					
		Maximum Predicted Noise Level	Noise Affected Noise Management Levels (NMLs)				Highly Noise Affected NML
			Day [1] Standard	Day OOH	Eve OOH [2]	Night OOH [3]	
	NCA04	42	55	50	48	42	
Construction	NCA01	56	45	40	40	35	
	NCA02	61	46	41	41	37	
	NCA03	30	46	41	38	35	
	NCA04	36	55	50	48	42	

Note 1: Standard Hours (7am – 6pm Monday to Friday, 8am – 1pm Saturday with no work on Sundays or Public Holidays)
Note 2: Evening OOH (6pm – 10pm)
Note 3: Night OOH (10pm – 7am)

During standard construction hours (as defined in the ICNG), noise from demolition and clearing works is expected to exceed the NML in regions of NCA01 and NCA02 during all stages, at NCA03 during stage 1 and 2 only, and at NCA04 during stage 2 only. The range of exceedance is from 3 dB to 22 dB, with the greatest exceedances being recorded at NCA01.

During standard construction hours (as defined in the ICNG), noise from excavation and piling are expected to exceed the NML in regions of all NCAS during stage 1 and 2, and at NCA01 and NCA02 only during stage 3 and 4. The range of exceedance is from 5 dB to 30 dB, with the greatest exceedances being recorded at NCA01. One exceedance to the commercial NML is recorded, at receiver C11.

During standard construction hours (as defined in the ICNG), noise from building works are expected to exceed the NML in regions of NCA01 and NCA02 during all stages, with the exception of NCA01 during stage 3. Exceedances at NCA03 are predicted during stage 1 and stage 2, and during stage 2 only for NCA04. The range of exceedance is from 7 dB to 24 dB, with the greatest exceedances being recorded at NCA01. Predicted noise levels at NCA04 during stage 1 are on the NML criteria.

There are no expected exceedances of the highly-noise affected NML at any of the NCAs during any phases or stages. In light of the findings from this preliminary construction noise assessment, all reasonable and feasible noise mitigation measures should be implemented to minimise construction noise impacts on the surrounding sensitive receivers.

Measures to manage construction noise emissions are discussed in section 9.3.3.

9.3.3 Construction Noise Mitigation

As discussed in section 9.3.2, noise levels from construction activities during standard hours are predicted to exceed the NMLs of the ICNG at several receivers surrounding the site. Therefore, in accordance with the ICNG, all reasonable and feasible measures should be applied to manage construction noise emissions from the site. In particular, the following is recommended:

A detailed Construction Noise and Vibration Management Plan (CNVMP) should be prepared and should include, but not be limited to the following:

- Identification of nearby residences and other sensitive land uses;
- Description of approved hours of work;
- Description and identification of construction activities, including work areas, equipment and duration;
- Description of what work practices (generic and specific) will be applied to minimise noise;
- Consider the selection of plant and processes with reduced noise emissions;
- A complaints handling process;
- Noise monitoring procedures;
- Overview of community consultation required for identified high impact works;
- Overview of community consultation process and assessment required for identified additional works outside of standard construction hours; and
- Induction and training will be provided to relevant staff and sub-contractors outlining their responsibilities with regard to noise.

Examples of typical construction noise mitigation measures are provided in **Table 9-10**, along with the likely reduction in noise levels. Where reasonable and feasible, these measures should be employed during the construction of the development.

Table 9-10 Indicative Construction Noise Mitigation Measures

Mitigation Measure	Anticipated Noise Reduction, dBA
Administrative Controls	
Operate during approved hours	N/A
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	N/A
Appropriate training of onsite staff	N/A
Undertake community consultation and respond to complaints in accordance with established project procedures	N/A
Turning off machinery when not in use	0-5
Respite periods for pile drivers and rock breakers (if applicable)	N/A
Conducting regular maintenance of plant to ensure that they are operating as efficiently and quietly as practicable	N/A
Engineering Controls	
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers	3-6
Avoiding using noisy plant simultaneously and / or close together, adjacent to sensitive receivers	2-3
Orienting equipment away from sensitive receivers	3-5
Carrying out loading and unloading away from sensitive receivers	3-5
Using dampened tips on rock breakers	3-6

Mitigation Measure	Anticipated Noise Reduction, dBA
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as reasonably practicable away from sensitive receivers	3-6
Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms	2-5
Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

9.4 Predicted Construction Vibration Impacts

9.4.1 Recommended Minimum Safe Working Distances

The nearest neighbouring residential building to the site is approximately 4 metres from the site boundary, located at 159-161 Epping Rd.

Based on the CNVG's recommended minimum working distances for vibration sensitive equipment (refer to **Table 9-3**), the vibration intensive activities that could potentially occur at distances less than the recommended minimum working distances from the sensitive receivers with respect to cosmetic building damage and human comfort are listed in Table 9-11. This list applies only if equipment is used on or just within the border of the site.

Table 9-11 Vibration Intensive Equipment that Could Operate within the Minimum Recommended Distances of Sensitive Receivers

Equipment Potentially Operating Within Recommended Minimum Distances to Sensitive Receivers	
Cosmetic Damage (BS 7385)	**Human Response (NSW EPA Guideline)**
Vibratory Roller (any tonnage)	Vibratory Roller (any tonnage)
Small Hydraulic Hammer	Small Hydraulic Hammer
Medium Hydraulic Hammer	Medium Hydraulic Hammer
Large Hydraulic Hammer	Large Hydraulic Hammer
Pile Driver – Vibratory	Piling Rig – Bored
Piling Rig – Hammer	Pile Driver – Vibratory
	Piling Rig – Hammer

Should these pieces of plant be operated at any location on site which is within the minimum recommended distances of the CNVG of a sensitive receiver, or if there are any other vibration intensive plant items that the Contractor has concerns for causing disruption at neighbouring development, it is recommended that a

preliminary vibration survey (typically attended vibration measurements) be undertaken of each vibration generating piece of plant.

This vibration survey will determine whether there will be any exceedances of the relevant construction vibration criteria. If exceedances are observed, vibration mitigation and management strategies can be developed to minimise vibration impacts as far as practicable, and ideally to be compliant with the vibration criteria.

The vibration management strategy may also include the installation of unattended vibration monitors at sensitive receivers to notify the contractor of any exceedances of the vibration criteria. Any such vibration management strategy should be developed as part of a CNVMP.

10 CONCLUSION

This report has presented a noise and vibration impact assessment for the proposed BaptistCare redevelopment located at 157 Balaclava Road in Macquarie Park, NSW. This assessment has been prepared to address the noise and vibration clauses of the SEARs for the State Significant Development Application (SSD 46561712).

Existing ambient noise levels have been established at nearby sensitive receivers via long-term unattended noise monitoring as presented in section 4.1. The noise monitoring data has been processed in accordance with the NPfI to establish the RBLs at sensitive receivers.

Noise impacts associated with the operation of the development (primarily school noise, vehicle noise from roads within site, and mechanical plant noise) have been assessed with reference to the NPfI and RNP as appropriate, presented in section 5.2. The results of the assessment indicate in-principle that noise emissions from the site are capable of complying with the relevant acoustic requirements through considered design and the implementation of appropriate acoustic treatments and noise management controls.

Noise intrusion into the development from road noise from Balaclava Road and Epping Road have been assessed with reference to the internal noise recommendations of AS/NZS 2107:2016. Indicative recommendations for the building façade construction have been presented in section 6.2 to achieve the internal noise requirements. These recommendations are based on preliminary drawings, and should be reviewed for each building once the room layouts and façade constructions have been determined.

Traffic noise impacts from additional vehicle flow on existing roads associated with the operation of the development have been assessed in accordance with the RNP, and predicted traffic noise generation associated with the site complies with the RNP impact assessment criteria as shown in section 7.1.

Construction NMLs for sensitive receivers, and in-principle potential noise and vibration impacts during construction, have been established in accordance with the ICNG in section 9. No proposed construction or demolition works are associated with the Master Plan DA; the preliminary assessment should be reviewed at detailed DA stage.

11 STATEMENT OF LIMITATIONS

This report entitled BaptistCare Master Plan Noise & Vibration Impact Assessment 18/11/2022 was prepared by RWDI Australia Pty Ltd ("RWDI") for BaptistCare ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

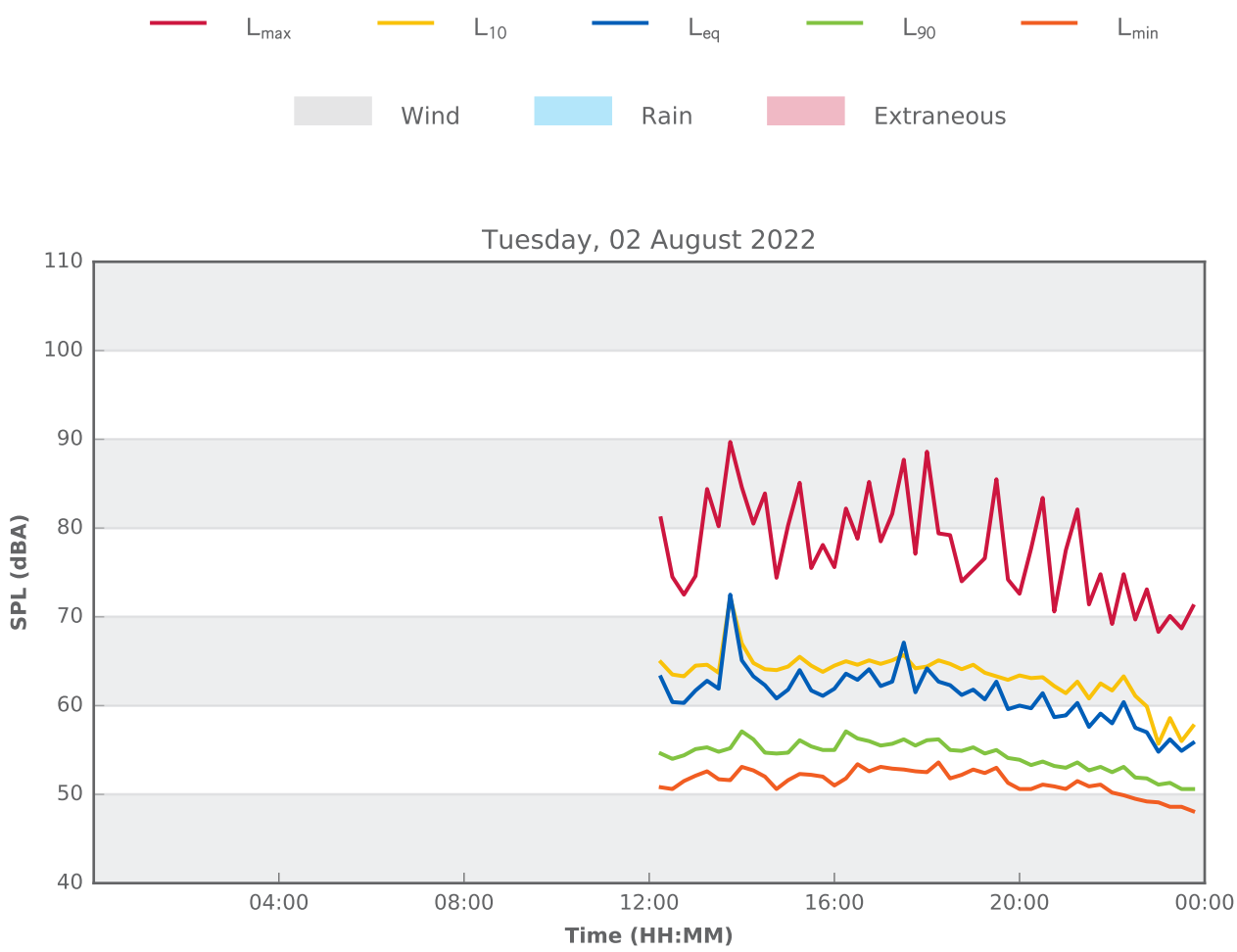
The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

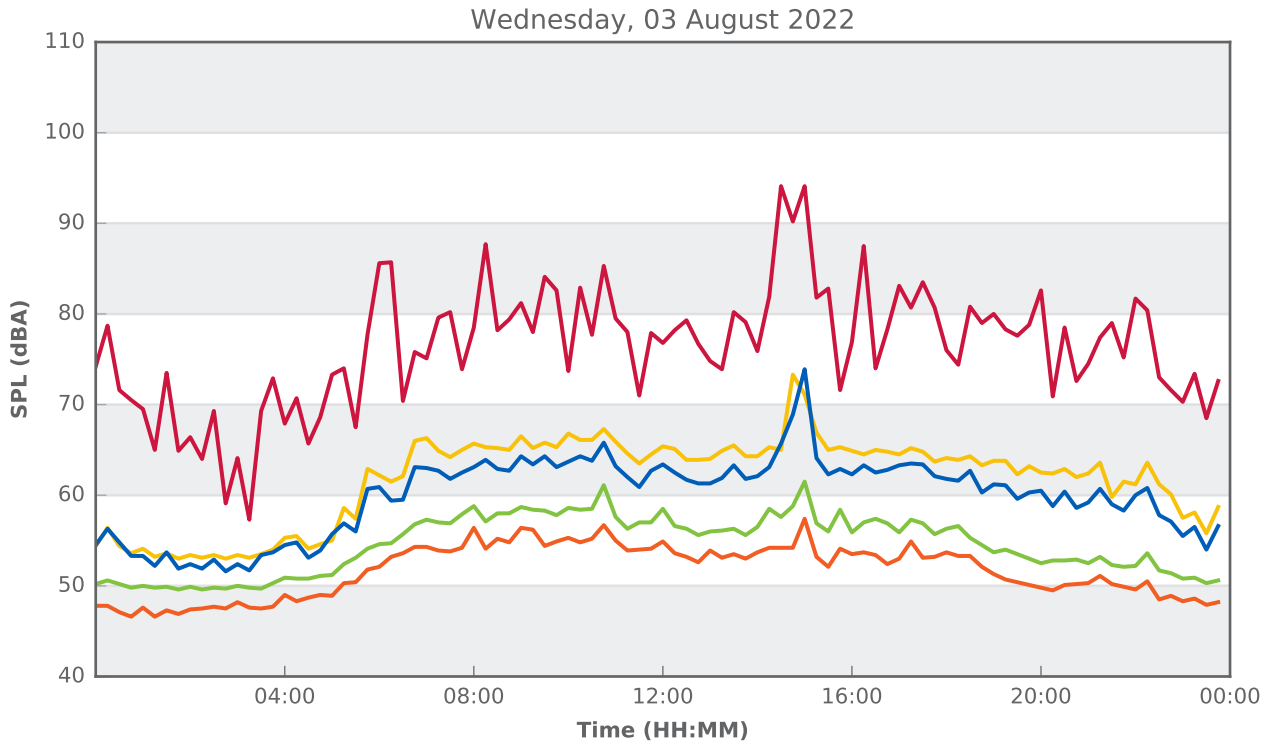
Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and understand the different factors which may impact the conclusions and recommendations provided.

APPENDIX A

UNATTENDED NOISE MONITORING RESULTS

L1 (Balaclava Road)





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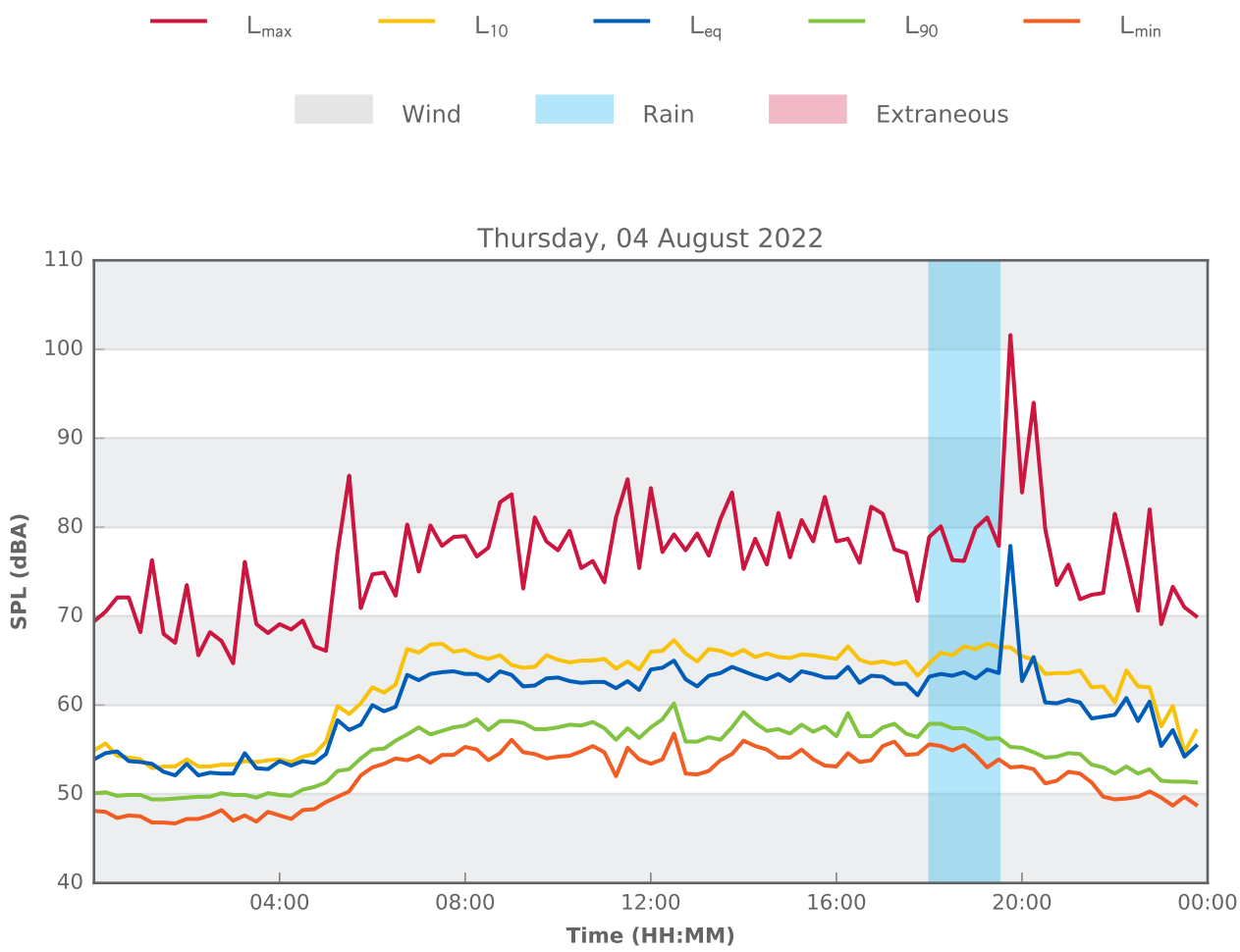

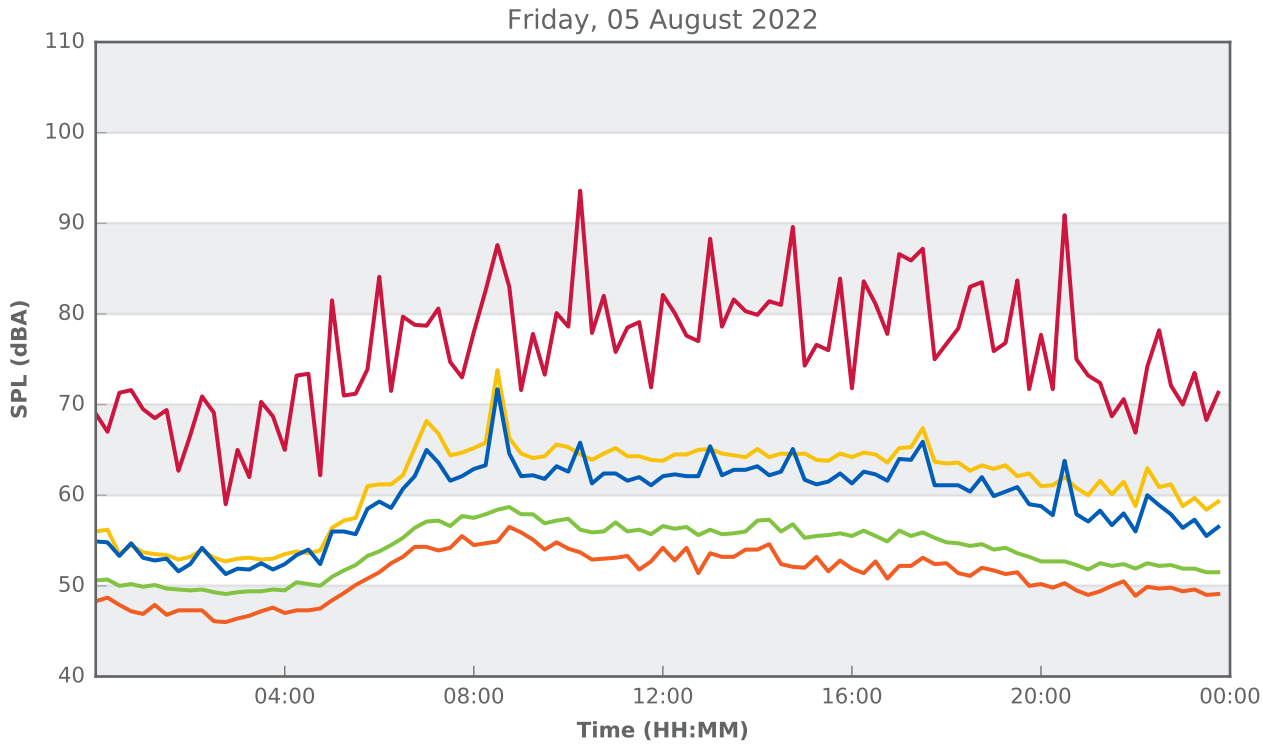

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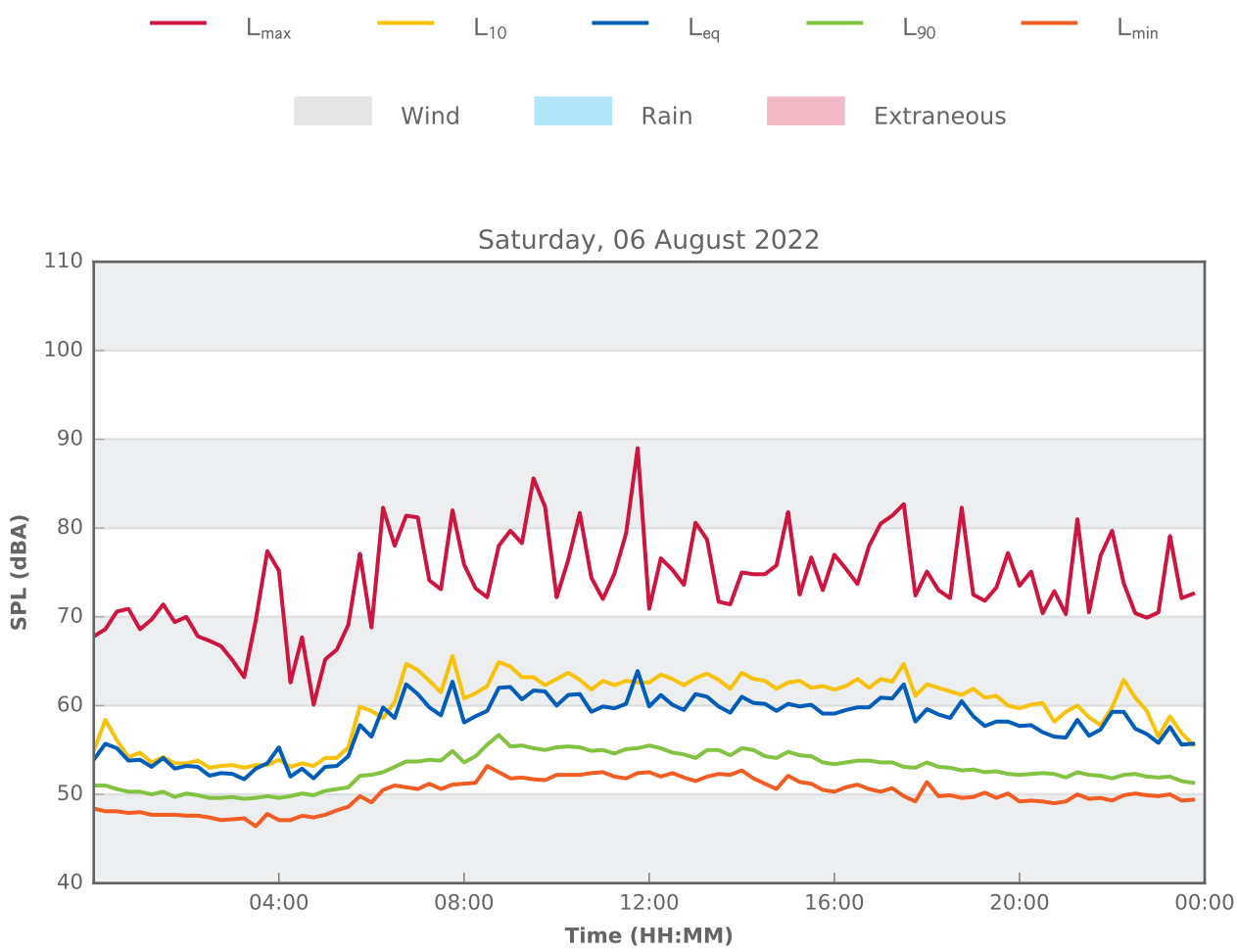

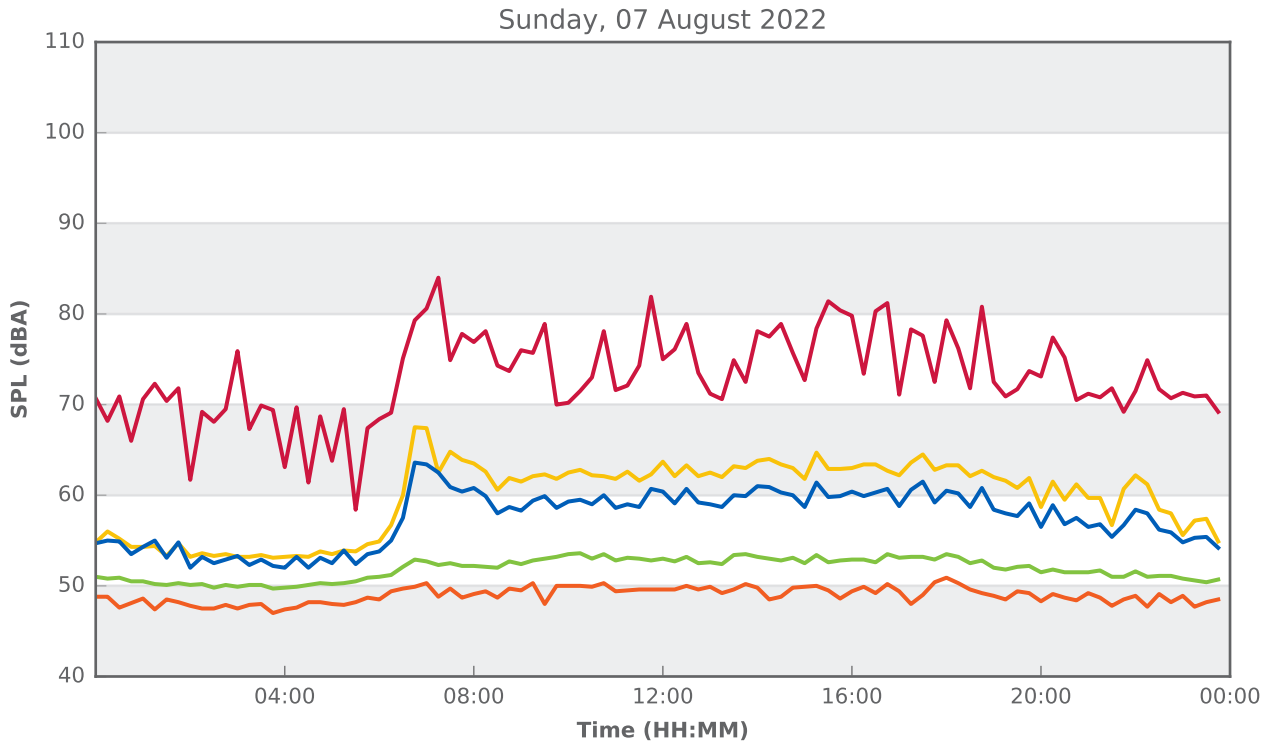

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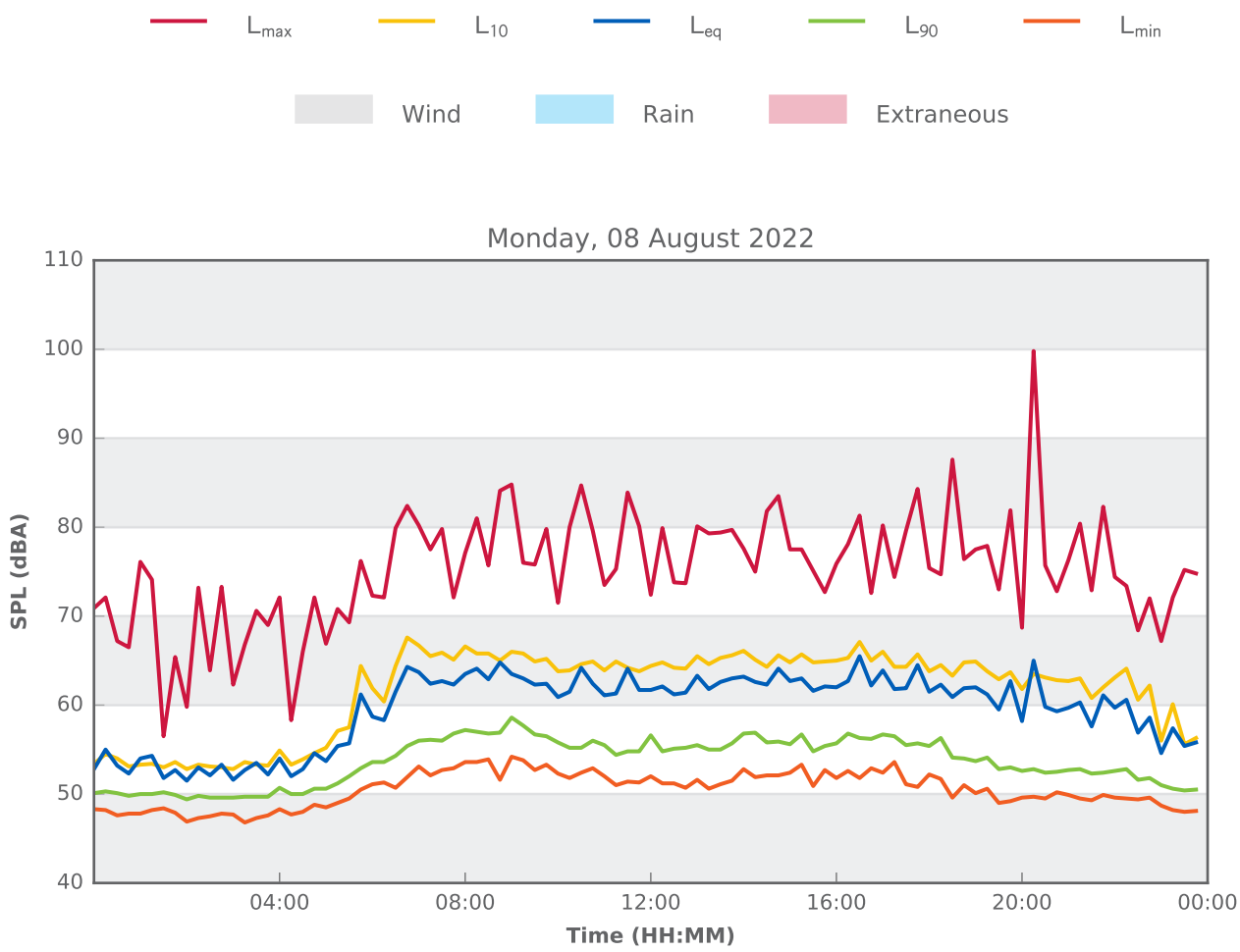

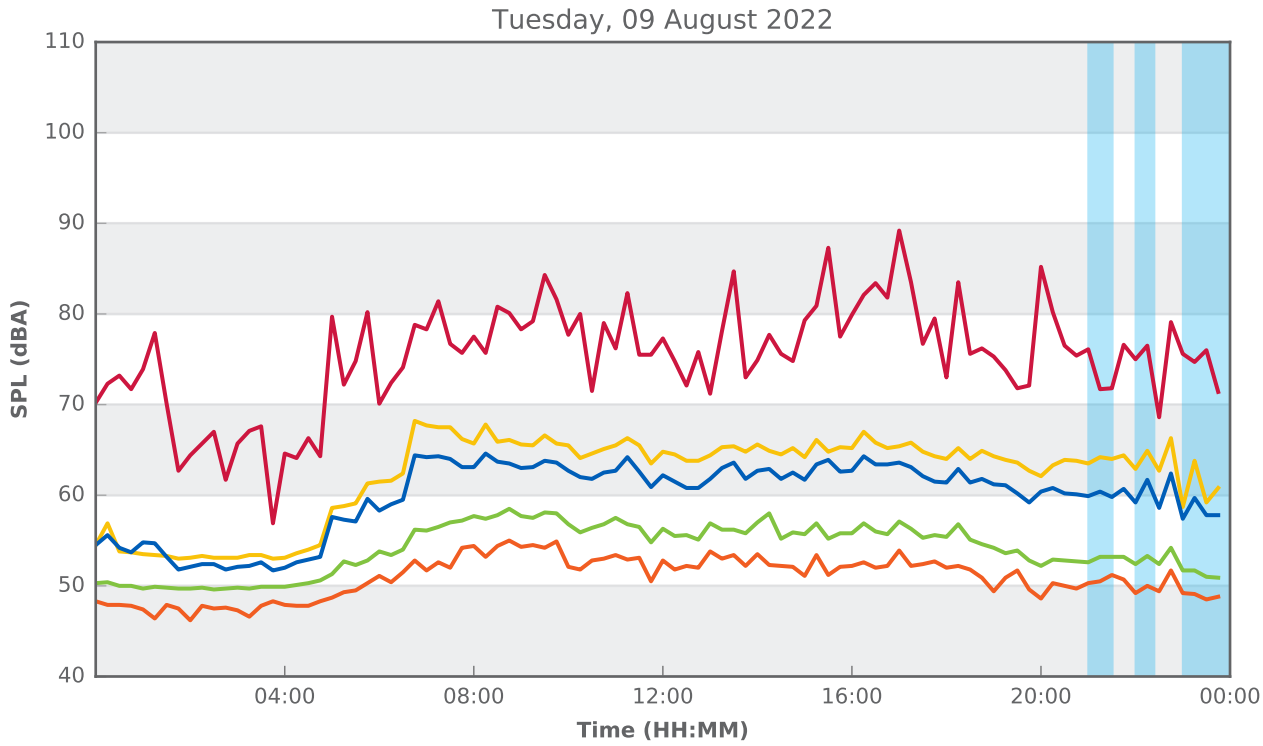

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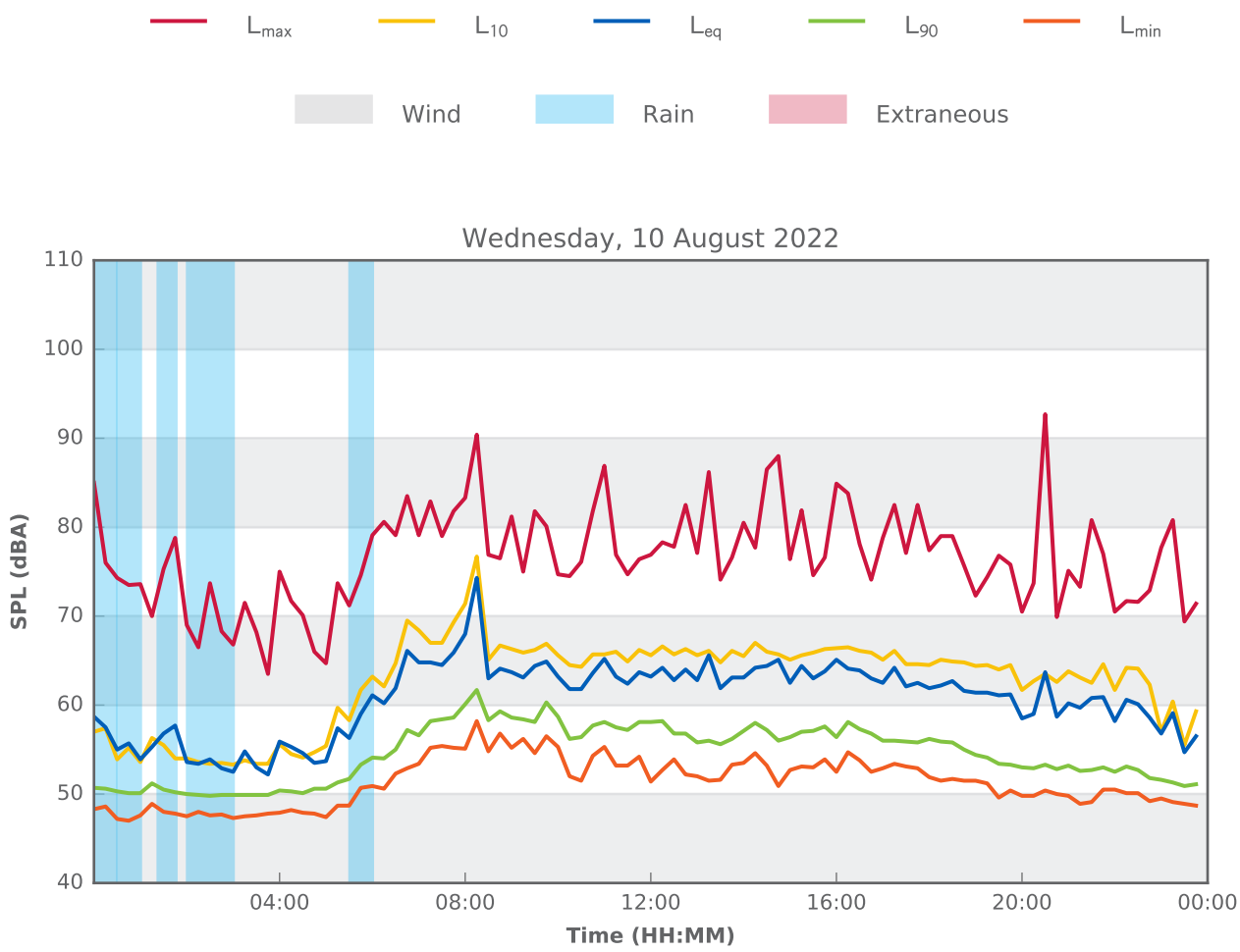

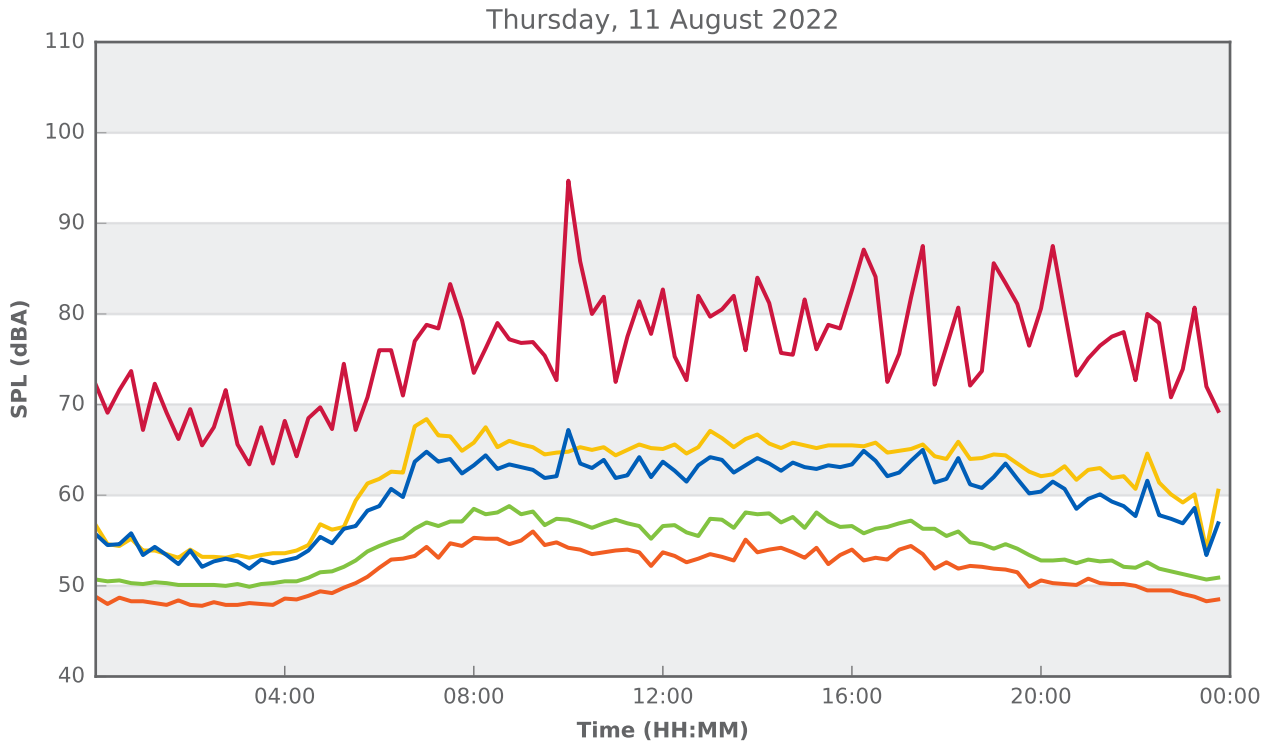

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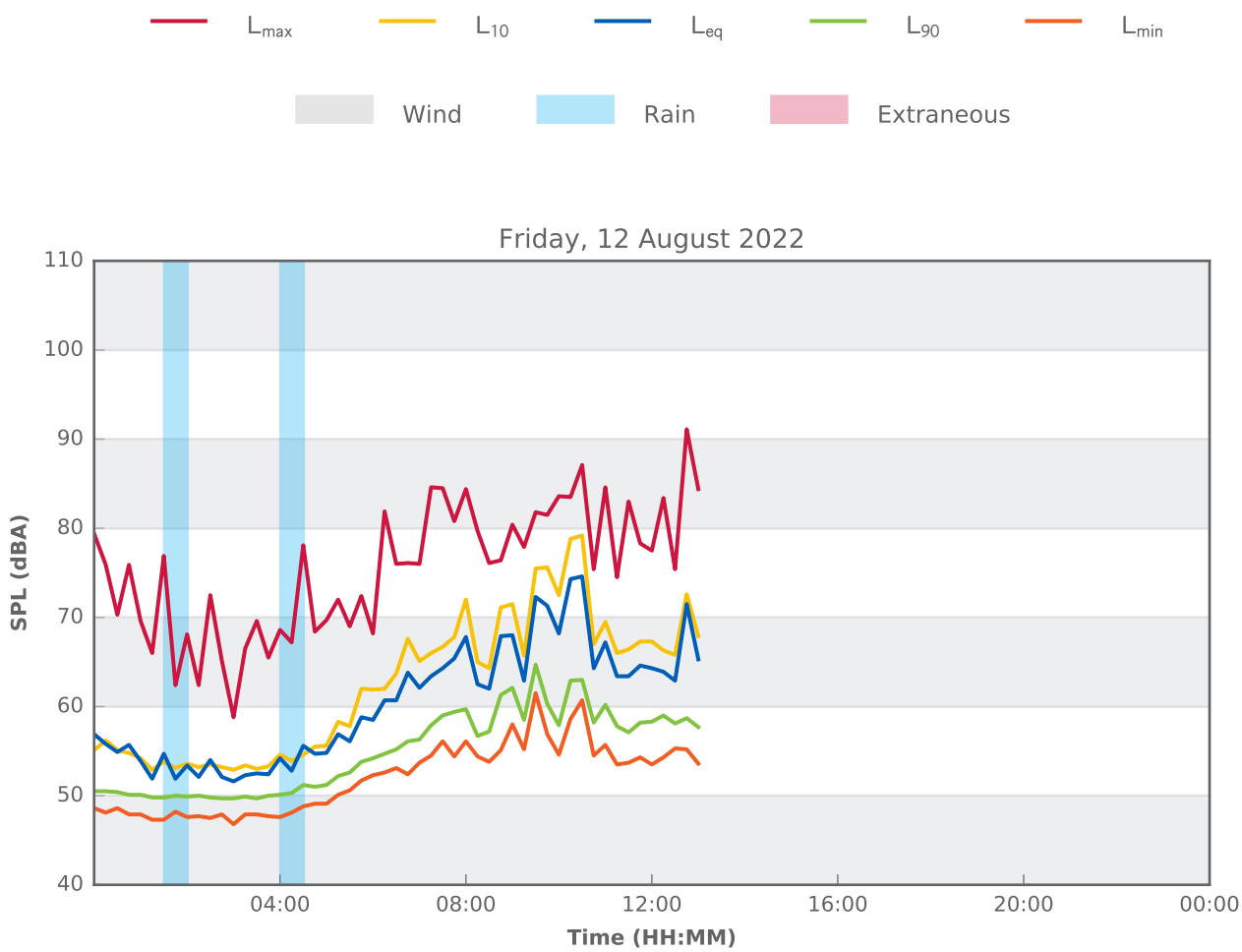

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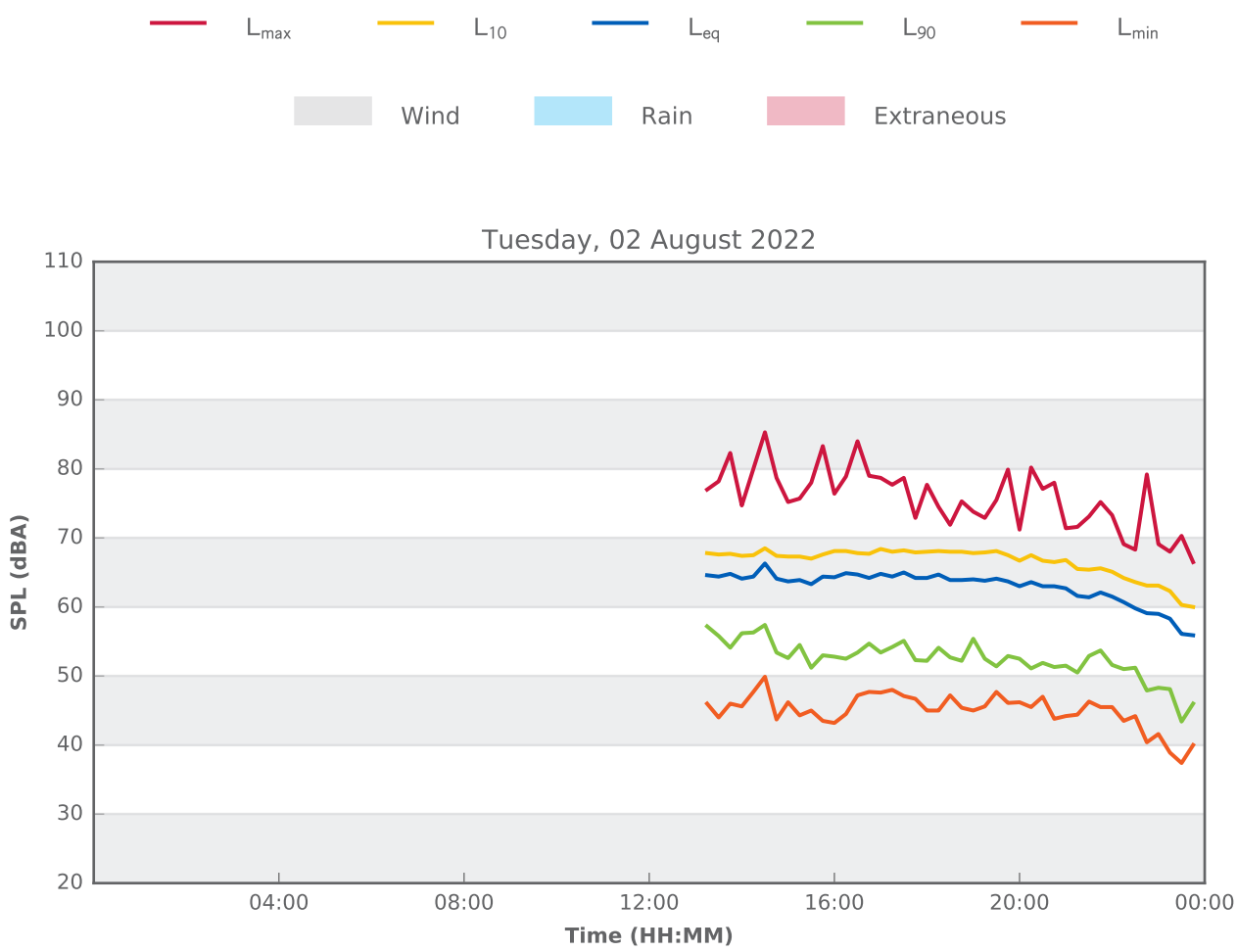

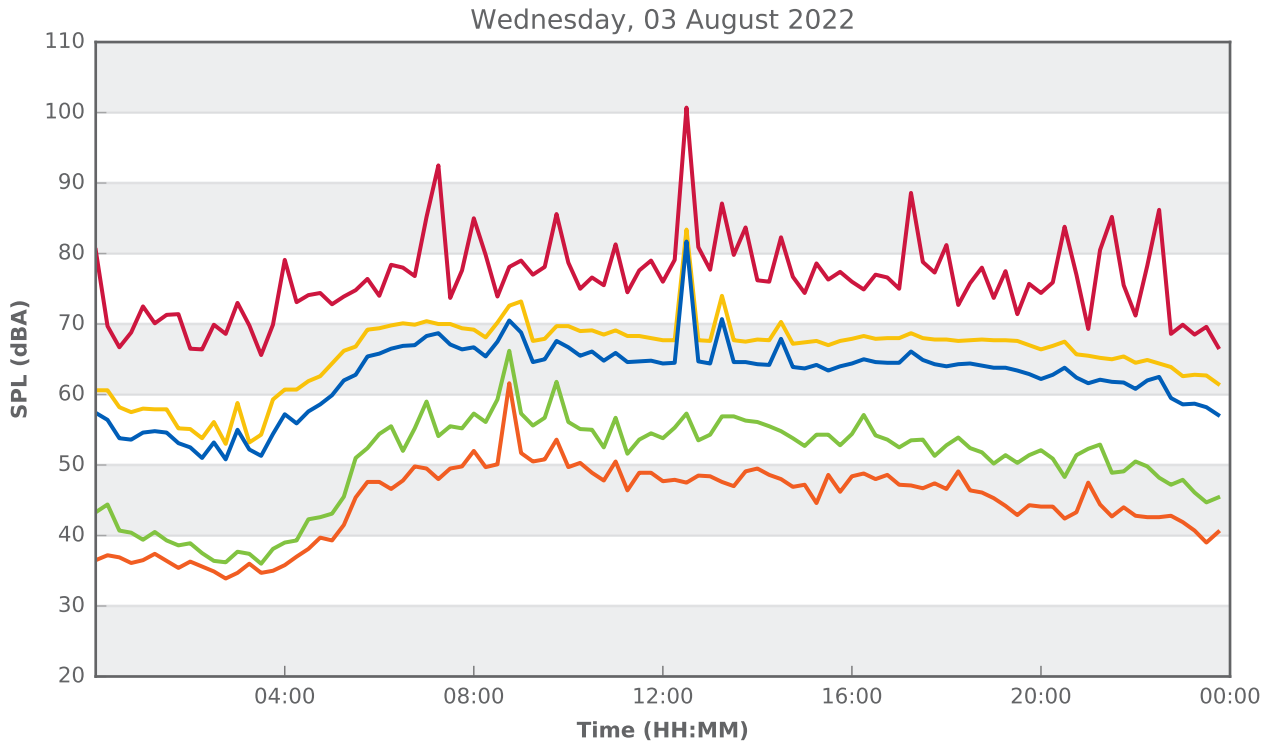

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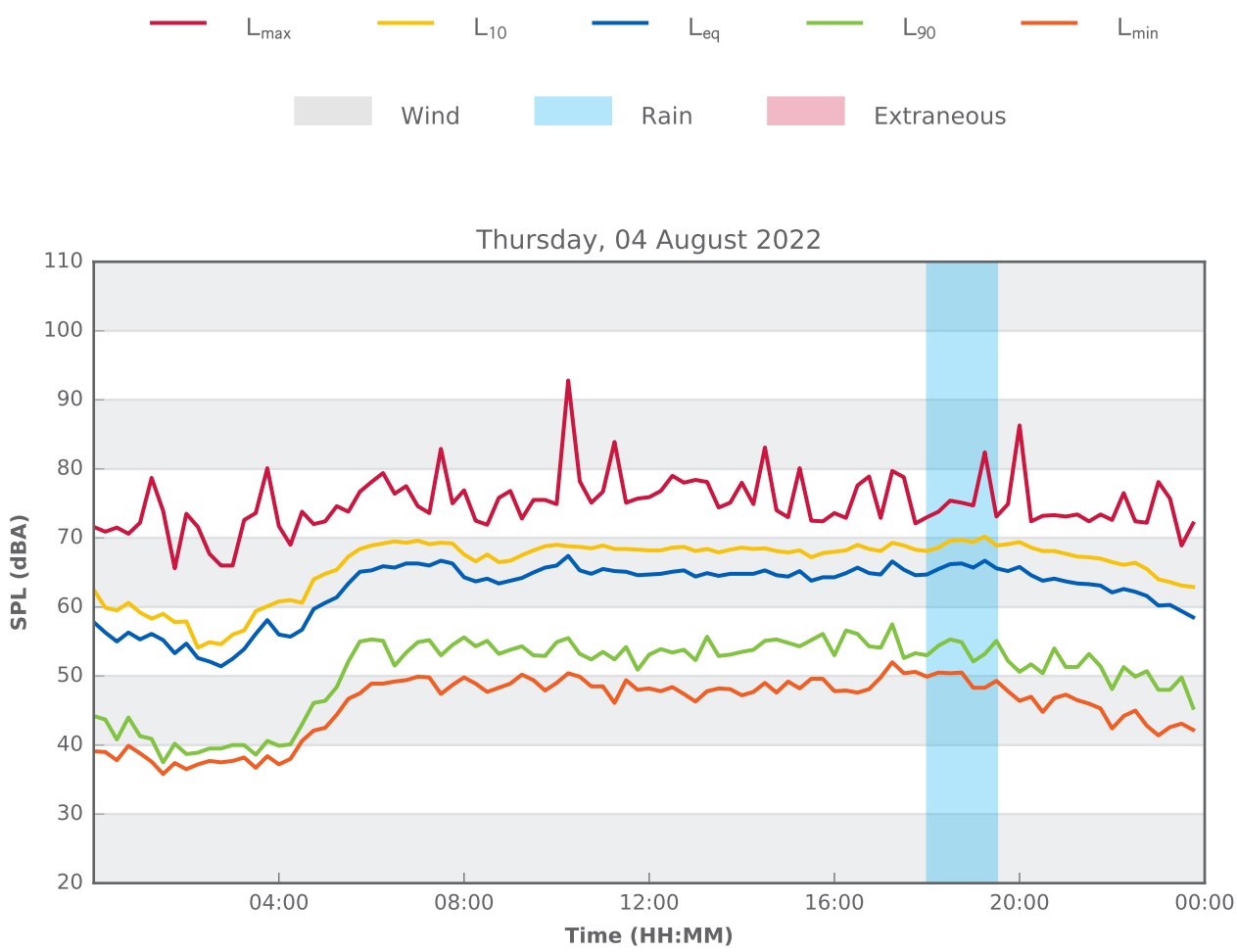

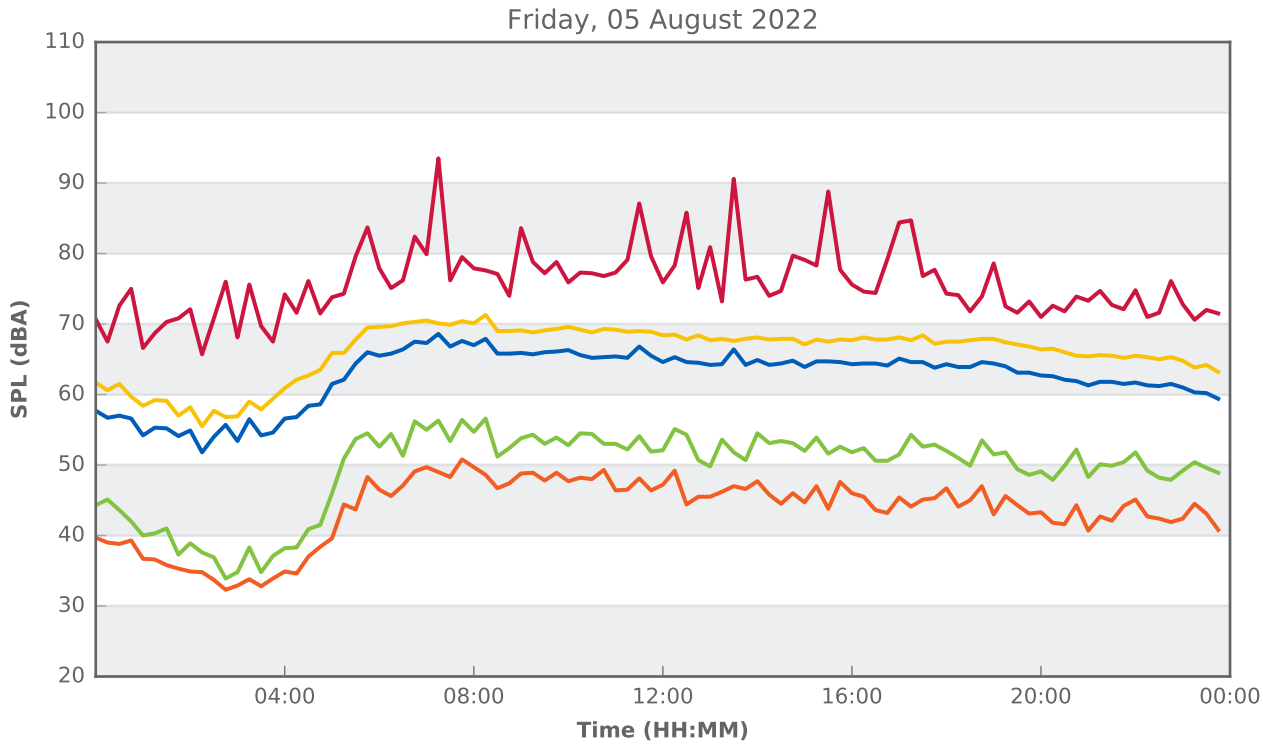

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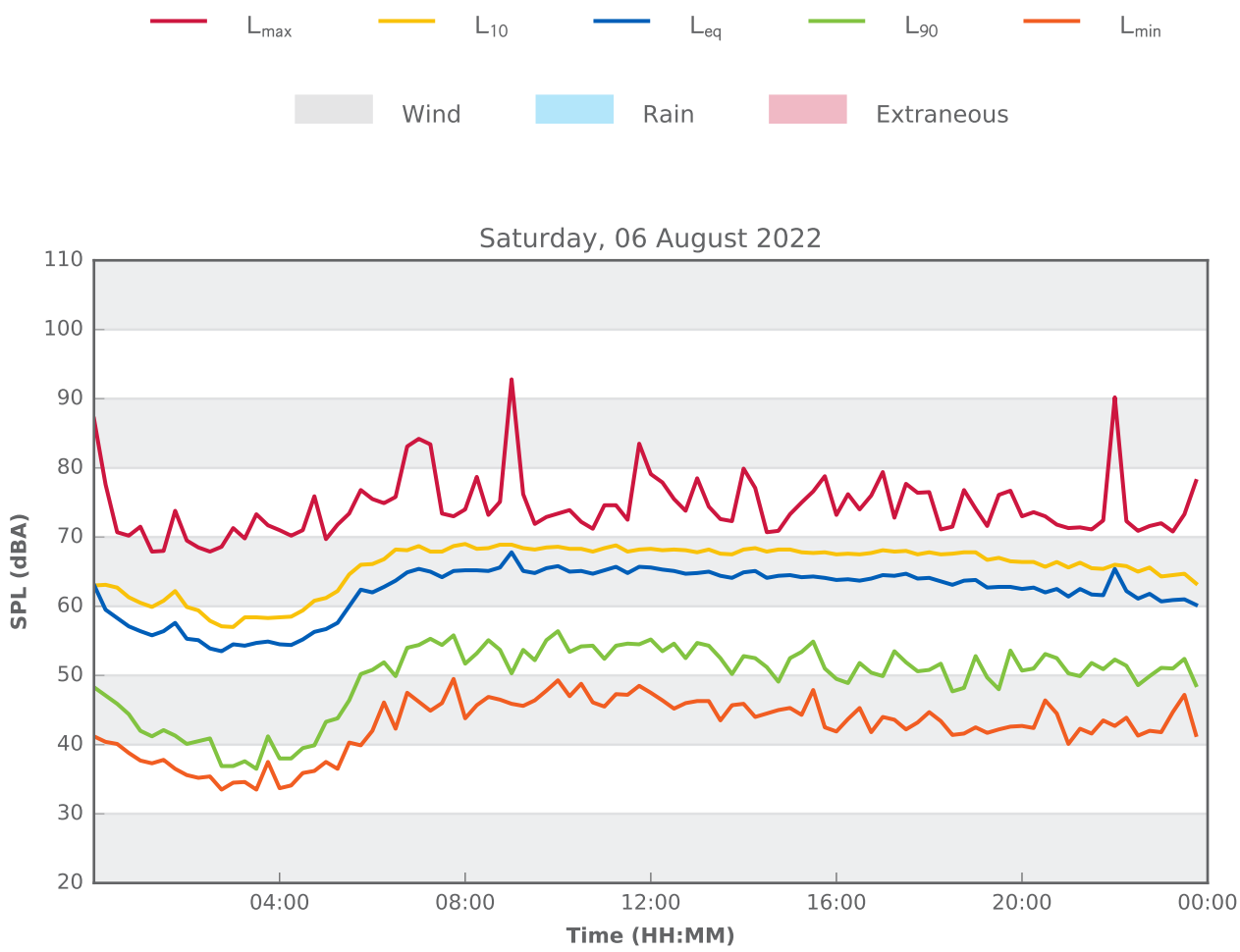

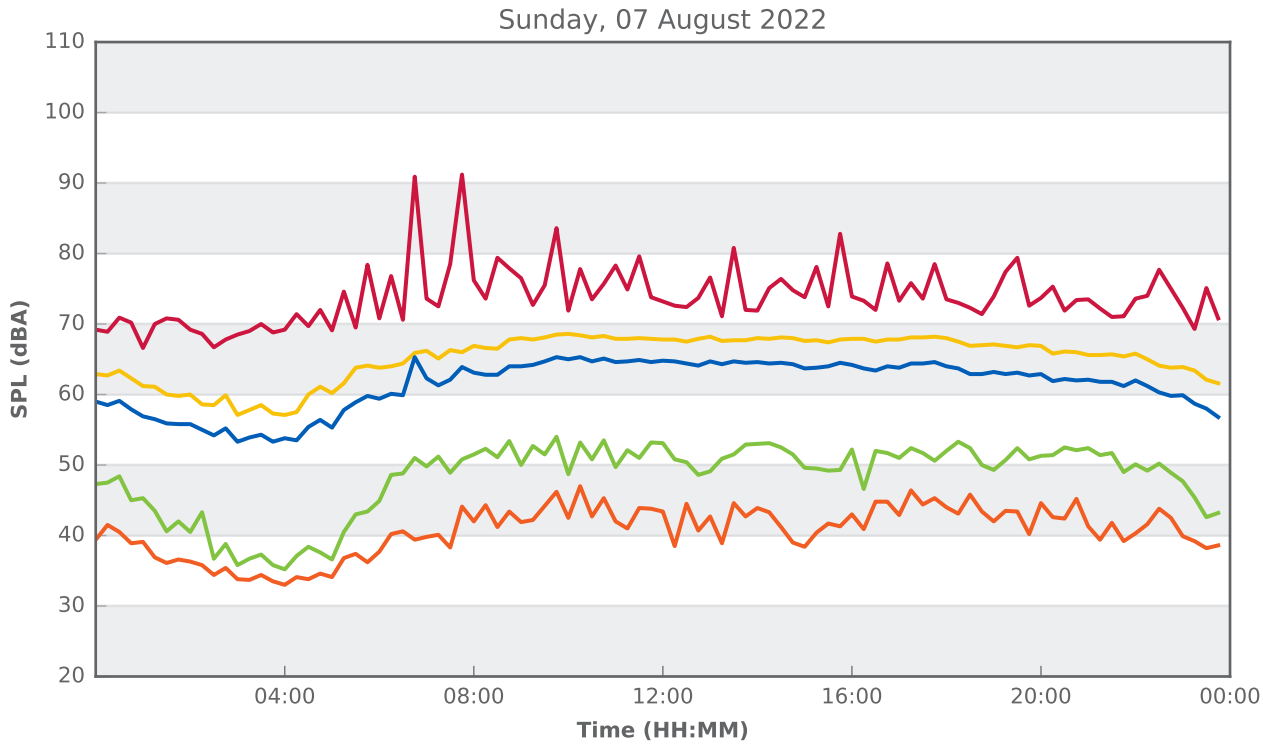

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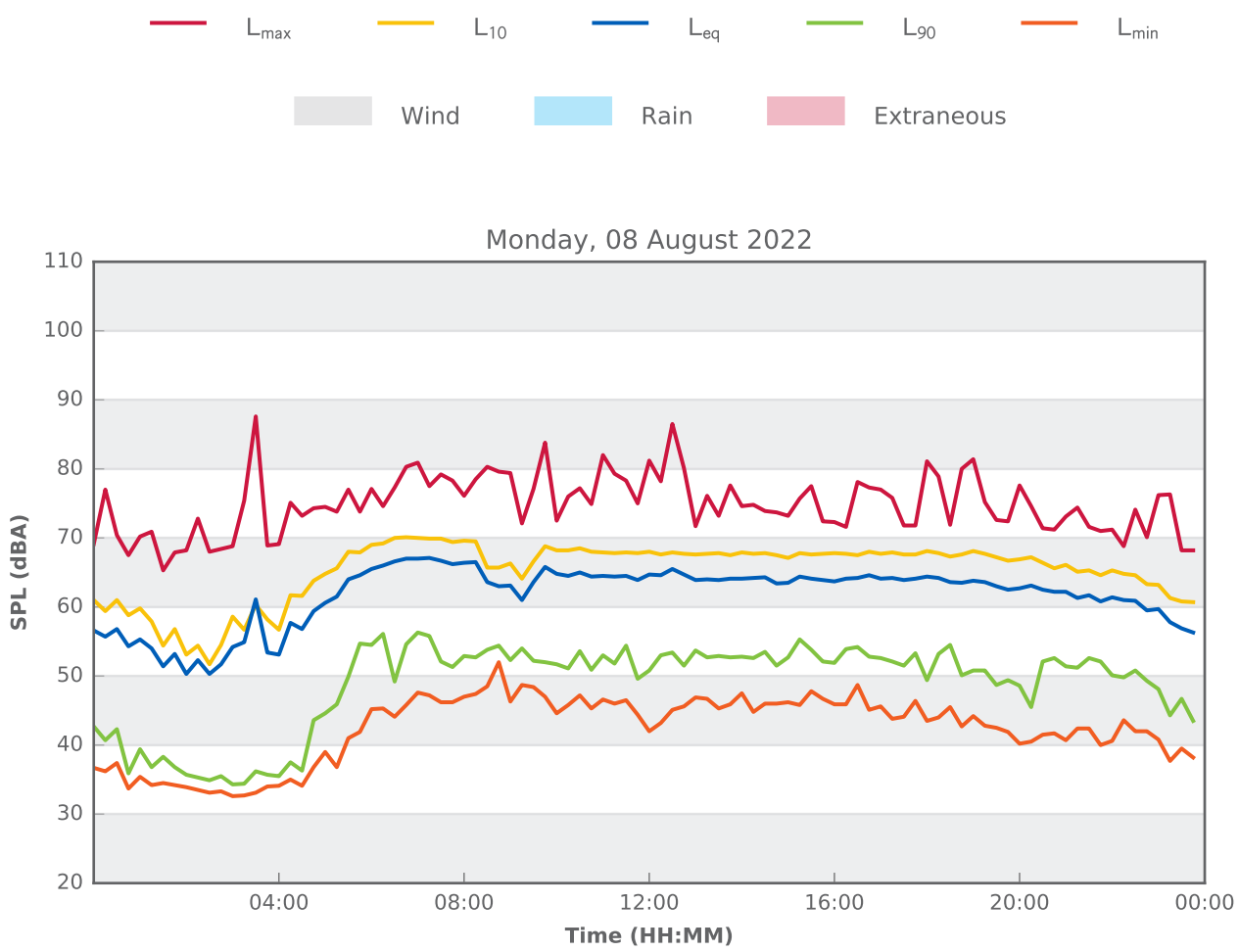

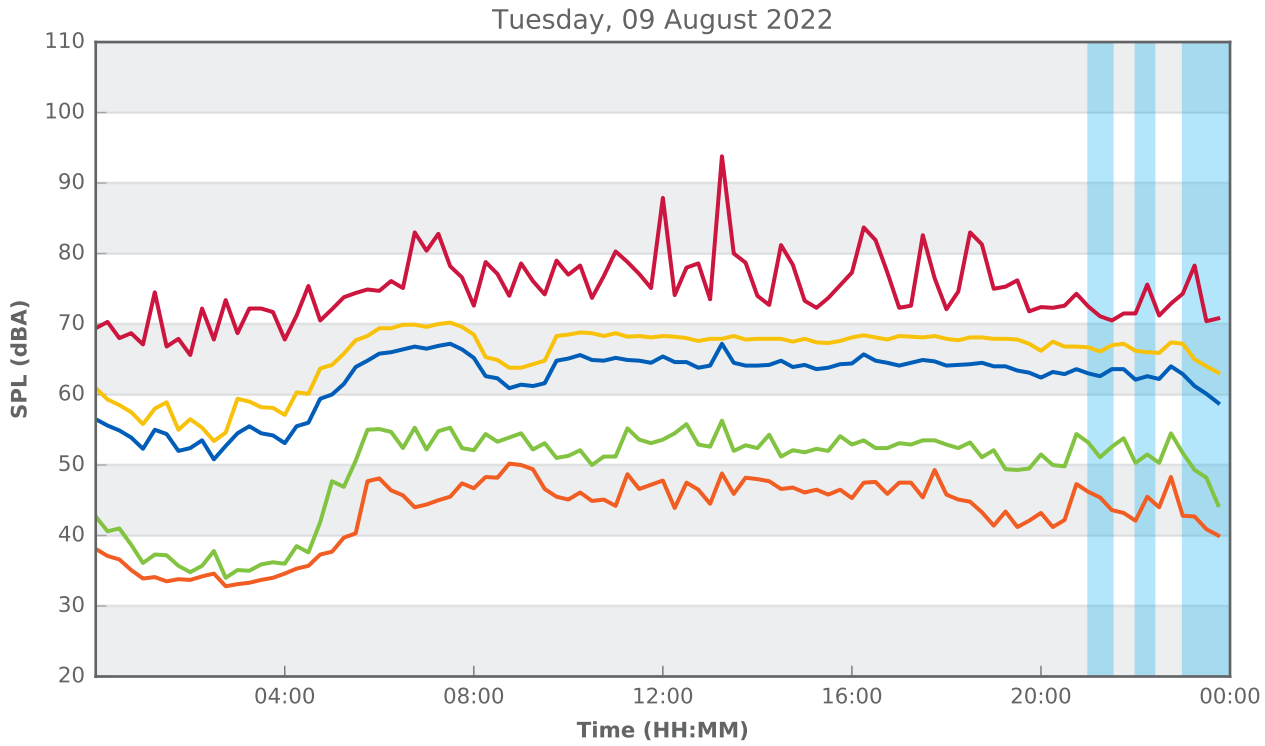

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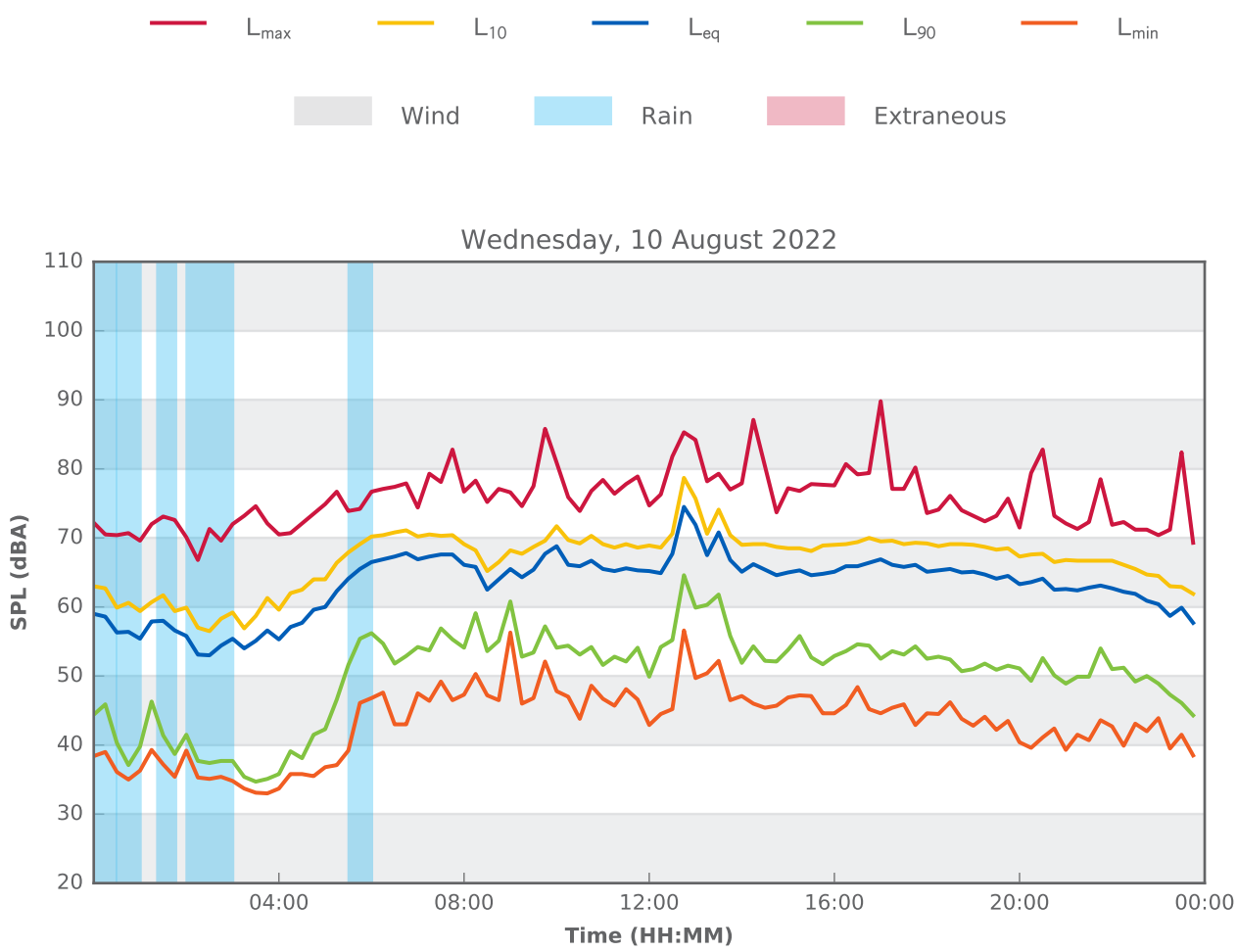
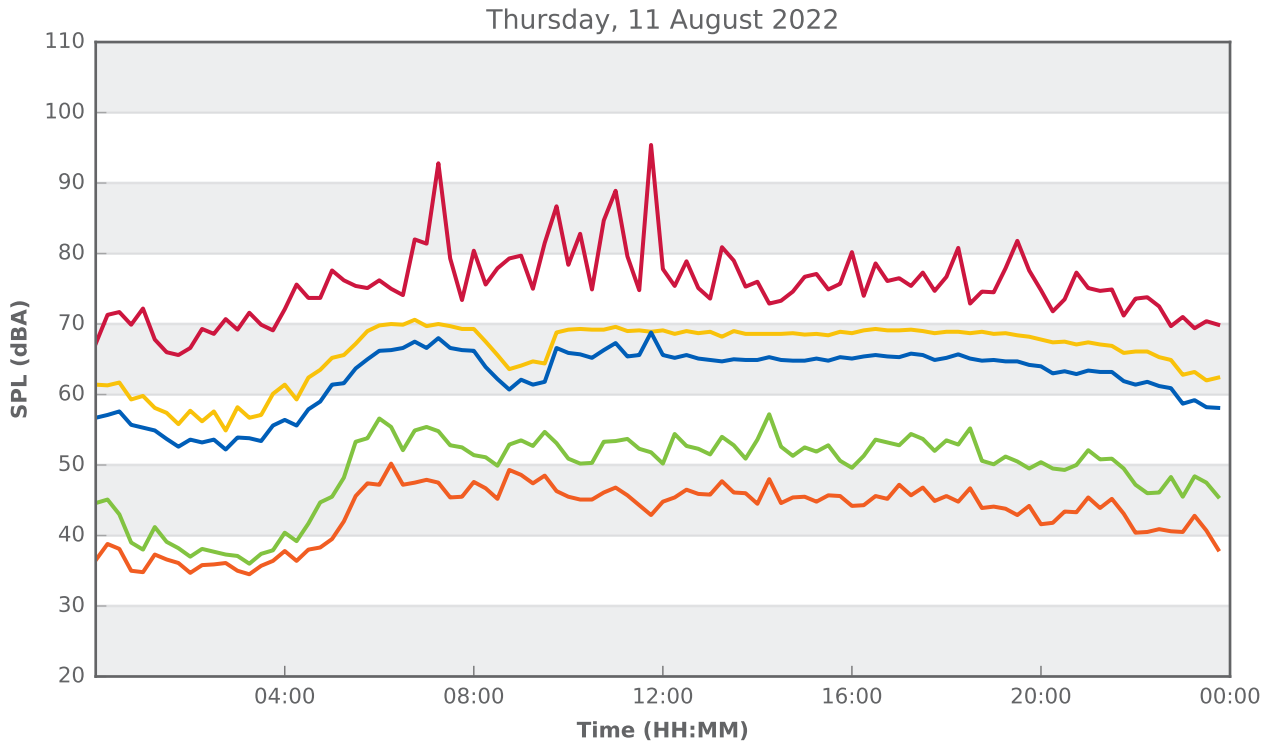
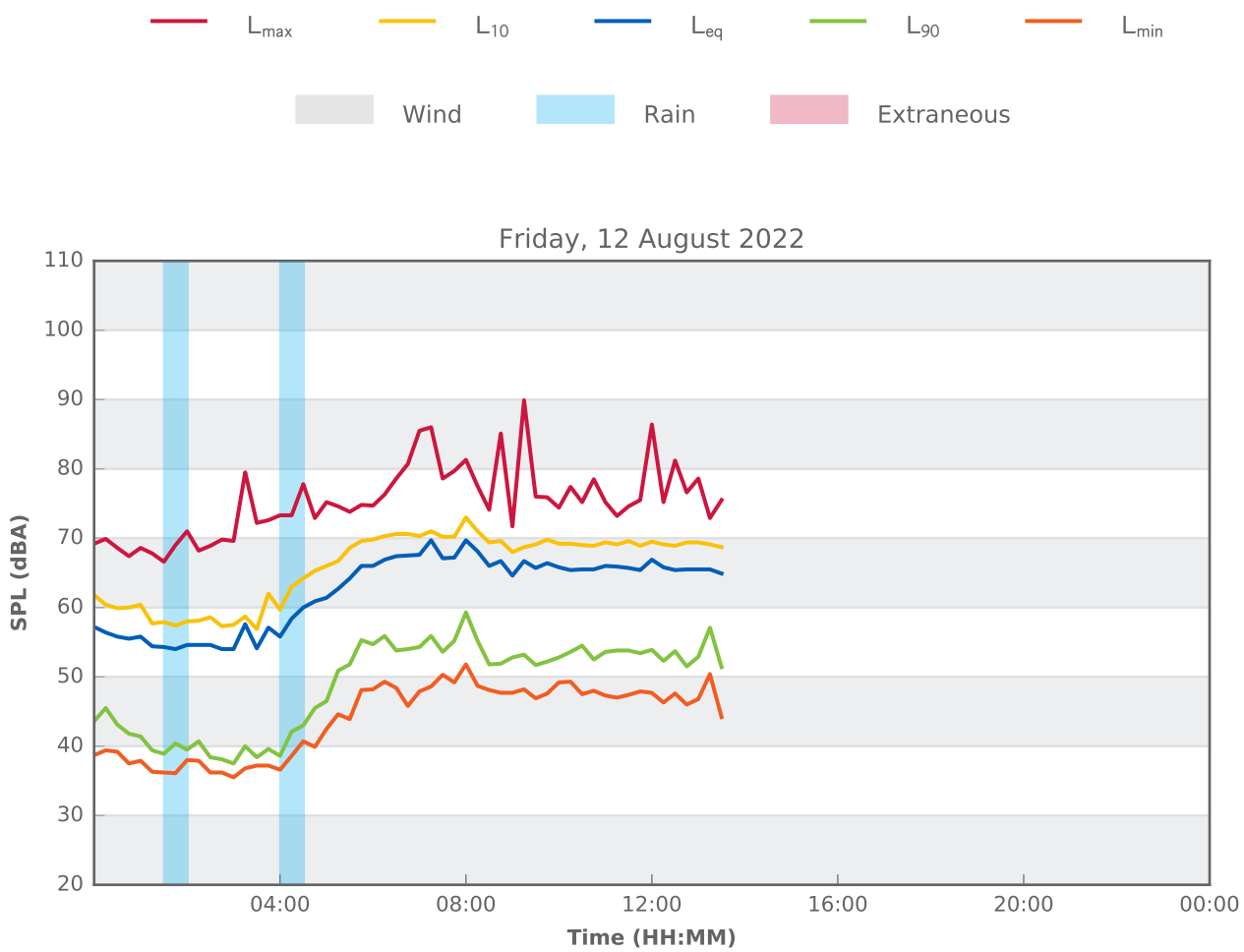
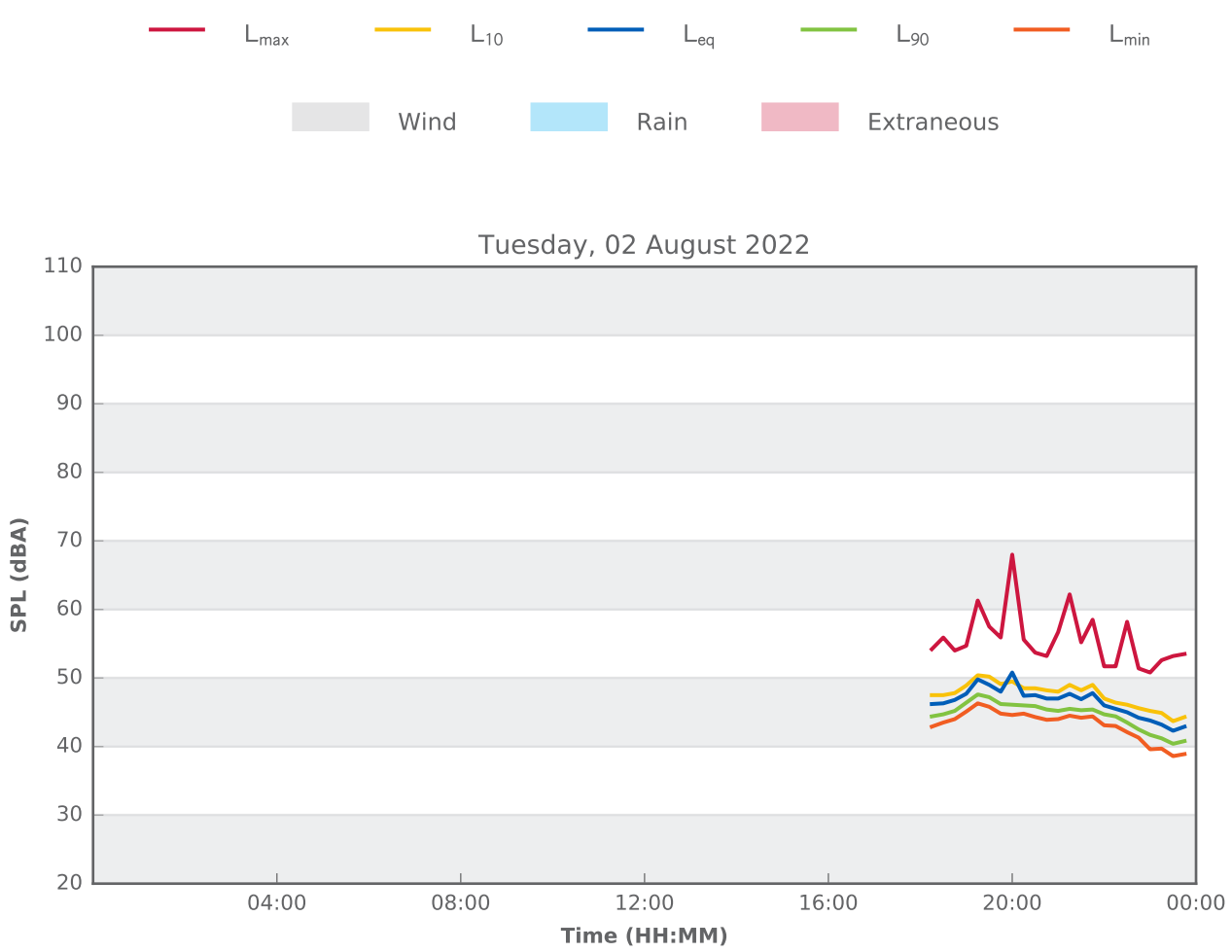


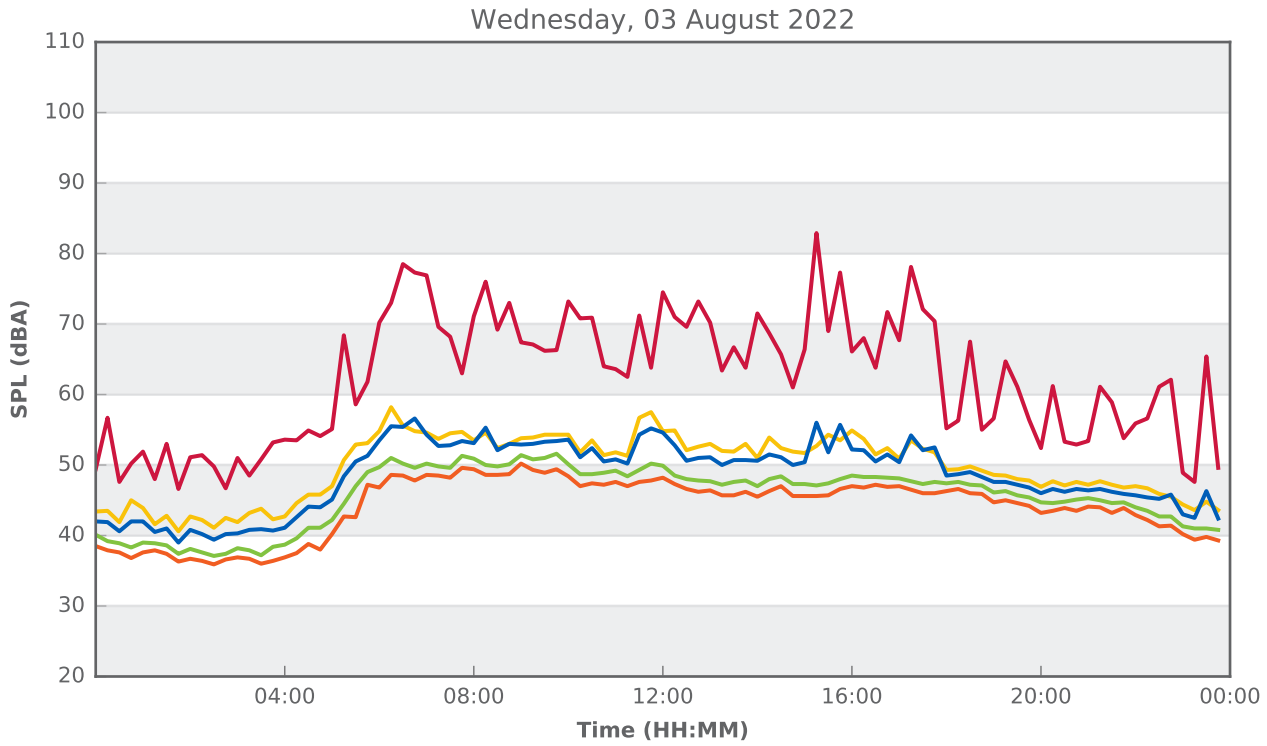


L2 (Epping Road)

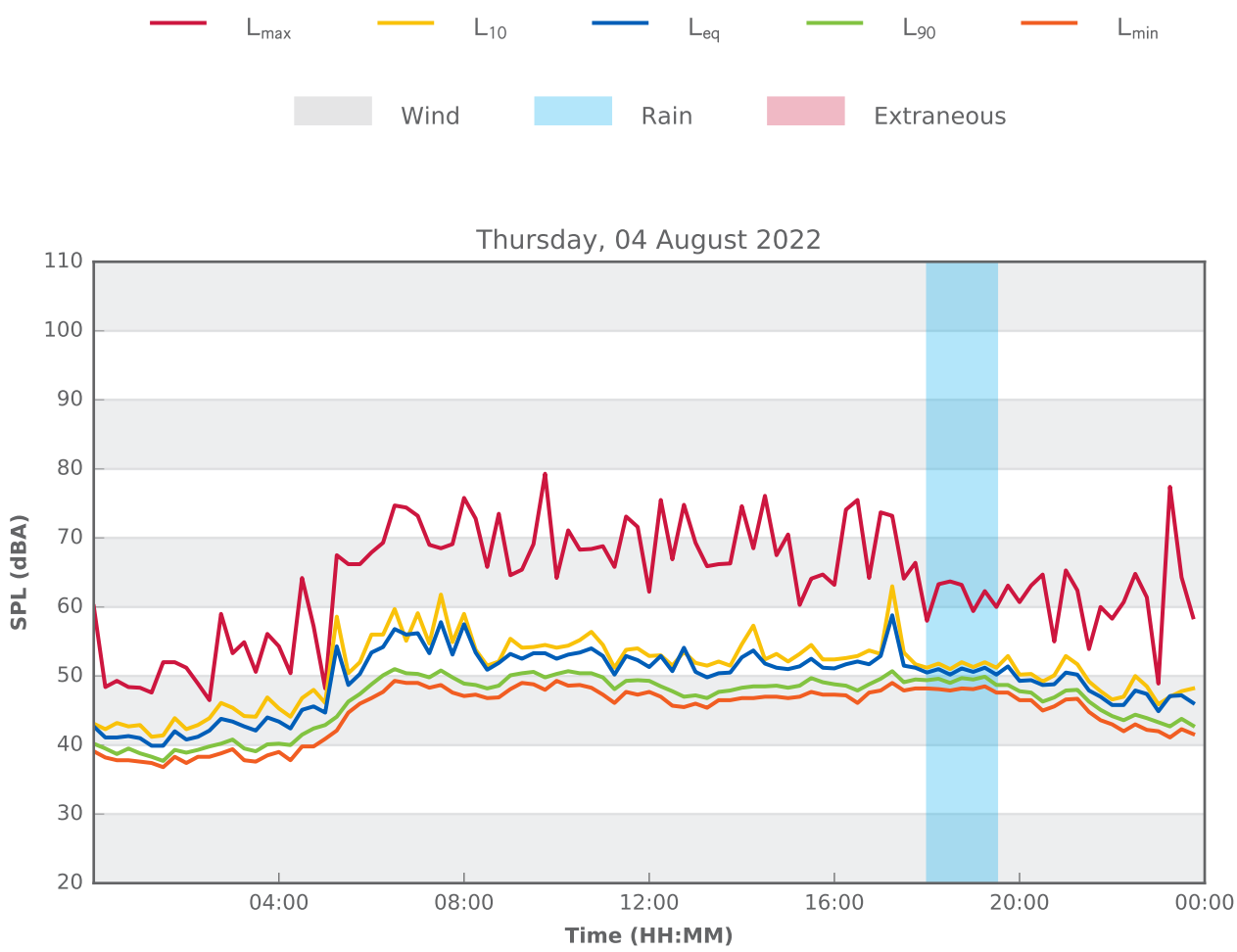


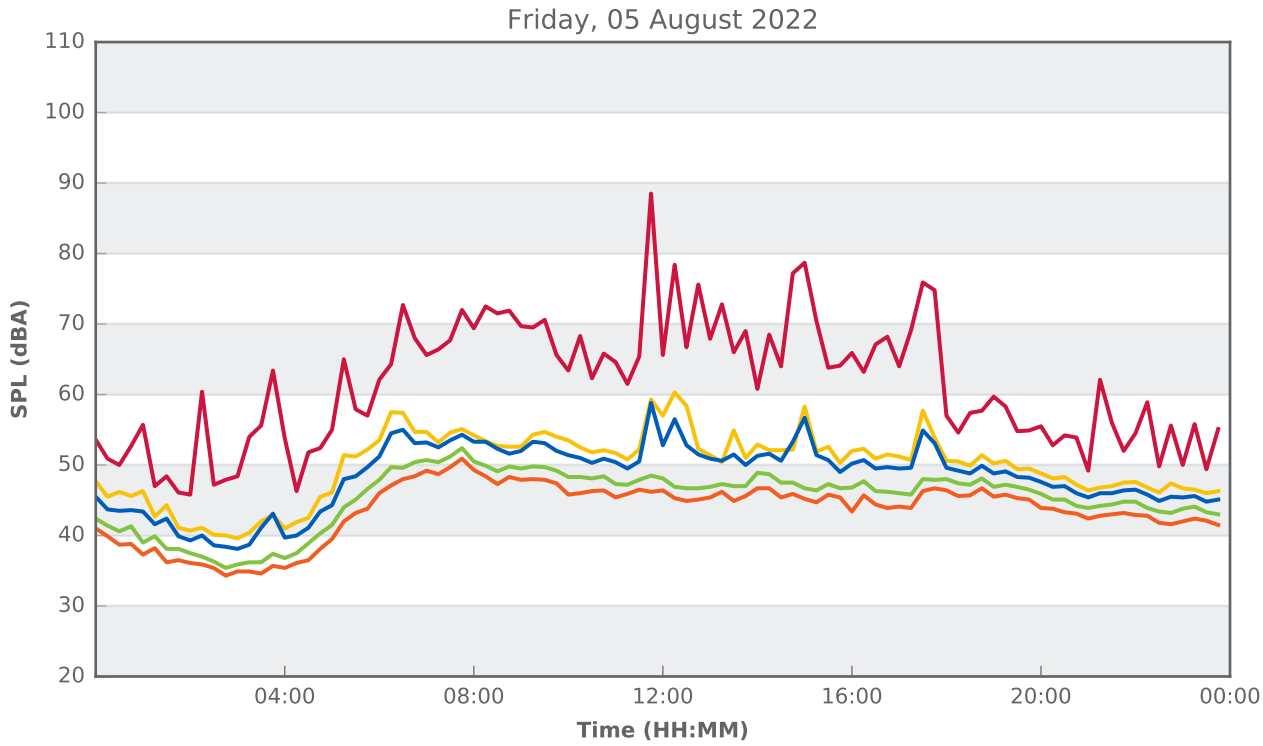
L3 (Near Morling College)



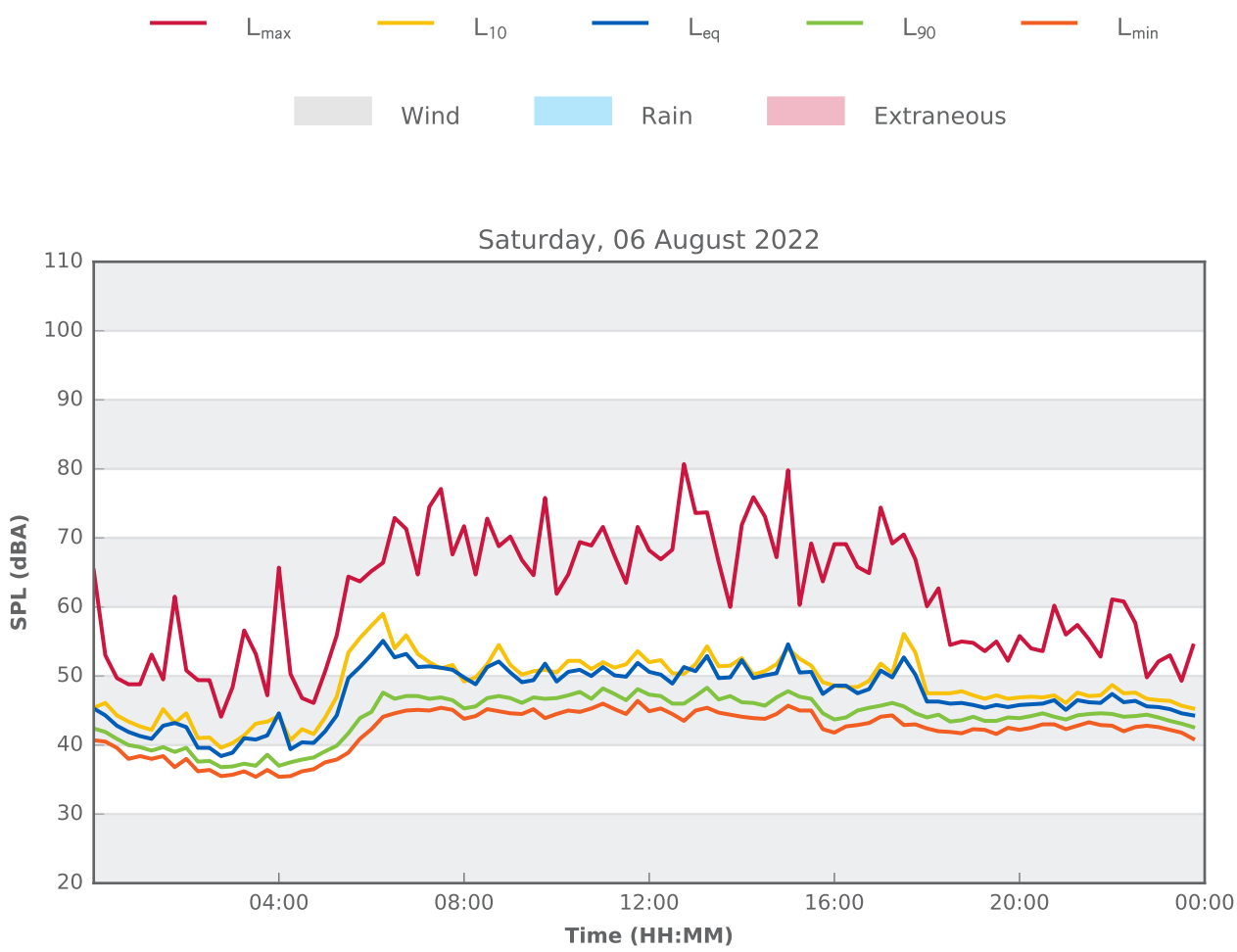


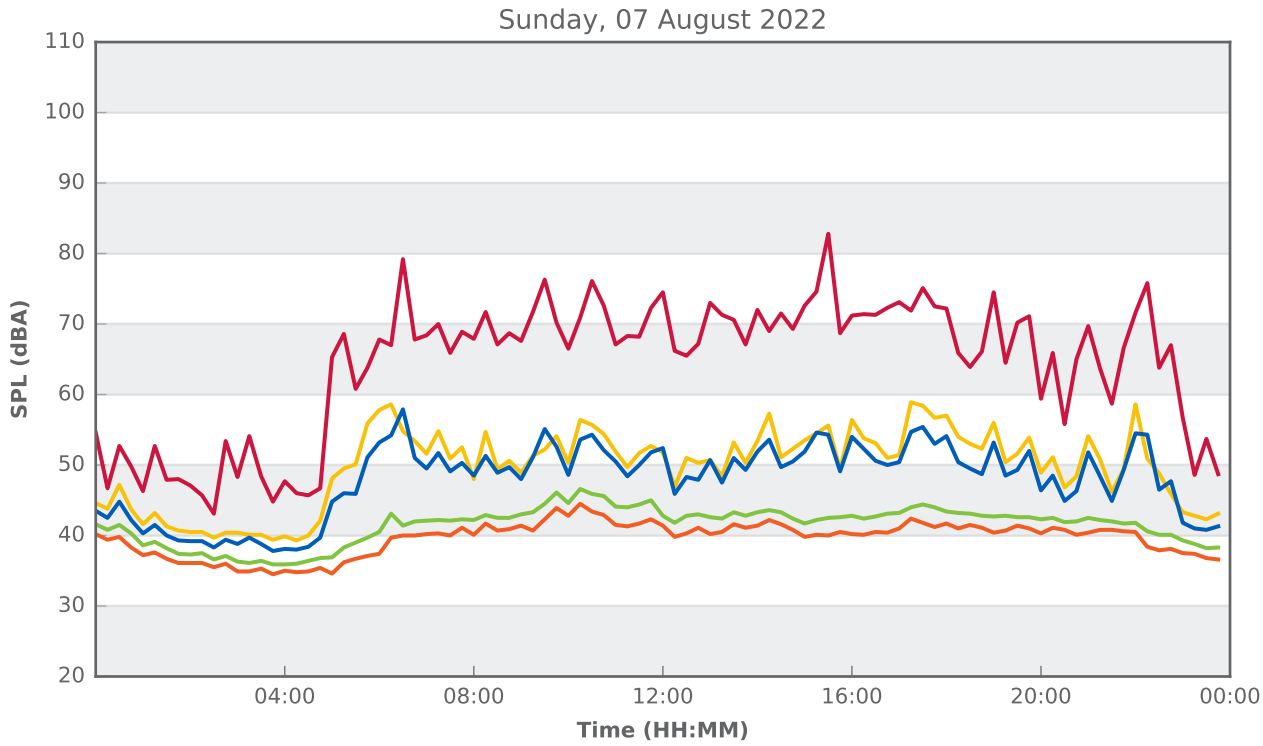
L3 (Near Morling College)



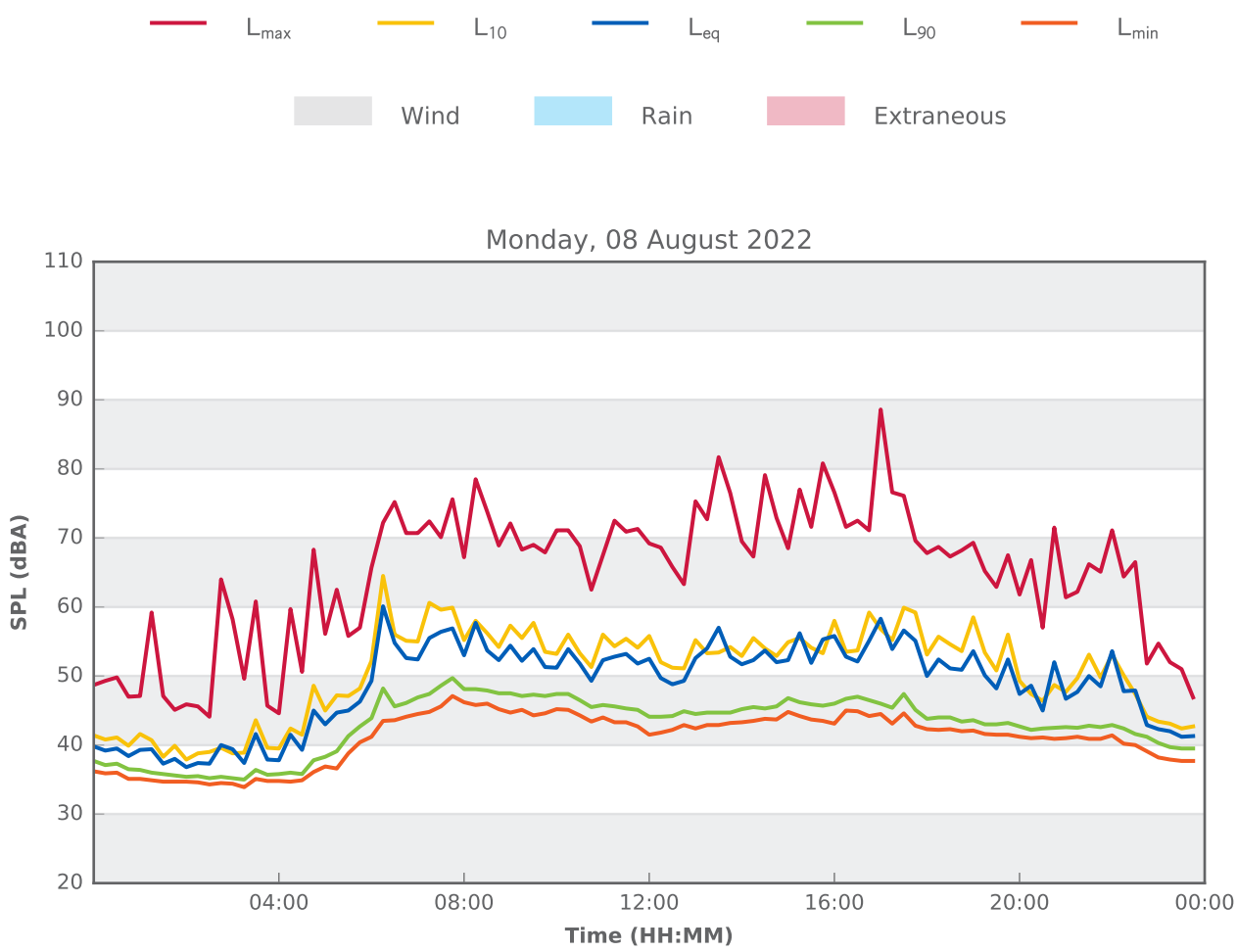


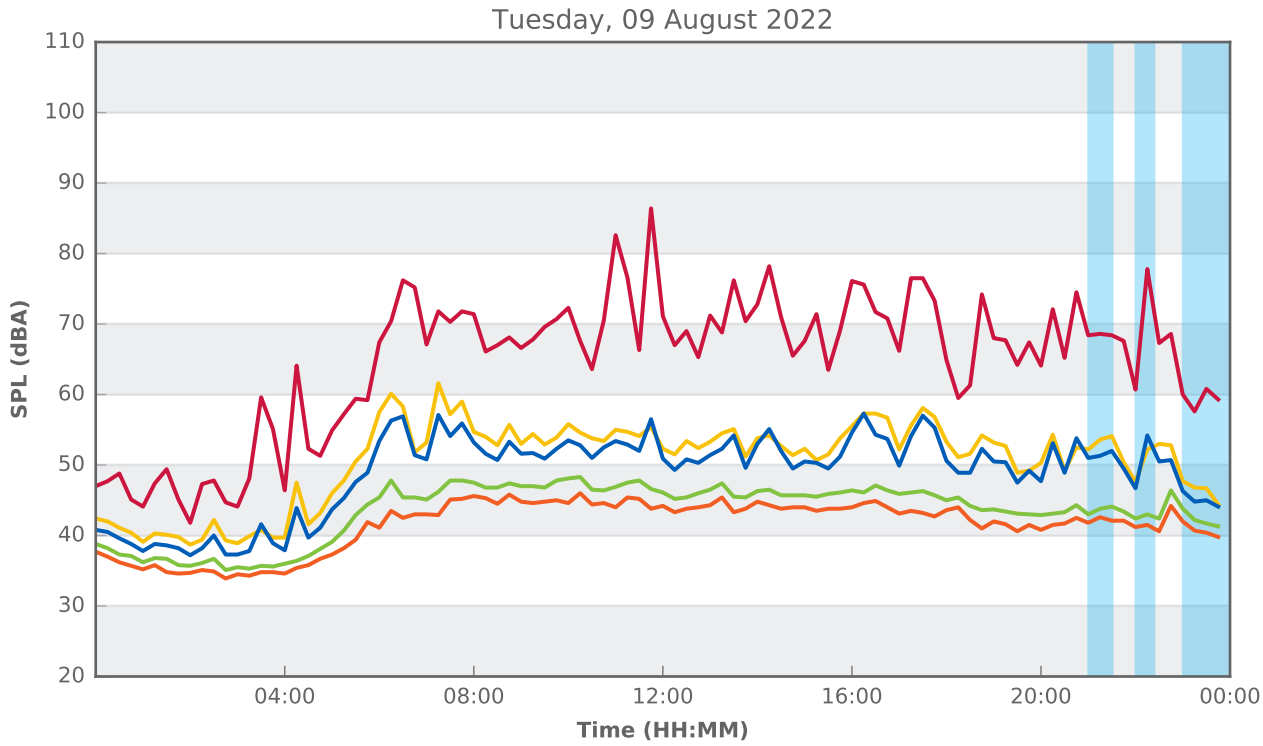
L3 (Near Morling College)



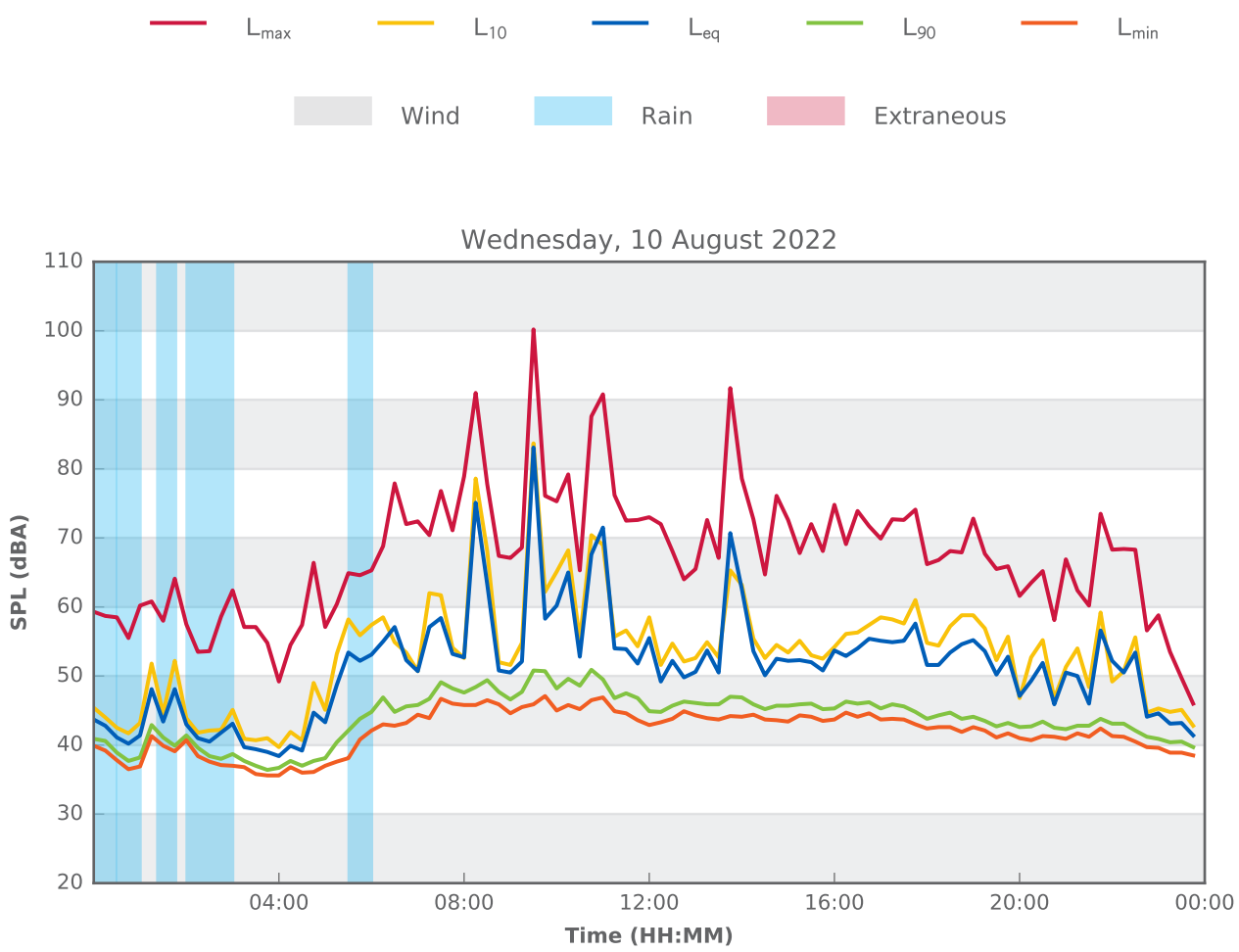


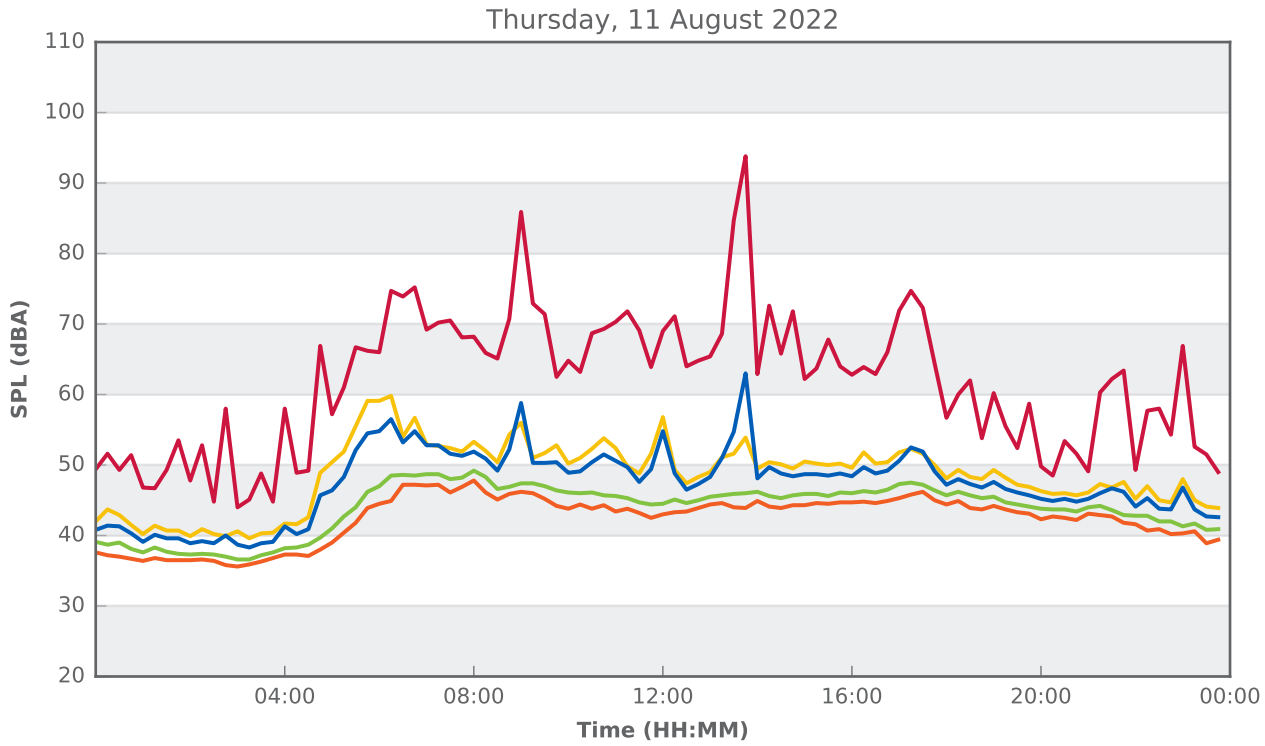
L3 (Near Morling College)





L3 (Near Morling College)





L3 (Near Morling College)