ACOUSTICS AND AIR

AL-FAISAL COLLEGE AUSTRAL CAMPUS MASTERPLAN

SSDA NOISE & VIBRATION IMPACT ASSESSMENT

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VERSION A

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PREPARED FOR

AL-FAISAL COLLEGE
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TABLE OF CONTENTS

Page

GLOSSARY OF ACOUSTIC TERMS

1 INTRODUCTION 1

2 PROPOSED DEVELOPMENT 3

3 SITE LOCATION AND PROJECT SCOPE 4

3.1 Primary School 4

3.2 Secondary School 6

3.3 Construction and Operation 8

4 EXISTING NOISE ENVIRONMENT 9

4.1 Ambient Noise Survey 9

4.2 Noise Monitoring Results 10

5 CONSTRUCTION NOISE & VIBRATION 12

5.1 Construction Noise Criteria – Residential Receivers 12
5.1.1 Construction Noise Management Levels 12
5.1.2 Construction Works Hours 14

5.2 Vibration Criteria 14
5.2.1 Human Comfort 14
5.2.2 Building Damage 15

5.3 Construction Equipment & Noise Source Levels 15

5.4 Construction Noise Assessment 16
5.4.1 Noise Modelling 16
5.4.2 Discussion of Results 19

5.5 Construction Vibration Assessment 20

5.6 Construction Traffic Noise Assessment 20

5.7 Construction Noise & Vibration Mitigation Measures 20

5.8 Community Liaison & General Approaches to Mitigation 21

5.9 Noise & Vibration Management Plan 22

6 OPERATIONAL NOISE ASSESSMENT 23

6.1 Assessment Criteria 23
6.1.1 Operational Noise Emissions 23
6.1.2 Road Traffic Noise 26

6.2 Operational Noise Assessment 27
6.2.1 Assessment of the Staged Development 27
6.2.2 Mechanical Services 28
6.2.3 Use of Built Spaces 29
6.2.4 Multi-purpose Halls 29
6.2.5 Performing Arts and Industrial Technology Workshops 30
6.2.6 Secondary Lecture Theatre 31
6.2.7 Canteen/Dining Areas 31
6.2.8 PE/PDHPE Classes 31
6.2.9 Carparks 31
6.2.10 Cumulative Operational Noise 31
6.2.11 School Announcements and Bells 33
6.2.12 Outdoor Noise 33
6.2.13 Road Traffic Noise 37

7 CONCLUSION 42

APPENDIX A – Noise Measurement Results

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.

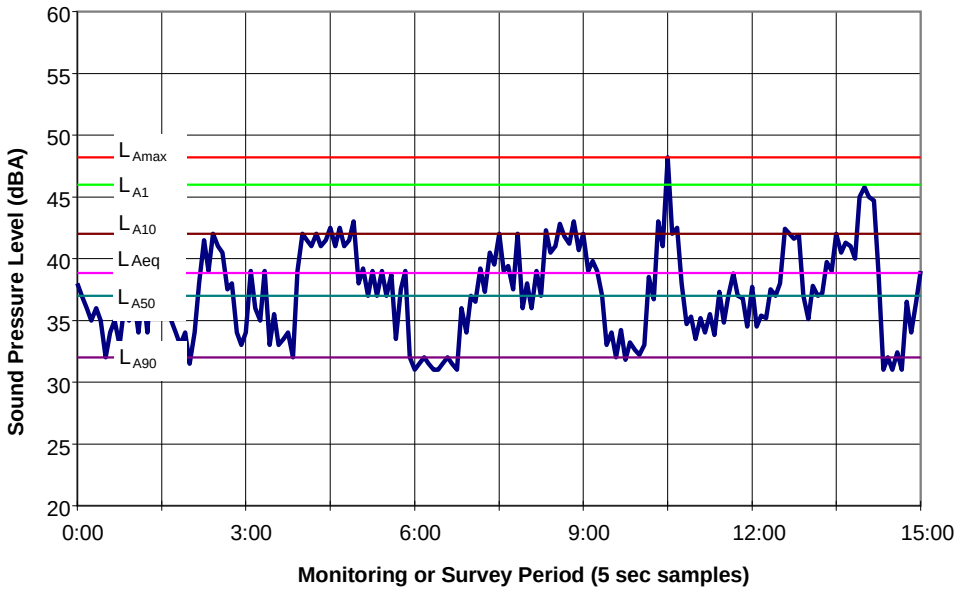
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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 major alterations and additions to the existing primary and secondary school at 83 – 87 Gurner Avenue, Austral for use as a primary school and construction of a new secondary school at 80 Gurner Avenue, Austral (the site).

This application is SSD by way of clause 15 (educational Establishments) of Schedule 1 under *State Environmental Planning Policy (State and Regional Development) 2011* on the basis that the development has a capital investment value of more than $20 million for the purpose of alterations or additions to an existing school.

This report has been prepared having regard to the Secretary's Environmental Assessment Requirements issued for the project by DPIE, ref no SSD-10445 issued in April 2020.

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 5.3, 5.4, 5.5, 6.2.
13. Noise and Vibration	
Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts upon surrounding occupiers of land.	Section 5.
Identify and assess operational noise, including consideration of any public address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours), and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.	Section 6.

This assessment considers noise (and vibration) emissions associated with the proposed development, and their potential impact on nearby residential receivers, including:

- Noise and vibration generated during construction works;
- Noise from mechanical plant associated with the new buildings;

- Noise from activities and operations associated with the new buildings and facilities at the school including vehicular movements; and
- Road traffic noise generation.

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

- *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 PROPOSED DEVELOPMENT

Al-Faisal's long-term goal is to build a primary school (K-6) and secondary school (7-12) within the Liverpool LGA accommodating up to 5,460 students to meet the growing need for an educational institute which services its local community. The construction of the project will be staged with completion anticipated for 2037. The staged construction is planned alongside the stagged increase to the school's population which is projected to realise full capacity by 2042. This capacity will be split between the primary and senior schools with enrolment projections of 420 students per year group, resulting in a primary school capacity of 2,940 students and a senior school capacity of 2,520 students.

The existing K-12 school is located on the northern side of Gurner Avenue at No.83-87 Gurner Avenue. Currently, the school caters for K-10, with the first year 12 class set to graduate in 2022. The proposed development includes alterations and additions to the existing school at Nos.83-87 Gurner Avenue and expansion of the school to amalgamate with the adjoining site, No.79 Gurner Avenue. Once complete, No.79 & 83-87 will contain the primary school, catering for K-6. On the southern side of Gurner Avenue the secondary school, catering for years 7-12, will be constructed at No.66 & 80 Gurner Avenue.

The proposed development will accommodate the following across the two schools:

- Primary Teaching and Learning;
- Secondary Teaching and Learning;
- Specialist technological and applied science (TAS) facilities;
- Library and Support facilities;
- Administration & Staff areas;
- Communal/multi-purpose spaces, lecture spaces;
- Amenities & sports fields;
- Underground and above ground car parking; and
- Drop off/pick up area & bus stops.

A central pathway through each school provides access to the buildings and outdoor recreation areas. Buildings are strategically placed throughout the site to provide staff and students with access to facilities and respond to the open space throughout the site. Services such as the reception and administration, library and canteen are positioned near the main school entrance. In the primary school, year groups are positioned together, while in the senior school, classrooms are positioned based on use, with specialist facilities located in the central building.

The proposed development will provide high quality educational and teaching space, catering for the growing population within the surrounding emerging community.

3 SITE LOCATION AND PROJECT SCOPE

3.1 Primary School

The primary school site is located on the northern side of Gurner Avenue and the eastern side of Fourth Avenue and is shown in Figure 3-1. The primary school site comprises two allotments as follows:

- 83 – 87 Gurner Avenue, Austral (existing school) – Lot 9 DP 1207216
- 79 Gurner Avenue, Austral – Lot 14 DP 831988.

Figure 3-1 Primary School Site

Aerial image courtesy of ©2020 Nearmap

The site presently operates as a K-12 school with a current enrolment of 778. Classes encompass grades K -10 with an approved maximum of 1,200 students projected by 2024 with the first year 12 class commencing in 2022. The school is being delivered in eight stages with stages 1, 2, 3 and 4 completed.

The existing school hours of operation are as follows:

- Office 8.00am to 5.00pm
- School classes 8.40am to 3.25pm
- All students are collected by 3.45pm.

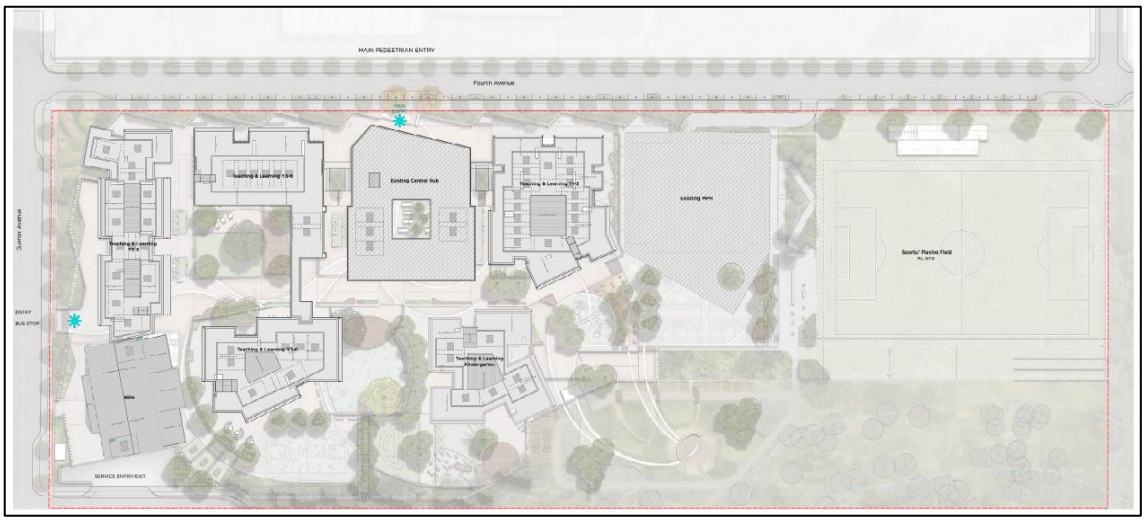
The proposal involves substantial modifications to the existing buildings and construction of new buildings and associate infrastructure at the existing school location at 83 – 87 Gurner Avenue and expansion onto 79 Gurner Avenue for use as a primary school. On completion the primary campus will include:

- 2 x multi-purpose halls;
- Year 3-6 general learning areas delivered by alterations and additions to the existing buildings;
- Administration and library facilities involving alterations and additions to existing buildings;
- Year K-2 learning spaces delivered through alterations and additions to existing buildings;
- Large open space areas to the east of the buildings;
- Playing fields to the rear of the site (as per existing);
- Basement parking accessed of Fourth Avenue;
- Kiss, drop and leave area to the west of the buildings (adjoining Fourth Avenue); and
- Pedestrian ingress and egress points proposed on Fourth Avenue.

The future primary school campus will accommodate a maximum enrolment of 2940 students.

The proposed primary school site plan is shown in Figure 3-2.

Figure 3-2 Primary School Site Plan



Drawing courtesy PMDL

3.2 Secondary School

The proposed secondary school site is located on the southern side of Gurner Avenue as shown in Figure 3-3. The site comprises two separate lots as follows:

- 80 Gurner Avenue, Austral – Lot 37 DP 3403
- 66 Gurner Avenue, Austral – Lot 1 DP 1243351

The two lots are separated by a 6m wide access handle associated with 70 Gurner Avenue (shown dotted) and it is the intention of the school to purchase this parcel of land.

No. 80 Gurner Avenue is currently vacant and has previously been used for agricultural purposes No. 66 contains a dwelling and ancillary structures.

Figure 3-3 Secondary School Site

Aerial image courtesy of ©2020 Nearmap

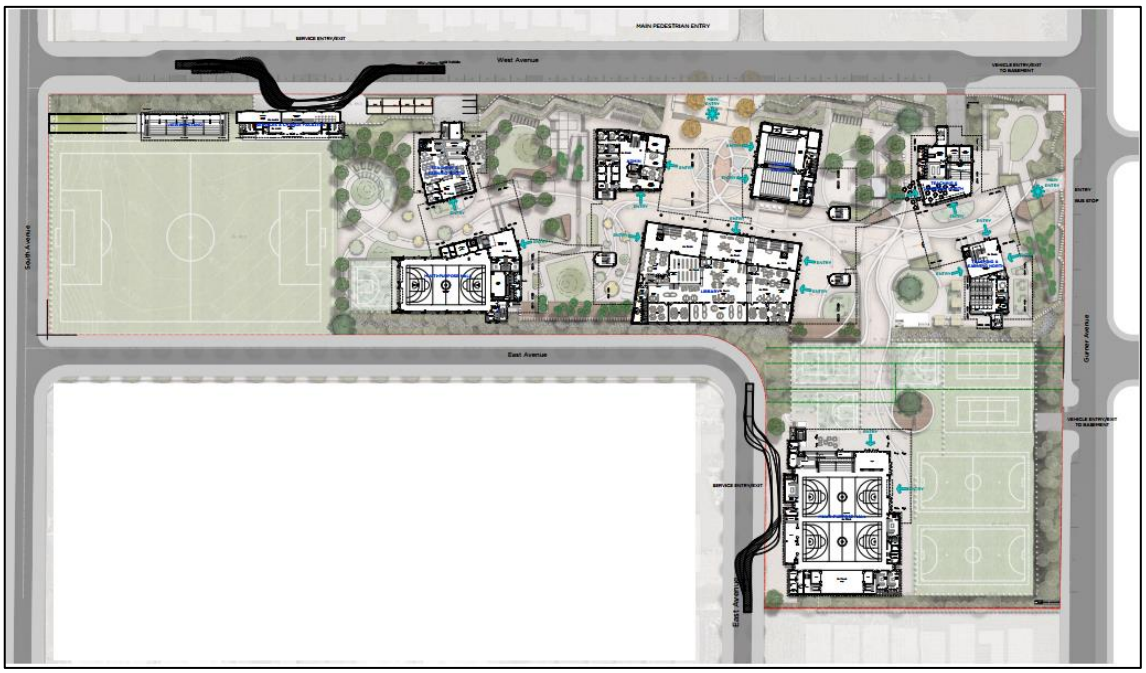
The secondary campus will provide for senior education and includes the following facilities:

- 2 x multi-purpose halls;
- General learning buildings;
- Playing fields;
- Specialist facilities;
- Administration building;
- Basement parking accessed off new proposed local road; and
- Pedestrian ingress and egress points are proposed off new proposed local road.

The future secondary school campus will accommodate a maximum enrolment of 2520 students.

The proposed secondary site plan is shown in Figure 3-4.

Figure 3-4 Secondary School Site Plan



Drawing courtesy PMDL

3.3 Construction and Operation

The proposed construction and occupation of the new secondary school and alterations and additions to the existing school will be staged to enable the existing school to continue to operate during construction works.

The school campuses will operate generally within the existing hours as previously documented in Section 3.1. Staggered start times are proposed for both schools. The primary school will commence at 8.15 am and 8.45am. The secondary school start times will be 8.30am and 9.00 am. Recess, lunch and school finish times will be staggered accordingly. Occasional evening use up until 10.00pm may occur but is unlikely.

It is understood that no outside organisations have arrangements to use the schools' facilities.

The proposed plans of the primary and secondary campus' have been produced by PMDL and are included separately within the EIS.

4 EXISTING NOISE ENVIRONMENT

4.1 Ambient Noise Survey

In order to quantify and characterise the existing noise environment in the area, long-term ambient noise levels were monitored between 17 July 2020 and 30 July 2020, at four (4) locations, selected to cover the range of ambient noise environments surrounding the site.

Long-term noise monitoring locations are documented in Table 4-1 and illustrated in Figure 4-1.

Figure 4-1 Ambient Noise Monitoring Locations

Aerial image courtesy of ©2020 Nearmap

Table 4-1 Ambient Noise Monitoring Locations

Location	Address	Instrumentation
M1	Front boundary 83 Gurner Avenue (SW corner)	ARL Ngara 87807C
M2	Eastern boundary 83 Gurner Avenue	ARL Ngara 878062
M3	Northern boundary 66 Gurner Avenue	ARL Ngara 878092
M4	70 Gurner Avenue (SE corner)	ARL Ngara 8780F2

Instrumentation for the survey comprised (4 off) Acoustic Research Laboratories (ARL) Ngara Environmental Noise Loggers (refer Table 4-1) 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**.

4.2 Noise Monitoring Results

To determine project specific criteria on which to base assessment of operational noise emissions, the measured weekday data was processed according to the NSW Environment Protection Authority's (EPA) *Noise Policy for Industry* (NPfI) assessment time periods. Table 4-2 details the RBL (background) noise levels and the L_{Aeq} noise levels recorded during the daytime, evening and night-time periods.

Table 4-2 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}
M1	41	66	38	60	40	56
M2	37	58	34	44	33	42
M3	42	62	35	53	32	52
M4	40	68	36	44	30	43

The results of the unattended noise logging have been processed in accordance with the NSW *Road Noise Policy* time periods to determine the levels of road traffic noise experienced during the daytime and night-time. Table 4-3 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 4-3 Measured Road Traffic Noise Levels

Location	Noise Level - dBA re 20 µPa		
	$L_{Aeq(15hour)}$	$L_{Aeq(9hour)}$	$L_{Aeq(1hour)}$
M1	65	56	66
M3	61	52	65

5 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.

5.1 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*.

5.1.1 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 5-1 details the *ICNG* noise management levels.

Table 5-1 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 4.2 the noise management levels adopted for construction activities during standard hours at residential receivers are presented in Table 5-2.

Table 5-2 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)
M1	83 Gurner Avenue (SW corner)	Gurner Avenue west existing school campus	51	75
M2	83 Gurner Avenue (East)	Gurner Avenue setback residential & new development areas	47	
M3	66 Gurner Avenue (N)	Gurner Avenue east of existing school campus	52	
M4	70 Gurner Avenue (SE corner)	Residences to south (rear Fourth Avenue & rear Fifteenth Avenue)	50	

5.1.2 Construction Works Hours

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

5.2 Vibration Criteria

5.2.1 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 5-3.

Table 5-3 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 5-4.

Table 5-4 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.

5.2.2 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 5-5 summarises the guideline values for the prevention of building damage, which are derived from the more stringent German Standard.

The values presented in Table 5-5 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 5-5 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 5-5).

5.3 Construction Equipment & Noise Source Levels

Sound Power Levels (L_W) for typical construction plant are identified in Table 5-6. These L_w are based upon archival data from measurements at other construction sites.

Table 5-6 Typical Construction Plant Sound Levels

Plant	Sound Power Level L_w dBA	Source
Backhoe	97	DEFRA
CFA Piling Rig	108	WM /DEFRA/SLR
Concrete Truck	103	DEFRA
Concrete Pump	103	DEFRA
Compressor	103	WM
Dump Truck	107	WM

Plant	Sound Power Level L_w dBA	Source
Front End Loader	107	DEFRA
Dozer	107	DEFRA
Excavator (40t)	102	DEFRA/SLR
Hand Tools	101	WM/DEFRA
Mobile Crane	98	DEFRA

5.4 Construction Noise Assessment

5.4.1 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 5-7 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 5-7 Construction Works Scenarios

Stage	Description	Works
1	Bulk Excavation & Earthworks	Site preparation and excavation works – mainly using excavators with dozers and front end loaders. Truck movements.
2	Piling, Drainage works, Slabs	Bored piling, concreting and lifting. Bored piling rig, concrete pumps & boom, crane are assumed to operate continuously over 15 minutes. Also, concrete trucks and normal delivery trucks.
3	General Building Works Facade / Fitout	General construction works including facade and internal fitout. Mobile crane and power tools 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 sites.

The modelling assumes a "typical worst-case" scenario whereby it has been assumed plant operates continuously and simultaneously on both school campus sites. 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 5-8. The location of the surrounding residential receivers adopted for prediction of construction noise are shown in Figure 5-1. Exceedances of the construction noise management levels (NMLs) and highly noise affected level (HNL) are listed applicable to works during recommended standard hours.

Figure 5-1 Surrounding Residential Receiver Locations

Aerial image courtesy of ©2020 Nearmap

Table 5-8 Predicted Construction Noise Levels at Residences – $L_{Aeq(15\ min)}$ – dBA

Residential Receiver	Predicted Noise Level	NML	Exceedance	HNL	Exceedance
Bulk Excavation and Earthworks					
R1 67 Gurner Avenue	63	52	+11	75	0
R2 55 Gurner Avenue	57	47	+10	75	0
R3 Kingfisher Estate Crown Street (between Scrubwren & Thornbill)	46	47	0	75	0
R4 Kingfisher Estate Crown Street (between Gerygone & Edmondson)	44	47	0	75	0
R5 95 Gurner Avenue	56	51	+5	75	0
R6 110 Gurner Avenue	50	51	0	75	0
R7 90 Gurner Avenue	62	52	+10	75	0
R8 50 Gurner Avenue	50	52	0	75	0
R9 485 Fourth Avenue	53	50	+3	75	0
R10 475 Fourth Avenue	49	50	0	75	0
R11 459 Fifteenth Avenue	49	50	0	75	0
R12 70 Gurner Avenue (future residential)	58	50	+8	75	0
Piling, Drainage Works & Slabs					
R1 67 Gurner Avenue	59	52	+7	75	0
R2 55 Gurner Avenue	55	47	+8	75	0
R3 Kingfisher Estate Crown Street (between Scrubwren & Thornbill)	45	47	0	75	0
R4 Kingfisher Estate Crown Street (between Gerygone & Edmondson)	44	47	0	75	0
R5 95 Gurner Avenue	58	51	+7	75	0
R6 110 Gurner Avenue	53	51	+2	75	0
R7 90 Gurner Avenue	61	52	+9	75	0
R8 50 Gurner Avenue	48	52	0	75	0
R9 485 Fourth Avenue	53	50	+3	75	0
R10 475 Fourth Avenue	49	50	0	75	0
R11 459 Fifteenth Avenue	45	50	0	75	0
R12 70 Gurner Avenue (future residential)	56	50	+6	75	0
General Building Works – Facade/Fitout					
R1 67 Gurner Avenue	58	52	+6	75	0
R2 55 Gurner Avenue	54	47	+7	75	0
R3 Kingfisher Estate Crown Street (between Scrubwren & Thornbill)	43	47	0	75	0
R4 Kingfisher Estate Crown Street (between Gerygone & Edmondson)	42	47	0	75	0
R5 95 Gurner Avenue	55	51	+4	75	0
R6 110 Gurner Avenue	49	51	0	75	0
R7 90 Gurner Avenue	60	52	+8	75	0

Residential Receiver	Predicted Noise Level	NML	Exceedance	HNL	Exceedance
R8 50 Gurner Avenue	47	52	0	75	0
R9 485 Fourth Avenue	51	50	+1	75	0
R10 475 Fourth Avenue	47	50	0	75	0
R11 459 Fifteenth Avenue	43	50	0	75	0
R12 70 Gurner Avenue (future residential)	57	50	+7	75	0

5.4.2 Discussion of Results

A review of the predicted noise levels indicates maximum exceedances of up to 10/11dBA may occur at the residences directly to the east of the primary campus (R1 and R2) and at 90 Gurner Avenue (R7) located in closest proximity to the secondary campus during excavation and earthworks works when excavators and other large mobile plant are in operation. Maximum exceedance of up to 8dBA may occur at future residences to be developed on the 70 Gurner Avenue (R12) site during excavation and earthworks on the secondary campus. Exceedances (of up to 5dBA) are also likely to occur at 95 Gurner Avenue (R5), west of the primary school campus during earthworks and excavation involving large mobile plant.

During piling works and slab construction, marginal exceedances will be experienced at residences to the west and south west of the secondary campus (R9) and to the west of the primary campus (R6). Around 7/8dBA exceedance is predicted at residences directly to the east of the primary campus (R1 and R2), and 7dBA at 95 Gurner Avenue (R5). Exceedances of up to 9dBA may occur at 90 Gurner Avenue (R7) closest to the secondary campus. Maximum exceedance of up to 6dBA may occur at future residences to be developed on the 70 Gurner Avenue site (R12) during piling works and slab construction on the secondary campus.

During general construction works, exceedances of 6-8dBA can be expected at times when works are closest the eastern side of the site (nearer R1 and R2) in the case of the primary school and the western side (R7) and south east (R12) on the secondary site.

The maximum exceedances predicted are typical of construction works in reasonably close proximity to residential receivers, particularly where background sound levels are reasonably low 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.

5.5 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 5-9 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 50 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 5-9 Recommended Safe Working Distances for Vibration-Intensive Plant

Item	Description	Safe working distance	
		Cosmetic damage	Human response
Pile Boring	≤ 800mm	2m (nominal)	N/A
Excavator		1m (nominal)	Avoid contact with structure

5.6 Construction Traffic Noise Assessment

Details of truck movements during construction works were not available at the time of this study. According to the *Transport and Accessibility Assessment Al-Faisal College 80 and 83-87 Gurner Avenue Austral* prepared by Traffix (ref 19.607r02v02 dated 7 September 2020, a detailed Construction Traffic Management Plan (CTMP) will be prepared and submitted to Council in response to any conditions of consent. Truck routes would utilise the main arterial roads and a copy of the routes would be provided to all drivers and trucks serving the site. The proposed truck routes allow all vehicles to enter and egress the site in a forward direction so that there will be no reversing on public roadways. The majority of truck movements would be limited to outside school peak periods as much as is possible. On-site parking for contractors is envisaged. These arrangements will be further examined as part of the detailed CTMP.

5.7 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 ripping 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.

5.8 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.

5.9 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.

6 OPERATIONAL NOISE ASSESSMENT

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

6.1 Assessment Criteria

6.1.1 Operational Noise Emissions

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

- Mechanical services plant;
- Teaching and practical activities, particularly technology and performing arts-based;
- School announcements and bells;
- Sporting activities and events in the halls; and,
- Sports-related classes held on the outdoor 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 halls, technology rooms and performing arts 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 6-1.

Table 6-1 Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level L_{Aeq} (dBA)
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 6-2. The current noise environment is principally controlled by semi-rural residential, community-based and environmental sources and local road traffic. Contributions from the existing school campus also evident before school, during recess and lunch times and during the departure period at the end of the school day. Residential subdivision development and associated construction works and road traffic also contribute to the ambient noise levels. There are no existing industrial noise contributions of significance and any contributions from rural/agricultural activities would be 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 6-2 Project Noise Trigger Levels

Receiver	Period	Intrusiveness Noise Level[1] $L_{Aeq,15min}$ (dBA)	Project Amenity Noise Level[2] $L_{Aeq,15min}$ (dBA)
R1 67 Gurner Avenue	Daytime	**47**	58
	Evening	**40**	48
	Night-time	**37**	43
R2 55 Gurner Avenue	Daytime	**42**	58
	Evening	**39**	48
	Night-time	**38**	48
R3 Kingfisher Estate Crown Street (between Scrubwren & Thornbill)	Daytime	**42**	58
	Evening	**39**	48
	Night-time	**38**	43
R4 Kingfisher Estate Crown Street (between Gerygone & Edmondson)	Daytime	**42**	58
	Evening	**39**	48
	Night-time	**38**	43
R5 95 Gurner Avenue	Daytime	**46**	58
	Evening	**43**	48
	Night-time	**43**	43
R6 110 Gurner Avenue	Daytime	**46**	58
	Evening	**43**	48
	Night-time	**43**	43
R7 90 Gurner Avenue	Daytime	**47**	58
	Evening	**40**	48
	Night-time	**37**	43
R8 50 Gurner Avenue	Daytime	**47**	58
	Evening	**40**	48
	Night-time	**37**	43
R9 495 Fourth Avenue	Daytime	**45**	58
	Evening	**41**	48

Receiver	Period	Intrusiveness Noise Level[1] $L_{Aeq,15min}$ (dBA)	Project Amenity Noise Level[2] $L_{Aeq,15min}$ (dBA)
	Night-time	**35**	43
R10 475 Fourth Avenue	Daytime	**45**	58
	Evening	**41**	48
	Night-time	**35**	43
R11 459 Fifteenth Avenue	Daytime	**45**	58
	Evening	**41**	48
	Night-time	**35**	43
R12 70 Gurner Avenue (future residential)	Daytime	**45**	58
	Evening	**41**	48
	Night-time	**35**	43

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.

6.1.2 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 6-3.

Table 6-3 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*.

6.2 Operational Noise Assessment

6.2.1 Assessment of the Staged Development

The proposed development of the two schools will occur over a 20-year period. The primary and secondary school cohorts currently operate on the existing single campus. The indicative staff and student population over the current and future stages are summarised in Table 6-4.

Table 6-4 Student and Staff Numbers

Cohort	Primary				Secondary				Total
	Existing 2020	2026	2036	2042	Existing 2020	2026	2036	2042	2042
Primary Students	578	1470	2940	2940	0	0	0	0	2940
Secondary Students	212	0	0	0	0	486	1890	2520	2520
Total Students	790	1470	2940	2940	0	486	1890	2520	5460
Staff	54	92	182	182	0	41	158	210	392

Modelling and assessment of operational noise has been based upon the future final enrolment capacity of both schools as a "worst case" scenario.

6.2.2 Mechanical Services

The noise emissions from mechanical plant associated with the primary and secondary school campuses should be controlled so that the operation of such plant does not adversely impact upon surrounding residential properties. Air-conditioning will be provided throughout the general school with localised plantrooms and use of roof-mounted plant as required. Given the distance from the proposed campus buildings to surrounding residential properties, operational noise emissions from HVAC plant would achieve design limits at surrounding residential receivers.

Exhaust fans and dust extraction systems will likely be required for the TAS Food Technology and TAS Industrial Technology rooms. Given the distance from the proposed buildings to surrounding residential properties, operational noise emissions from the typical plant likely to be installed 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.

6.2.3 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 the current school usage on the existing primary campus site. Further consideration of general teaching and learning spaces on both campuses is not considered warranted. The multi-purpose halls, performing arts spaces and industrial technology workshops are more likely to result in audible noise emissions.

6.2.4 Multi-purpose Halls

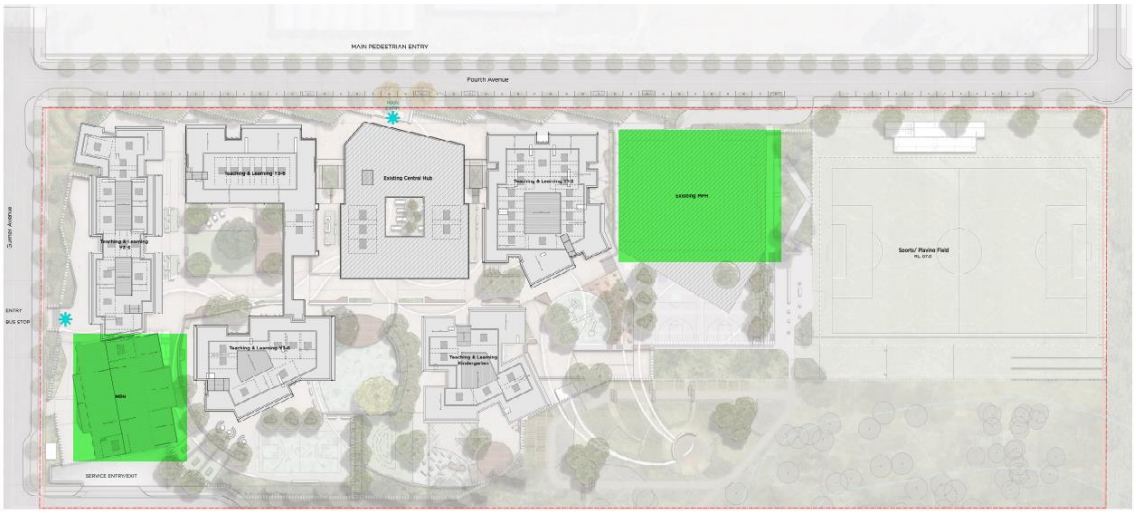
Each campus will be provided with two multi-purpose halls (MPH). The location of the MPH on the existing (primary) school campus is at the rear of the built space, approximately midway along the western boundary, adjacent Fourth Avenue. An additional MPH will be constructed fronting Gurner Avenue, in the south-eastern area of the school site.

The main MPH on the secondary campus is a stand-alone structure located in the north-eastern area and separated from Gurner Avenue by the series of sports courts.

The second MPH will be located towards the rear (south) of the secondary site and forms part of the Teaching & Learning South building.

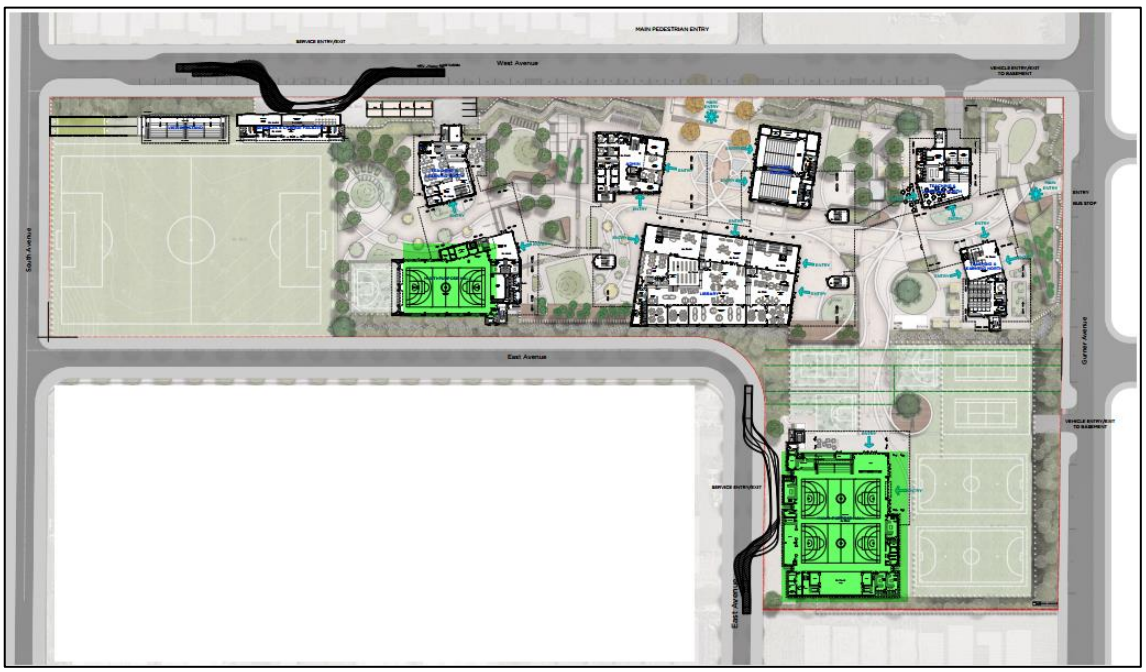
The approximately locations of the MPH buildings are shown in Figure 6-1 and Figure 6-2.

Figure 6-1 Primary Campus Multi-Purpose Hall Locations



Drawing courtesy PMDL

Figure 6-2 Secondary Campus Multi-Purpose Hall Locations



Drawing courtesy PMDL

It is envisaged that the multi-purpose halls would be used for school assemblies and sporting events. Schools generally hold major events a few times per year such as speech day and (possibly) special dinners.

On this basis, noise will be generated by sporting activities and events involving the use of a public address system.

In sports mode, the highest noise-generating usage would likely be associated with competitive basketball games. An L_{Aeq} over 15 minutes of around 84dBA (reverberant sound pressure level) is typical during normal school basketball games, which includes the use of whistles.

When operating in event mode, the worst-case acoustical scenario would involve the use of amplified public address system.

Modelling has been conducted for a combined sport/assembled event with PA scenario, with assumed reverberant sound pressure level within each MPH of 86dBA with entry doors open.

6.2.5 Performing Arts and Industrial Technology Workshops

Performing arts rooms are located on Level 1 of the Primary campus STEM building. A reverberant sound pressure level of 77dBA has been adopted as typical of pre-recorded amplified music. The window openings on the northern and southern elevations have been assumed to be open.

The secondary performing arts workshops are located on Level 3 of the Hub building. A reverberant sound pressure level of 77dBA has been adopted within these spaces as typical of pre-recorded amplified music. Window openings on the west elevation have been assumed to be open. Music practice and recording studios are located internally on Level 3 and emissions will be enclosed by the surrounding construction and do not warrant further consideration.

The industrial technology workshops are also located in the Hub on Level 3 (northern wing). A reverberant sound pressure level of 85dBA has been adopted within these spaces as a worst case. Window openings on the west elevation have been assumed to be open.

6.2.6 Secondary Lecture Theatre

The Hub includes two ground level lecture theatre, separated by an operable wall. An internal reverberant sound pressure levels of 75dBA has been adopted as representative of the optimum audio level within a typical lecture theatre. The door openings on the southern elevation have been assumed open.

6.2.7 Canteen/Dining Areas

The secondary campus features two dedicated canteen/dining spaces within the Teaching & Learning North and Teaching & Learning South buildings. Each space includes operable external doors. Internal reverberant sound pressure levels of 75dBA, representative of typical canteen noise environment have been assumed within both spaces with door open.

6.2.8 PE/PDHPE Classes

PE and PDHPE practical classes will take place on the outdoor sports courts and fields. To represent the potential noise emissions from a PE class held on the sporting field at the northern end of the primary campus, a sound power level of 82dBA has been adopted to represent instructional voice level.

For outdoor PDHPE classes on the secondary campus, sound power levels of 82dBA have been located on the main football field and at two locations on the sports courts on the northern side of the Campus to represent the upper end noise levels that may be expected to be generated throughout.

6.2.9 Carparks

Both campuses will be served by underground carparks. The access route to the primary school basement carpark is via Fourth Avenue, to entrance beneath the (existing) MPH. Basement carparking for the secondary campus will be access from two locations, via Gurner Avenue into the entry point beneath the font sport courts and via the new proposed road on the western side of the site (Western Avenue) to the entry beneath the Teaching & Learning North building.

A sound power level of 75dBA has been adopted to represent typical vehicular noise emissions within an enclosed carpark at the entry/exit portal.

6.2.10 Cumulative Operational Noise

Modelling to determine the indicative levels of noise received at surrounding residential properties due to the operation of the acoustically significant spaces, has been undertaken using the computer program, CadnaA version 2020 and based on the noise levels adopted as documented in Sections 6.2.4, 6.2.5, 6.2.6, 6.2.7, 6.2.8, 6.2.9 and 6.2.9.

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 6-5.

Table 6-5 Masterplan Cumulative Operational Noise

Receiver	Predicted Noise Level $L_{Aeq,15min}$ dBA	Noise Trigger Limit $L_{Aeq,15min}$ dBA Day[1]	Compliance (Day)	Noise Trigger Limit $L_{Aeq,15min}$ dBA Evening[2]	Compliance (Evening)
R1 67 Gurner Avenue	39	47	Yes	40	Yes
R2 55 Gurner Avenue	41	42	Yes	39	+2
R3 Kingfisher Estate Crown Street (between Scrubwren & Thornbill)	32	42	Yes	39	Yes
R4 Kingfisher Estate Crown Street (between Gerygone & Edmondson)	30	42	Yes	39	Yes
R5 95 Gurner Avenue	32	46	Yes	43	Yes
R6 110 Gurner Avenue	31	46	Yes	43	Yes
R7 90 Gurner Avenue	41	47	Yes	40	
R8 50 Gurner Avenue	31	47	Yes	40	Yes
R9 495 Fourth Avenue	36	45	Yes	41	Yes
R10 475 Fourth Avenue	35	45	Yes	41	Yes
R11 459 Fifteenth Avenue	33	45	Yes	41	Yes
R12 70 Gurner Avenue (future residential)	31	45	Yes	41	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 generally be achieved at all surrounding residential properties. A marginal 2dBA exceedance of the evening trigger limit is predicted at R2 (55 Gurner Avenue). The cumulative level at this receiver location is principally controlled by contributions from the Senior MPH with northern doors open (partial level 38dBA) and the Primary campus Gurner Block MPH with northern doors open (partial level 36dBA). With both these buildings in use and the northern elevation doors open during the evening period, in the absence of the other sources (which would not operate during the evening or do not contribute to the overall noise level at this receiver) the predicted cumulative level would be 40dBA. With only one of the halls operating, the maximum level at this location would be 38dBA, complying with the evening trigger limit.

In accordance with NPfI procedures, an exceedance of the project noise trigger limit of up to 2dBA is considered negligible. In terms of significance, this residual noise level would not be discernible by the average listener and would not warrant any further treatments or controls. With air-conditioning, doors to the halls can remain closed when required. Additionally, evening use of these facilities is envisaged to be infrequent.

6.2.11 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 maximum noise levels at surrounding residences do 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.

6.2.12 Outdoor Noise

The existing Primary campus includes playing fields to the rear of the site (as per existing) with a large open space area to the east of the buildings as part of the masterplan development.

The new secondary campus outdoor sporting facilities include a main playing field (football) at the southern end of the site and a series of sports courts on the northern side of the Campus, adjacent to Gurner Avenue.

Noise will be generated by students engaged in recreational activities possibly for a short period prior to commencement of classes, during recess and lunch.

Noise from school students engaged in outdoor play and recreational activities cannot be assessed in the same manner as noise generated by the use of learning facilities such as performing arts and technology rooms, 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 adjacent to 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 primary 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 outdoor sporting fields and recreational spaces.

Applying this guideline for the assessment of noise emissions from outdoor activities, the relevant 'limits' are presented in Table 6-6.

Table 6-6 Emission "Guidelines" for Noise from Outdoor Play/Recreation

Receiver Location	RBL [1] $L_{A90,(15min)}$ dBA	Emission Guideline $L_{Aeq,15min}$ dBA
R1 67 Gurner Avenue	42	52
R2 55 Gurner Avenue	37	47
R3 Kingfisher Estate Crown Street (between Scrubwren & Thornbill)	37	47
R4 Kingfisher Estate Crown	37	47

Receiver Location	RBL [1] $L_{A90,(15min)}$ dBA	Emission Guideline $L_{Aeq,15min}$ dBA
Street (between Gerygone & Edmondson)		
R5 95 Gurner Avenue	41	51
R6 110 Gurner Avenue	41	51
R7 90 Gurner Avenue	42	52
R8 50 Gurner Avenue	42	52
R9 495 Fourth Avenue	40	50
R10 475 Fourth Avenue	40	50
R11 459 Fifteenth Avenue	40	50
R12 70 Gurner Avenue (future residential)	40	50

Note 1: Outdoor use during daytime period only.

The playing fields are for school use only and sporting events will not be held outside of the normal school hours (with the possible exception of team practice for a short period before school).

For prediction of noise emissions from outdoor play and recreation, students are assumed to be evenly distributed across the sports courts and playing fields and each of the outdoor open space areas of both campuses. Each campus will have two staggered recess and lunch breaks with the school cohort of both campuses divided equally for each break period. The number of students has then been allocated proportionally according to the area of each outdoor space (ie the approximate total outdoor space at the primary campus is 17,500m^2, which corresponds to 11.9m^2/student. The secondary campus includes approximately 27,850m^2 corresponding to 22.1m^2 per student).

Based upon the results of previous measurements conducted by Wilkinson Murray of children engaged in outdoor play at a combined primary and secondary campus, an L_{Aeq} sound power level of 79dBA per student has been adopted. The sound power level (L_w) across each outdoor play area has been calculated according to the number of students allocated.

The noise levels generated during outdoor play periods will vary according to the following factors:

- The number of students in the area – students will be spread around the outdoor areas;
- The level of noise made by each student – this is obviously different from individual to individual, and various factors such as age, personality, mood, activity and countless other factors will play a part. The louder events are not capable of being sustained over an extended period; and

- The location of the students relevant to the residences – as the distance between the source and the receiver increases, the noise level at the receiver will decrease.

The noise levels ($L_{Aeq,\ 15min}$) generated during outdoor play and recreational activities have been predicted at the surrounding residential receivers. Modelling has been undertaken for each campus individually and, as a worst case, both campuses combined. The results at the surrounding residential receiver locations, are shown, together with the relevant emissions guideline, in Table 6-7.

Table 6-7 Predicted $L_{Aeq15min}$ Noise Levels from Outdoor Play/Recreation

Receiver Location	Primary Campus $L_{Aeq15min}$ dBA	Secondary Campus $L_{Aeq15min}$ dBA	Combined Primary & Secondary $L_{Aeq15min}$ dBA	Emission Guideline $L_{Aeq,15min}$ dBA
R1 67 Gurner Avenue	46	46	49	52
R2 55 Gurner Avenue	44	45	47	47
R3 Kingfisher Estate Crown Street (between Scrubwren & Thornbill)	38	39	41	47
R4 Kingfisher Estate Crown Street (between Gerygone & Edmondson)	37	36	39	47
R5 95 Gurner Avenue	39	37	41	51
R6 110 Gurner Avenue	39	35	40	51
R7 90 Gurner Avenue	44	47	48	52
R8 50 Gurner Avenue	37	43	44	52
R9 495 Fourth Avenue	38	43	44	50
R10 475 Fourth Avenue	36	43	43	50
R11 459 Fifteenth Avenue	34	45	45	50
R12 70 Gurner Avenue (future residential)	37	45	46	50

Noise emissions associated with outdoor activities from individual and combined campus scenarios are expected to be generally within the range of background L_{A90} + 10dBA.

In order to further minimise the potential impact at residences the following recommendations made:

- Restrict the use of outdoor play areas prior to 7.00am.
- Minimise PA use and ensure speakers are appropriately located and limited to achieve acceptable levels.
- The L_{Amax} noise level from the PA system operation should not exceed the ambient noise levels by more than 5dBA at the nearest residential receiver.
- The PA system should use small low-powered horn-type speakers oriented in such a manner to fire away from residential premises.
- Speakers should be mounted at a downward angle of 45^{o} and as close to ground level as possible.
- Only nominated persons, trained in the appropriate use of the system, should be permitted to operate the PA system.
- A sound limiter is to be installed to ensure that the maximum limiting criterion at residential properties is not exceeded.
- It is recommended that management of noise be included in any site management plan.

6.2.13 Road Traffic Noise

The proposed development of the two schools will occur over a 20 year period.

The Liverpool Growth Centre Precincts DCP 2012 Schedule 1 *Austral & Leppington North Precincts 2012* identifies upgrades to Fifteenth Avenue and Edmondson Avenue which will become transit boulevards and Gurner Avenue and Fourth Avenue which will both become collector roads.

According to the project traffic assessment *Transport and Accessibility Assessment Al-Faisal College 80 and 83-87 Gurner Avenue Austral prepared by Traffix (reference 19.607r02v02) dated 7 September 2020* the typical growth rate for traffic volume increases of 2% per annum is not considered applicable in a growth precinct. The expected through traffic volumes in the Austral and Leppington North area in the year 2036 have been previously projected and are shown in Table 6-8. These were used in the project traffic assessment to derive a yearly growth rate for every leg of each key intersection. Growth rates of up to 23% are predicted for Fifteenth Avenue and up to 18% on Edmondson Avenue. These growth rates illustrate that the project area is currently greenfield in character with a typically low traffic volume base.

Table 6-8 2036 Peak Traffic Flows for the Austral Precinct

Road	Location	Weekday morning	Weekday afternoon
Edmondson Avenue	North of Eleventh Ave	1610	1920
	North of Tenth Ave	1500	1480
	South of Tenth Ave	1340	1660
Fourth Avenue	North of Eleventh Ave	770	870
	North of Tenth Ave	670	940
	South of Tenth Ave	610	620

Source: Colston Budd Rogers & Kafes Pty Ltd Transport and Accessibility Impact Assessment for Proposed St Anthony of Padua Catholic School, 125-165 Tenth Avenue and 140-170 Eleventh Avenue, Austral (July 2018 - Amended October 2018)

According to the transport study prepared by Colston Budd Rogers & Kafes Pty Ltd for the St Anthony of Padua Catholic School, Austral, flows for Tenth Avenue (future collector road) and Eleventh Avenue were not included in the previous studies however traffic flows on these roads are expected to be some 200 to 400 vehicles during peak hourly periods.

In the absence of traffic flow data for the comparable roads in proximity to the project site, Gurner Avenue would likely carry similar volumes to Tenth Avenue based on the road heirarchy as a future collector road.

Traffic assessment has projected the trip generation for the existing 2020 base scenario with the combined primary and secondary campus. Future operational traffic projections have been carried out for the two school campuses for 2026 and 2036. The morning arrival periods have been examined since these were found to generate more vehicle trips than the afternoon peak.

Staggered start times are proposed for both schools to assist traffic distribution. The primary school will commence at 8.15 am and 8.45am. The secondary school start times will be 8.30am and 9.00 am. Each school will have two separate 30-minute periods which overlap and based upon the proposed start times, there will be one 15-minute period common to both school campuses.

The existing 2020 base case and projected 2026 and 2036 traffic generation along each road segment in the vicinity of the school campuses are shown in Table 6-9.

Table 6-9 Existing and Future Traffic Distribution

Road	Segment	Existing	Primary		Secondary	
		2020	2026	2036	2026	2036
Gurner Ave	Fourth Ave to Edmondson Ave	8	318	463	99	330
Gurner Ave	Devonshire Rd to Fourth Ave	0	0	76	0	63
Fourth Ave	Gurner Ave to Fifteenth Ave	275	176	329	61	236
Fourth Ave	Fifteenth Ave to Bringelly Rd	77	134	241	47	173
Edmondson Ave	Gurner Ave to Fifteenth Ave	0	318	463	111	331
Edmondson Ave	Fifteenth Ave to Bringelly Rd	162	284	242	99	174
Fifteenth Ave	Edmondson Ave to Cowpasture Rd	8	34	221	12	157
Fifteenth Ave	Devonshire Rd to Fourth Ave	28	42	88	14	63

Source: Traffix (Sept 2020): *Transport & Accessibility Assessment Al-Faisal College 80 and 83-87 Gurner Avenue Austral*

The levels of road traffic noise generated by project traffic have been predicted using the UK Department of Environment *Calculation of Road Traffic Noise* (CoRTN) *1988* method, based upon the traffic flows shown in Table 6-9. Offset distances representative of residences along the road segments have been adopted for the purposes of calculation. The primary school and secondary school morning peak traffic noise levels are shown in Table 6-10 and Table 6-11. Predictions have been undertaken for the staggered arrival scenario and the 30 minute overlap period. For the staggered arrival scenario it has been assumed that the traffic flows would be evenly split between each hourly arrival period.

Table 6-10 Predicted Primary School Project-Generated Road Traffic Noise

Residence Location	Road Segment	Predicted AM Peak Traffic Noise Level $L_{Aeq,1hr}$ dBA					Criterion $L_{Aeq,1hr}$ dBA
		Base 2020	2026 Staggered	2026 Overlap	2036 Staggered	2036 Overlap	
Gurner Avenue	Fourth Ave to Edmondson Ave	42	55	58	57	60	55
Gurner Avenue	Devonshire Rd to Fourth Ave	-	-	-	44	47	55

Residence Location	Road Segment	Predicted AM Peak Traffic Noise Level $L_{Aeq,1hr}$ dBA					Criterion $L_{Aeq,1hr}$ dBA
		Base 2020	2026 Staggered	2026 Overlap	2036 Staggered	2036 Overlap	
Fourth Avenue	Gurner Ave to Fifteenth Ave	52	47	50	50	53	55
Fourth Avenue	Fifteenth Ave to Bringelly Rd	47	47	50	48	51	55
Edmondson Avenue	Gurner Ave to Fifteenth Ave	-	55	58	57	60	55
Edmondson Avenue	Fifteenth Ave to Bringelly Rd	55	54	57	54	57	55
Fifteenth Avenue	Edmondson Ave to Cowpasture Rd	38	41	44	49	52	55
Fifteenth Avenue	Devonshire Rd to Fourth Ave	43	42	45	45	48	55

Table 6-11 Predicted Secondary School Project-Generated Road Traffic Noise

Residence Location	Road Segment	Predicted AM Peak Traffic Noise Level $L_{Aeq,1hr}$ dBA					Criterion $L_{Aeq,1hr}$ dBA
		Base 2020	**2026 Staggered**	**2026 Overlap**	**2036 Staggered**	**2036 Overlap**	
Gurner Avenue	Fourth Ave to Edmondson Ave	-	50	53	55	58	55
Gurner Avenue	Devonshire Rd to Fourth Ave	-	-	-	43	46	55
Fourth Avenue	Gurner Ave to Fifteenth Ave	-	42	45	48	51	55
Fourth Avenue	Fifteenth Ave to Bringelly Rd	-	42	45	48	51	55
Edmondson Avenue	Gurner Ave to Fifteenth Ave	-	50	53	55	58	55
Edmondson Avenue	Fifteenth Ave to Bringelly Rd	-	50	53	52	55	55
Fifteenth Avenue	Edmondson Ave to Cowpasture Rd	-	36	39	48	51	55
Fifteenth Avenue	Devonshire Rd to Fourth Ave	-	37	40	44	47	55

From the predictions of road traffic generated by the primary school campus, exceedances of the RNP 55dBA $L_{Aeq,1hr}$ design limit for local roads are likely to occur at residences along Gurner Avenue during the 30-minute overlap period for the 2026 scenario (3dBA), the 2036 staggered period (2dBA) and the 2036 overlap period (5dBA).

Gurner Avenue has been identified as a future collector road and as such, the RNP design limit of 60dBA ($L_{Aeq,15hr}$) is considered applicable. Project-generated road traffic noise would achieve this design limit for all future scenarios on Gurner Road.

Marginal exceedance (3dBA) of the RNP 55dBA $L_{Aeq,1hr}$ design limit for local roads is predicted at residences along Edmondson Avenue for the 2026 overlap scenario and the 2036 staggered period (2dBA). For the 2036 overlap period exceedance of 5dBA is predicted. Edmondson Avenue has been identified as a future transit boulevard and as such, the RNP design limit of 60dBA ($L_{Aeq,15hr}$) is consdiered applicable. Project-generated road traffic noise would achieve this design limit for all future scenarios.

Road traffic flows generated by the progressive development of the secondary school achieve the RNP recommended design limit of 55dBA $L_{Aeq,1hr}$ at the majority of residential receivers. A marginal (3dBA) exceedance is predicted on Gurner Avenue and Edmonson Avenue for the 30-minute 2036 overlap scenario. Given the future upgrade of these roads to collector and transit boulevard, respectively, the RNP design limit of 60dBA ($L_{Aeq,15hr}$) is considered applicable. Alll future traffic flow scenaris would achieve this design limit.

7 CONCLUSION

An assessment of the noise and vibration impacts associated with alterations and additions to the existing Al-Faisal College (K-10) school at 83 - 87 Gurner Avenue, Austral for use as a primary school and the construction of a new secondary campus at 66 – 80 Gurner Avenue, Austral has been conducted. The two campuses have been designed to accommodate a combined maximum enrolment of 5460 students. 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 assumed typical 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 and earthworks and to a lesser extent during building construction involving bored piling, concrete pours and the like and during general construction works (facade and fitout).

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 multi-purpose halls, performing arts and technology workshops, outdoor PE-type classes 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 existing and future outdoor sports fields and recreational spaces are expected to generally achieve a L_{A90} background + 10dBA emission benchmark. 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

Staggered start times are proposed for both schools to assist traffic distribution. The primary school will commence at 8.15 am and 8.45am. The secondary school start times will be 8.30am and 9.00 am. Each school will have two separate 30-minute periods which overlap.

From the predictions of road traffic generated by the primary school campus will generally achieve the RNP design limit for local roads at residential receivers along the traffic routes. Exceedances of the RNP 55dBA $L_{Aeq,1hr}$ design limit for local roads are predicted at residences along Gurner Avenue.

Gurner Avenue has been identified as a future collector road and as such, the RNP design limit of 60dBA ($L_{Aeq,15hr}$) is considered applicable. Project-generated road traffic noise would achieve this design limit for all future scenarios on Gurner Road.

Similar exceedance of the RNP 55dBA $L_{Aeq,1hr}$ design limit for local roads are predicted at residences along Edmondson Avenue. Edmondson Avenue has been identified as a future transit boulevard and as such, the RNP design limit of 60dBA ($L_{Aeq,15hr}$) is considered applicable. Project-generated road traffic noise would achieve this design limit for all future scenarios.

Road traffic flows generated by the progressive development of the secondary school achieve the RNP recommended design limit of 55dBA $L_{Aeq,1hr}$ at the majority of residential receivers. A marginal (3dBA) exceedance is predicted on Gurner Avenue and Edmonson Avenue for the 30-minute 2036 overlap scenario. Given the future upgrade of these roads to collector and transit boulevard, respectively, the RNP design limit of 60dBA ($L_{Aeq,15hr}$) is considered applicable. Alll future traffic flow scenaris would achieve this design limit.

Given the limited periods throughout the day over which road traffic noise is generated by the future school campus developments, and the times at which this traffic noise occurs, adverse impact upon the normal daily activities of residential receivers is considered unlikely.

APPENDIX A

NOISE MEASUREMENT RESULTS

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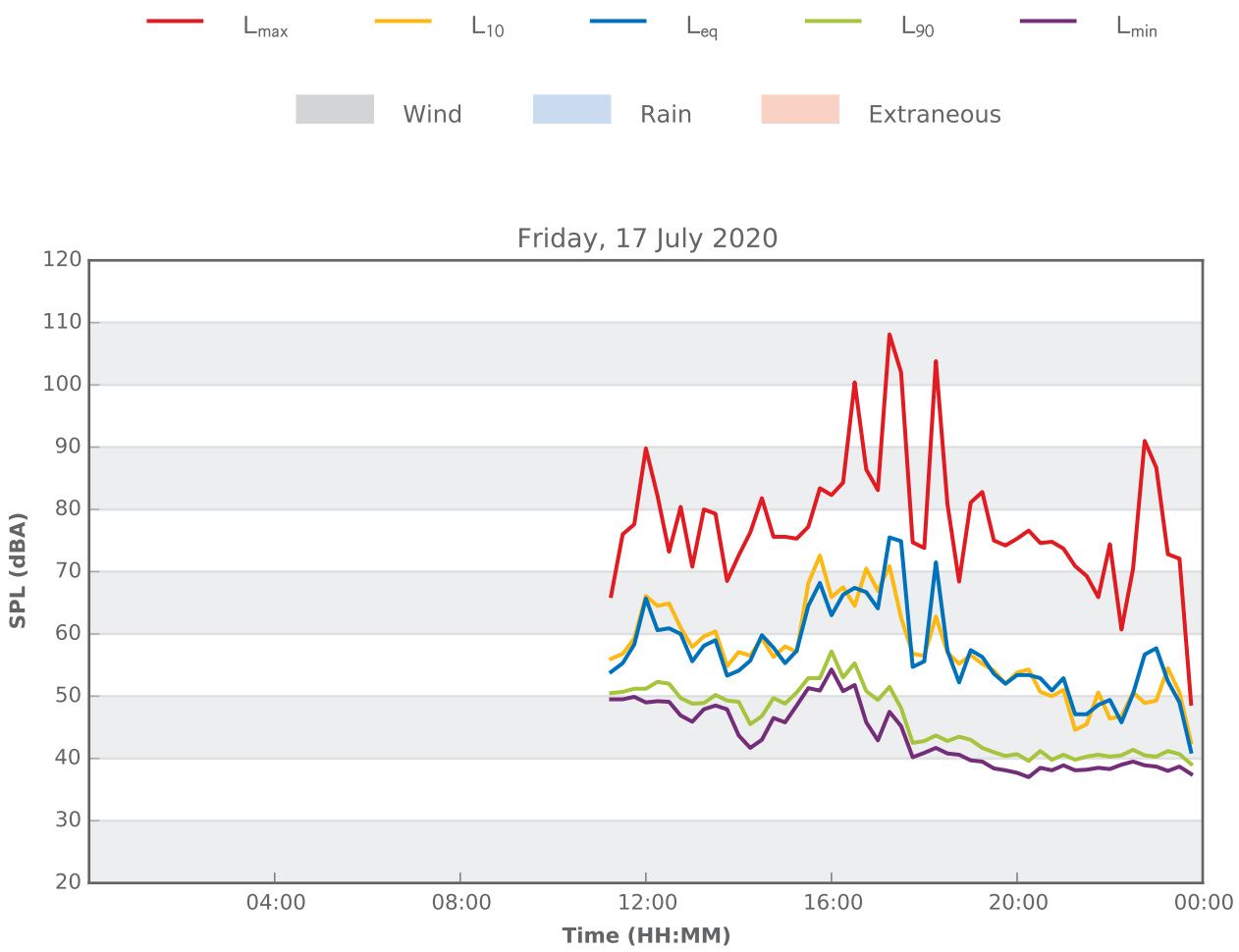

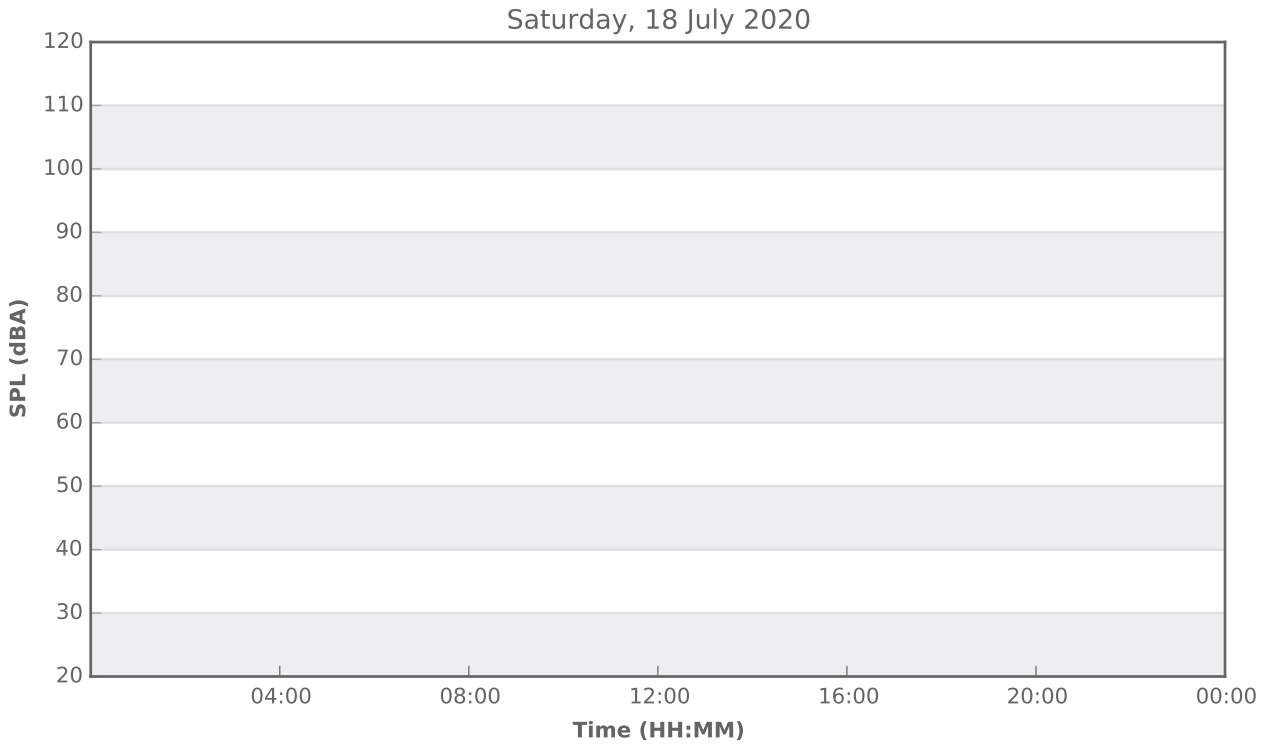

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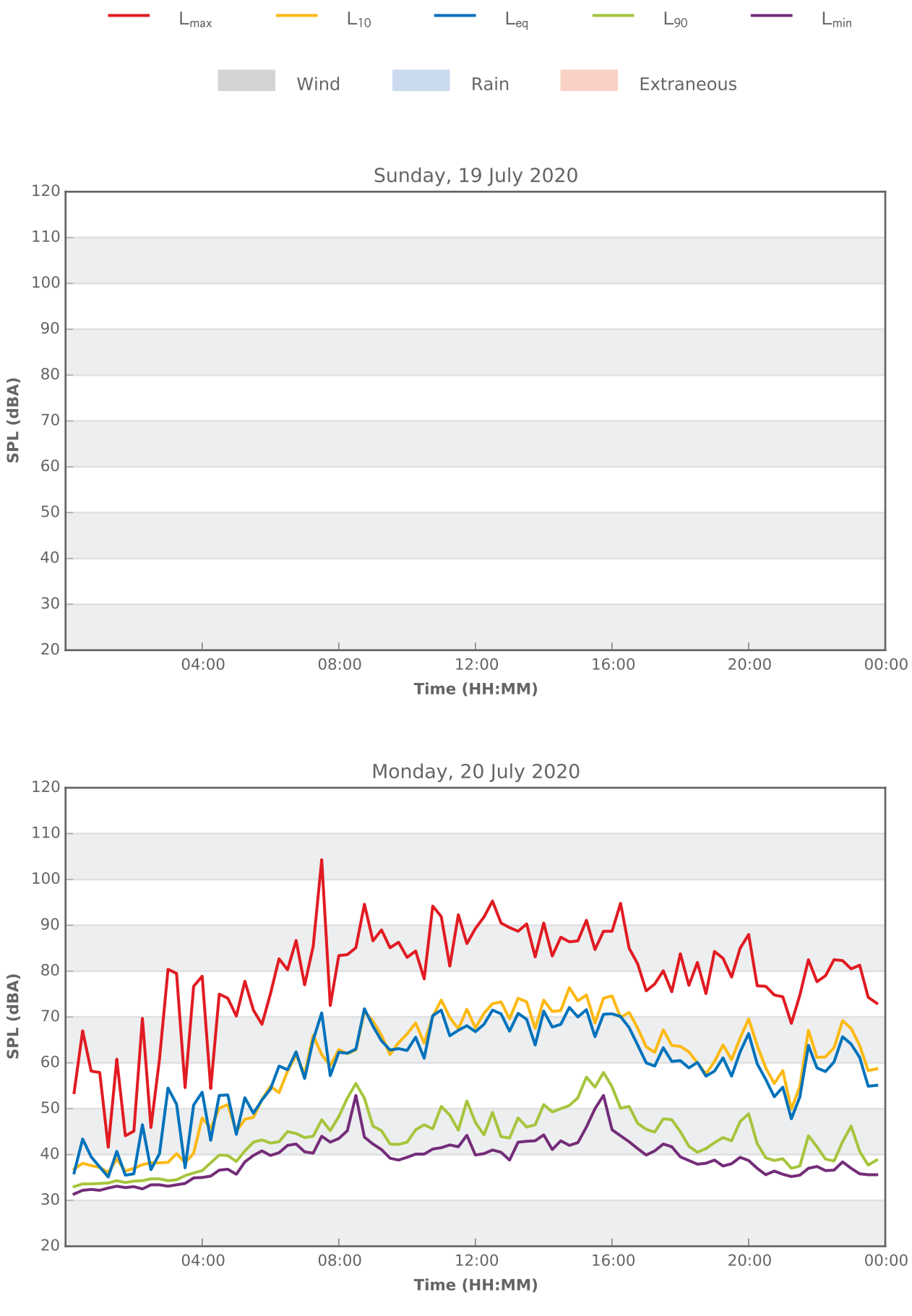

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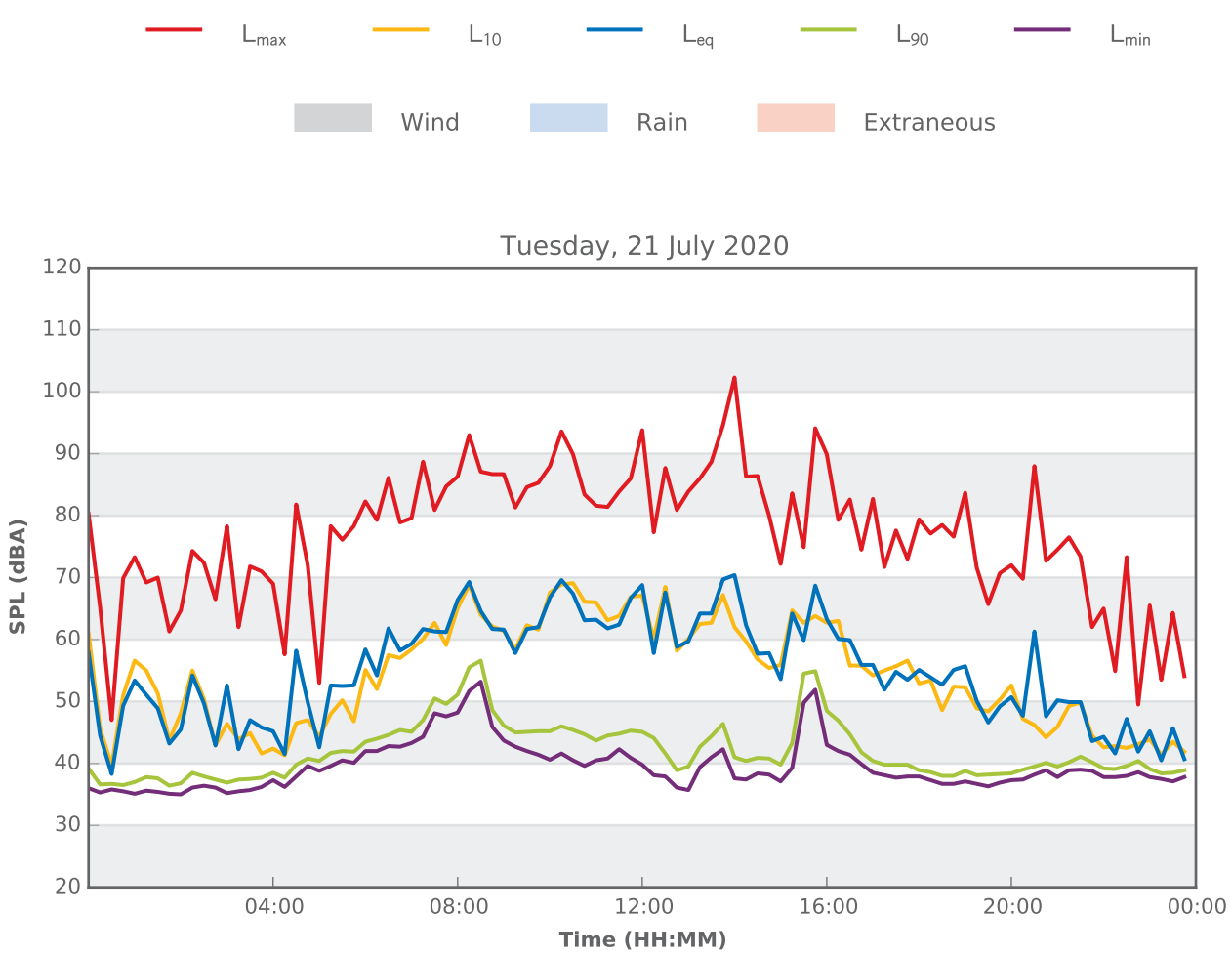

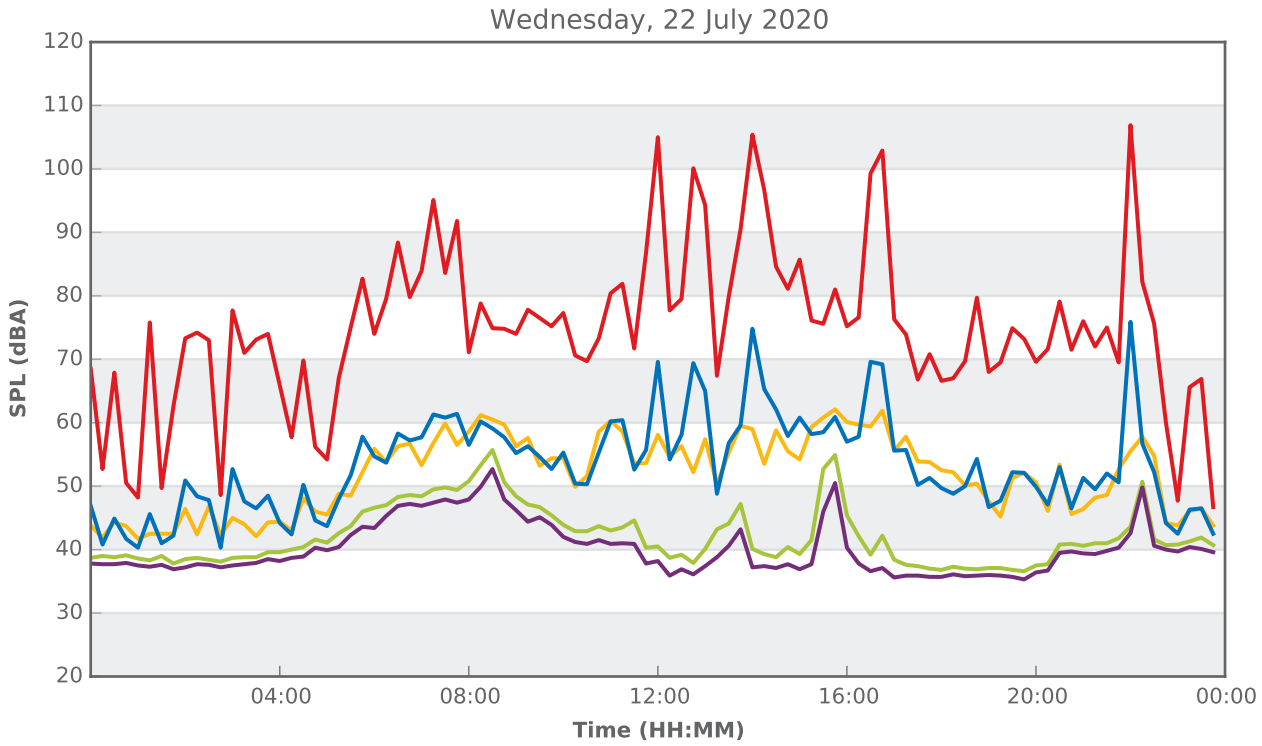

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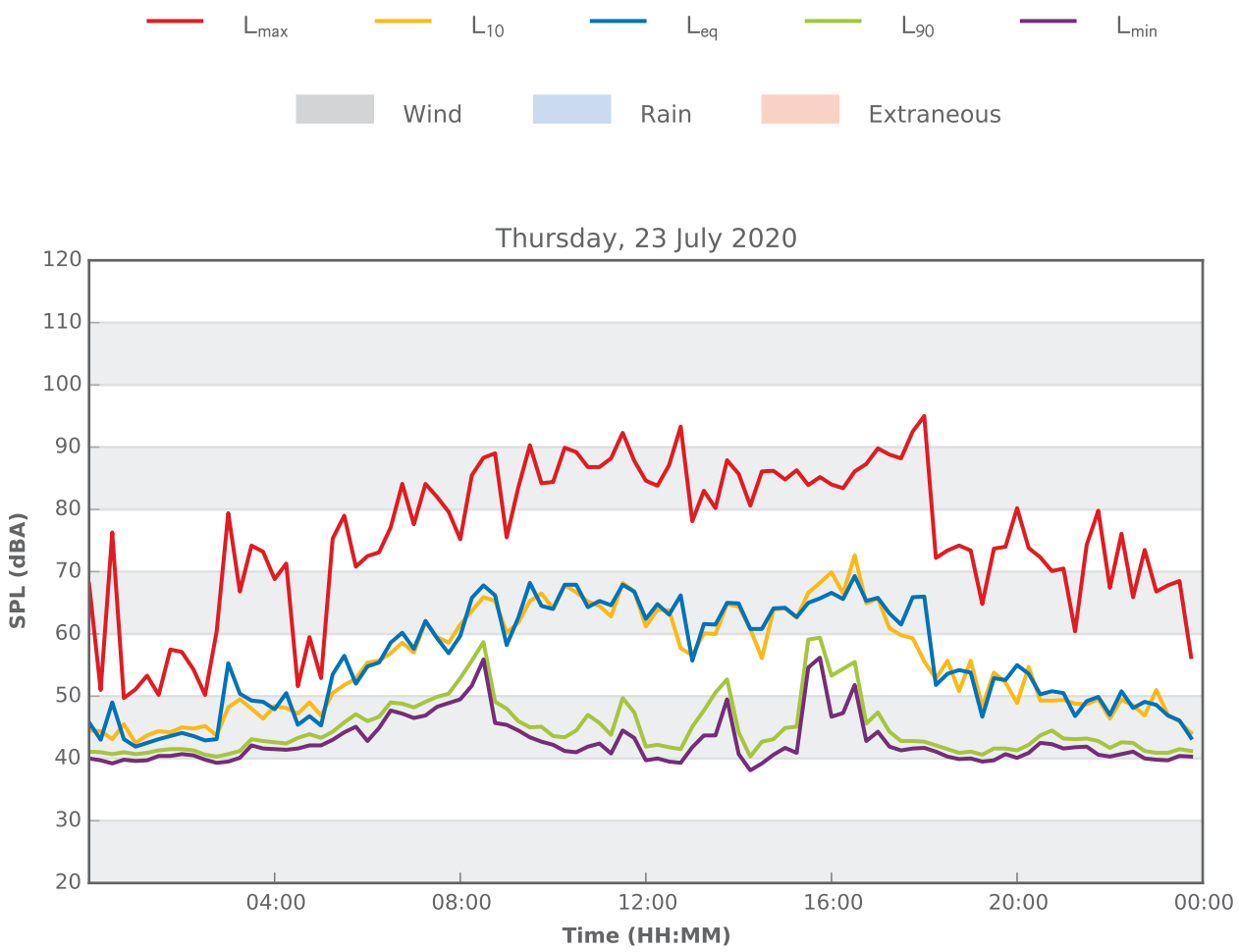

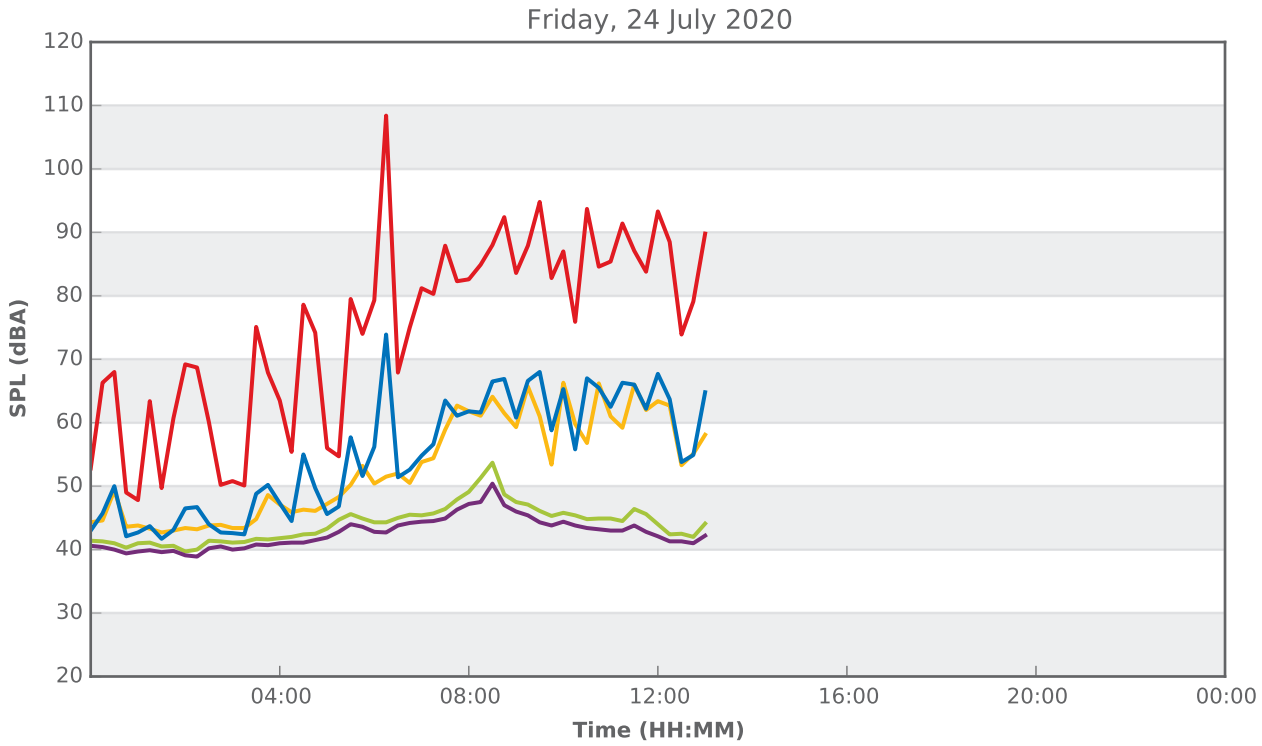

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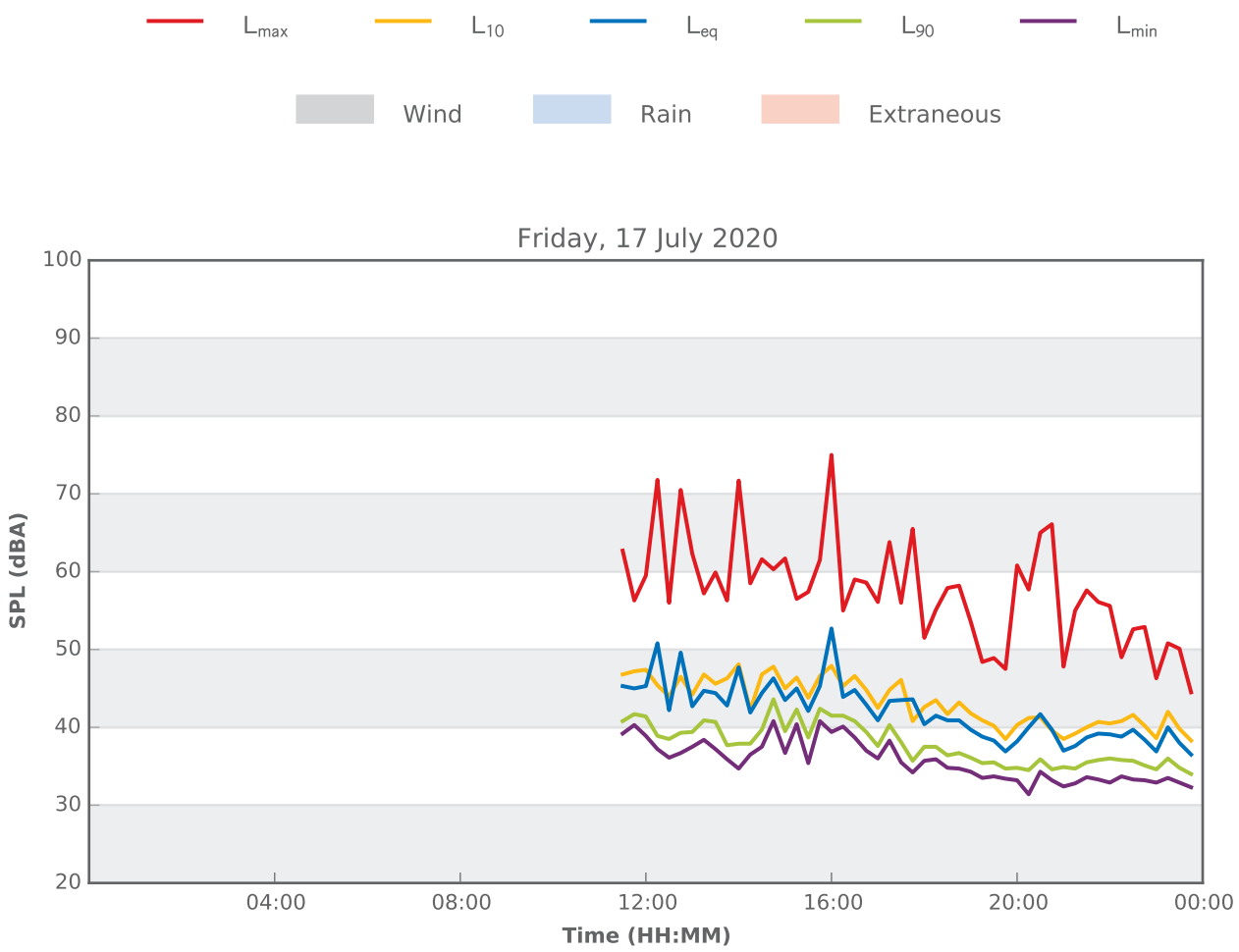

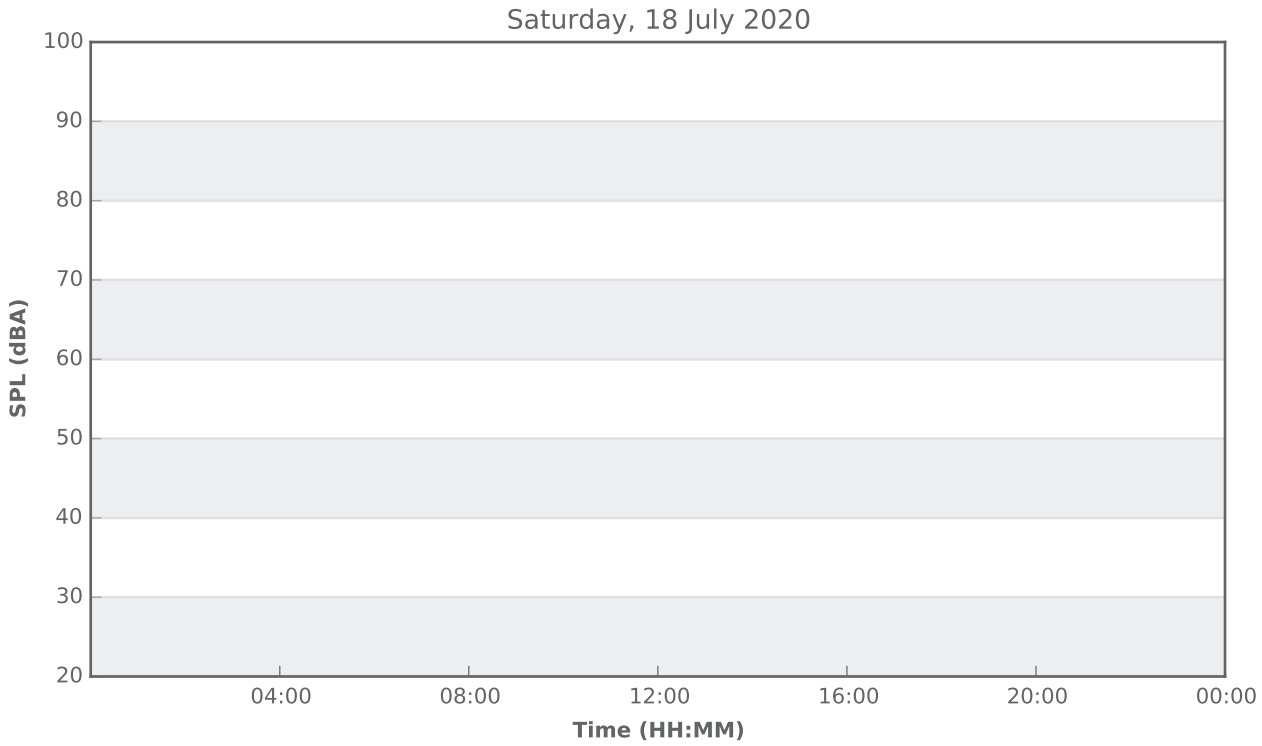

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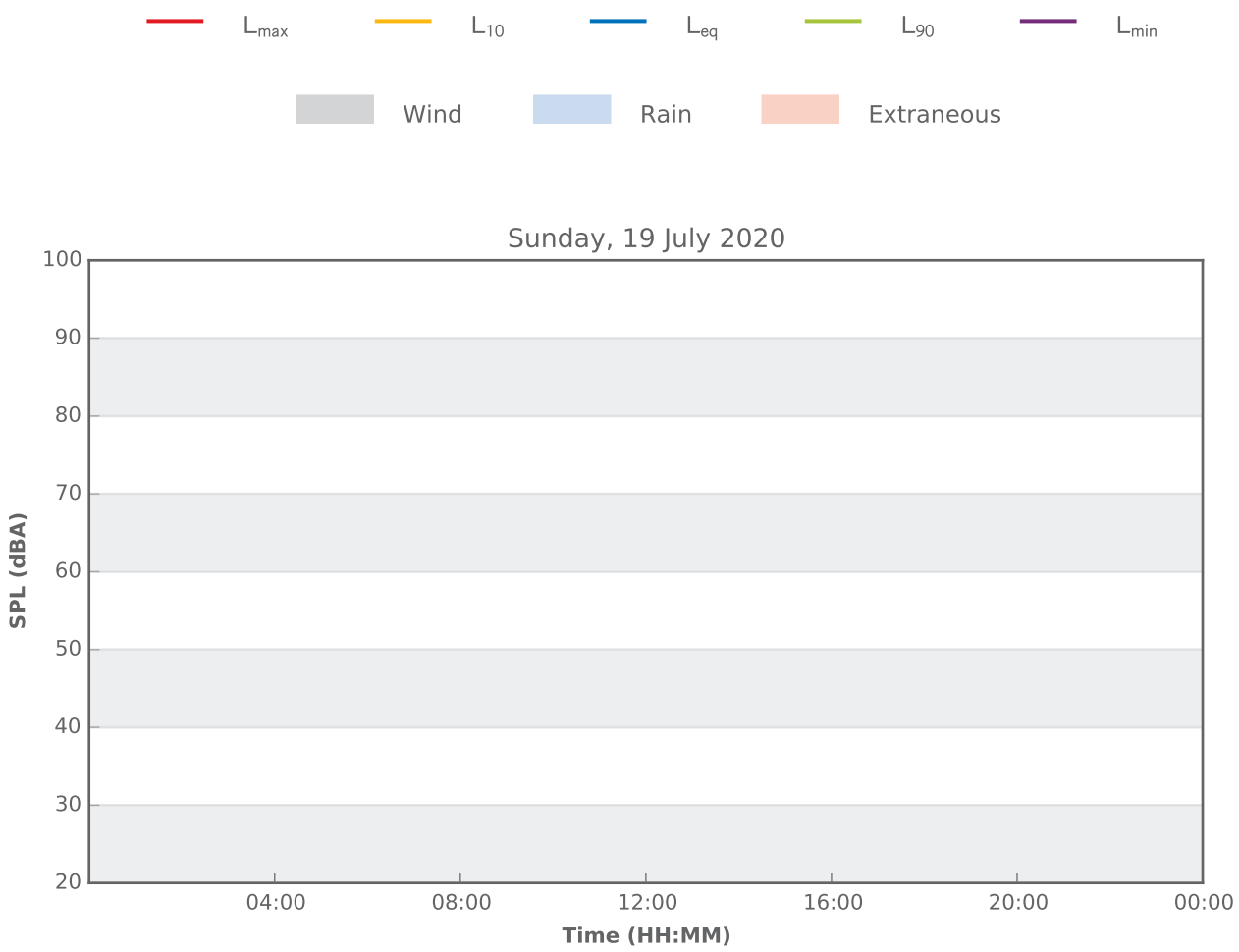

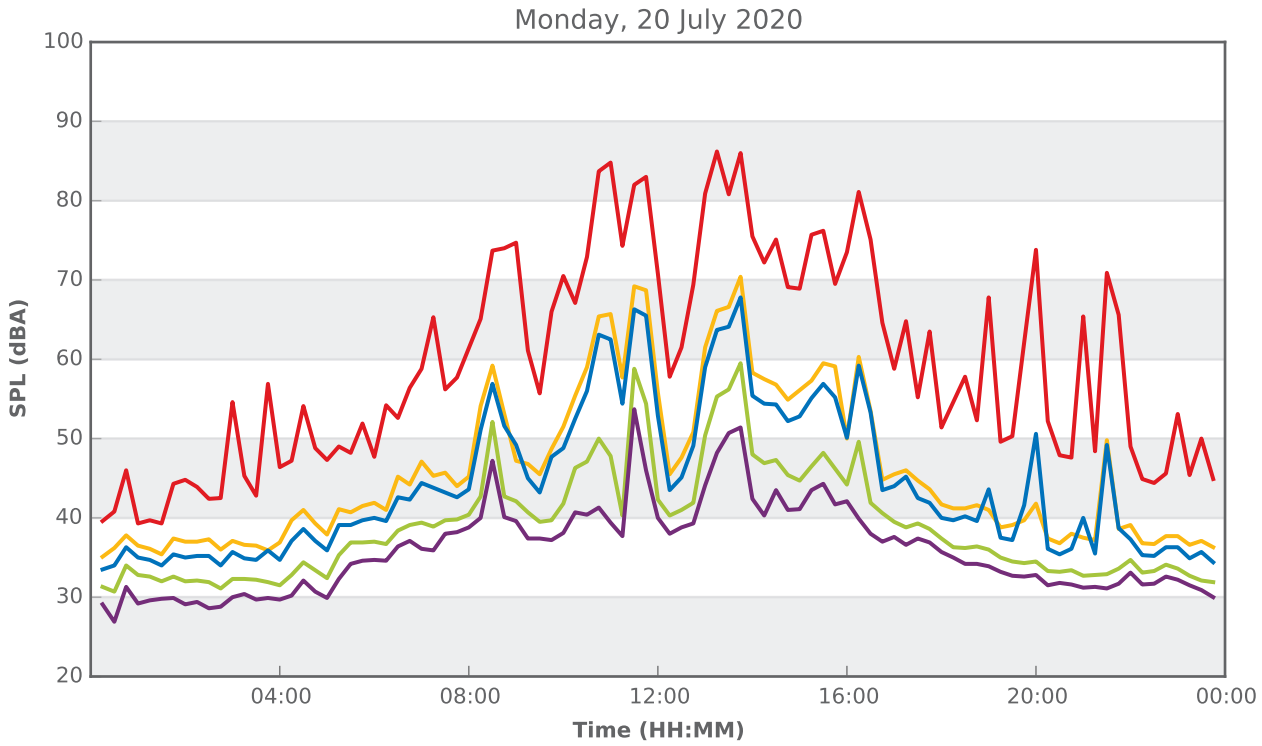

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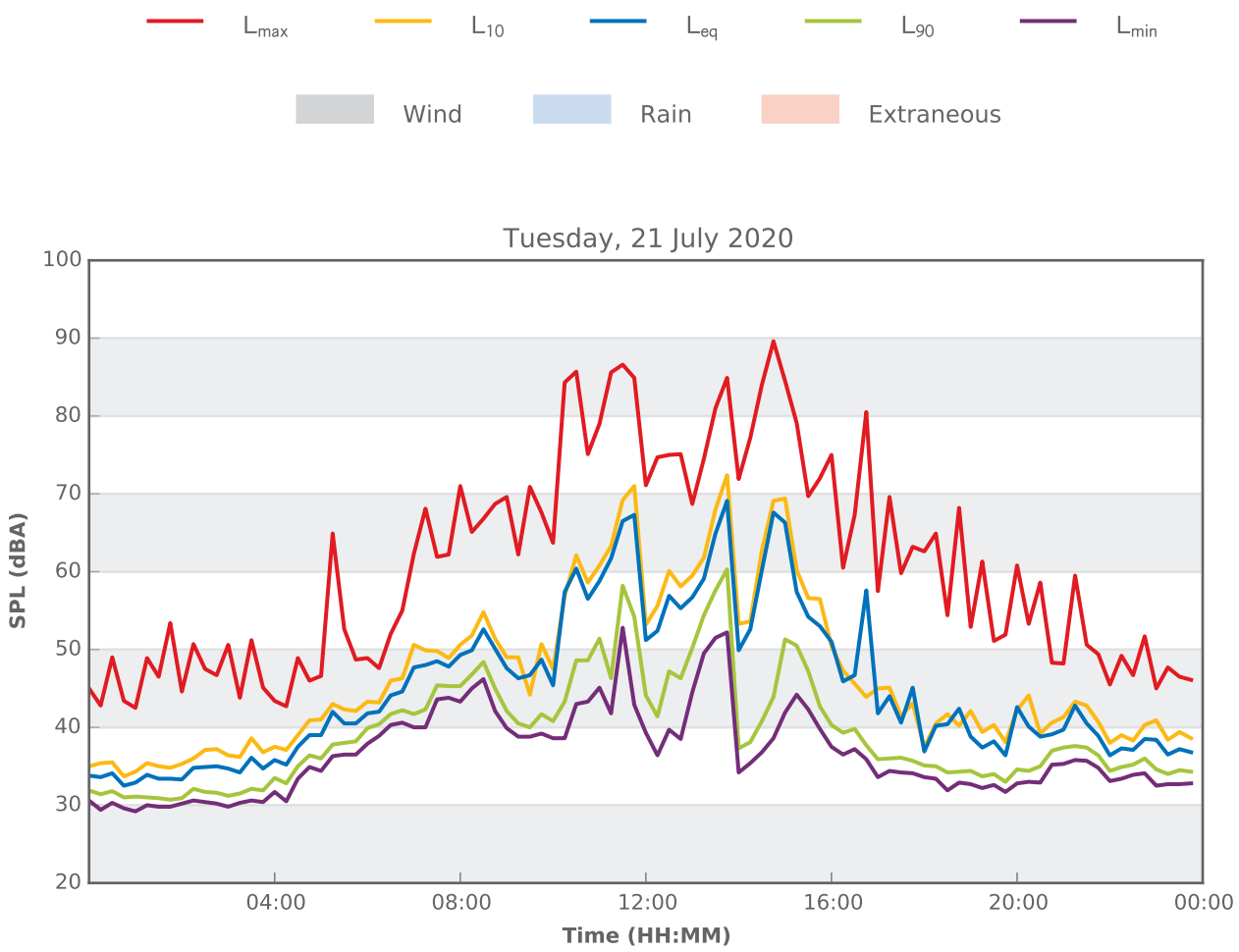

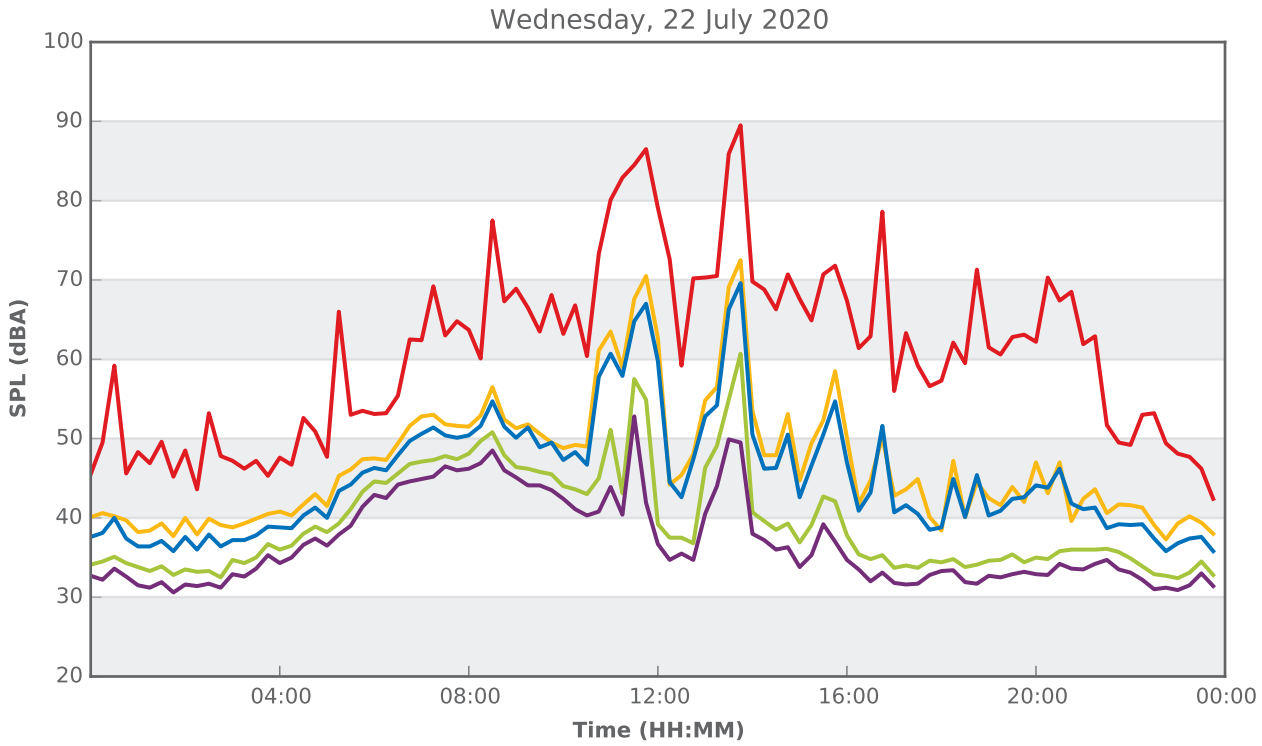

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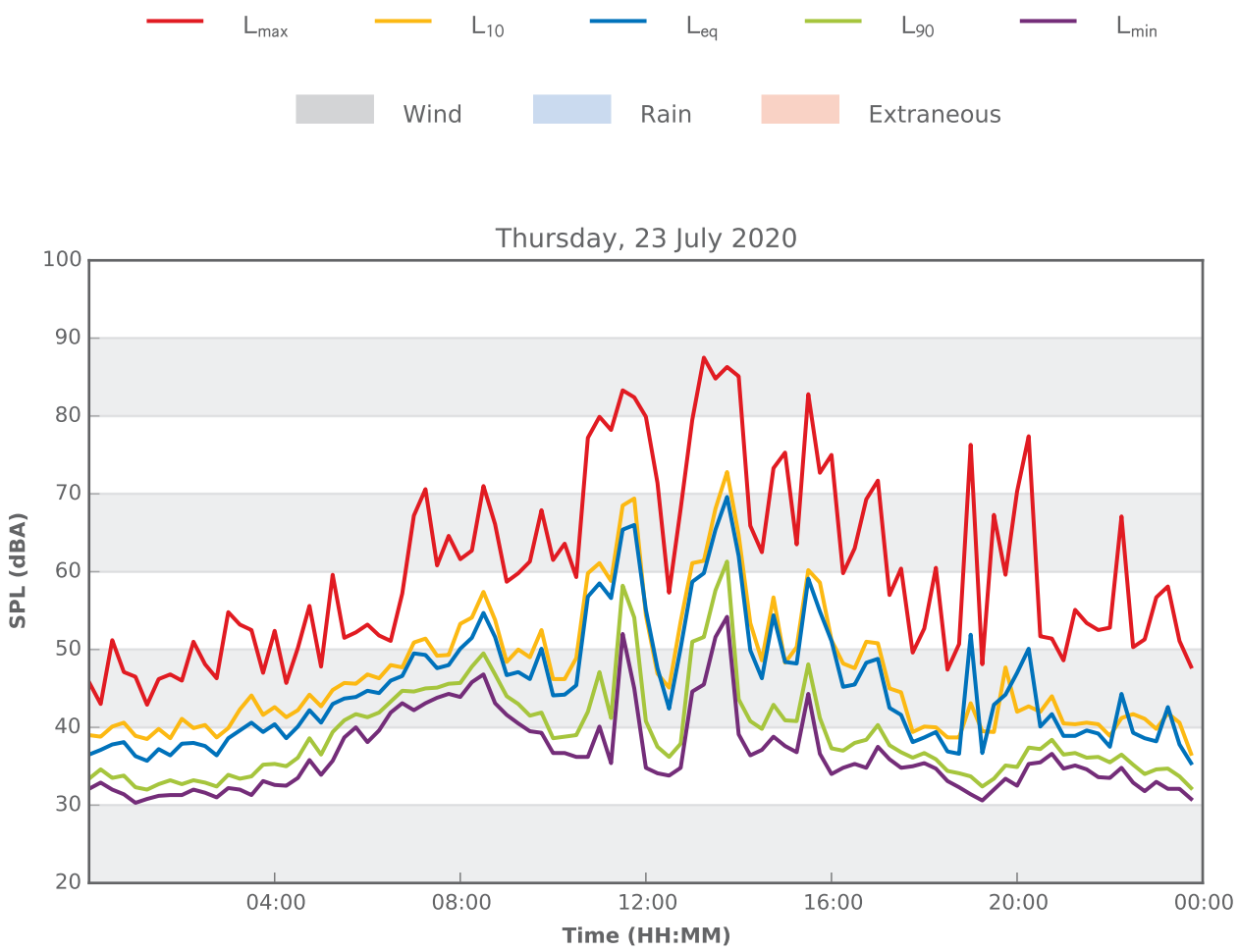

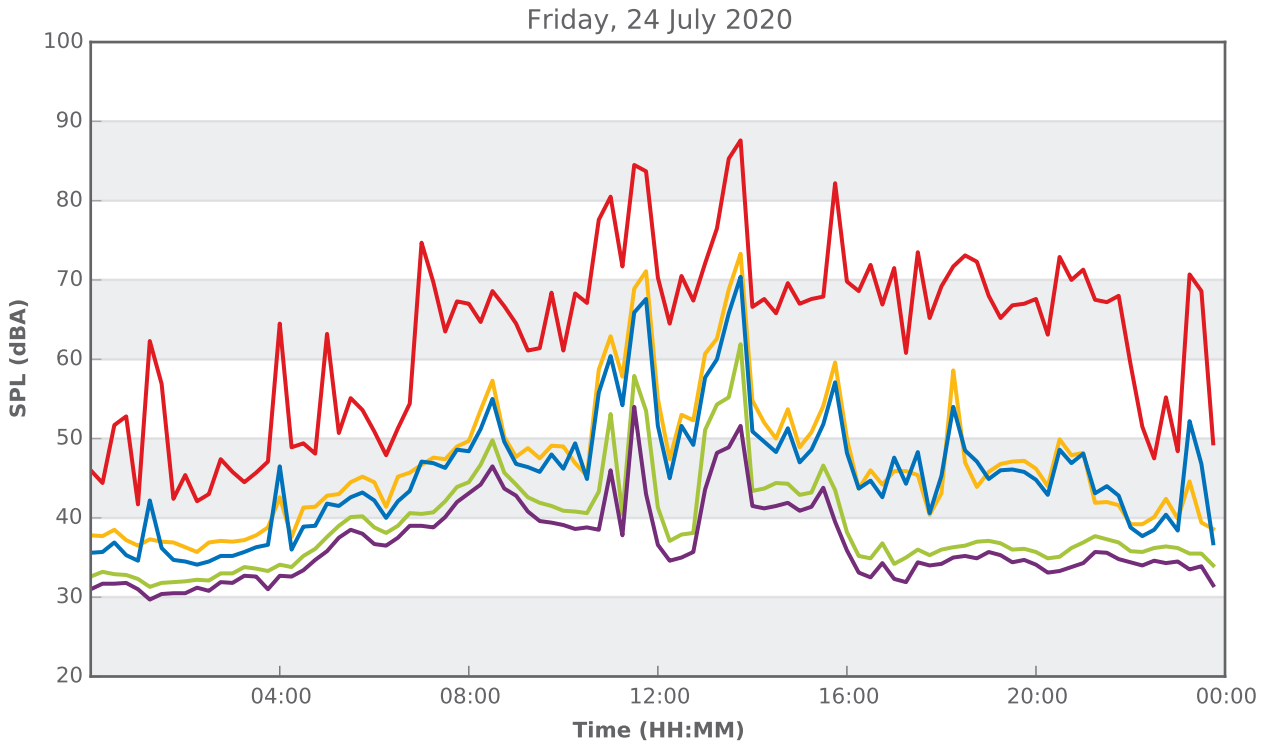

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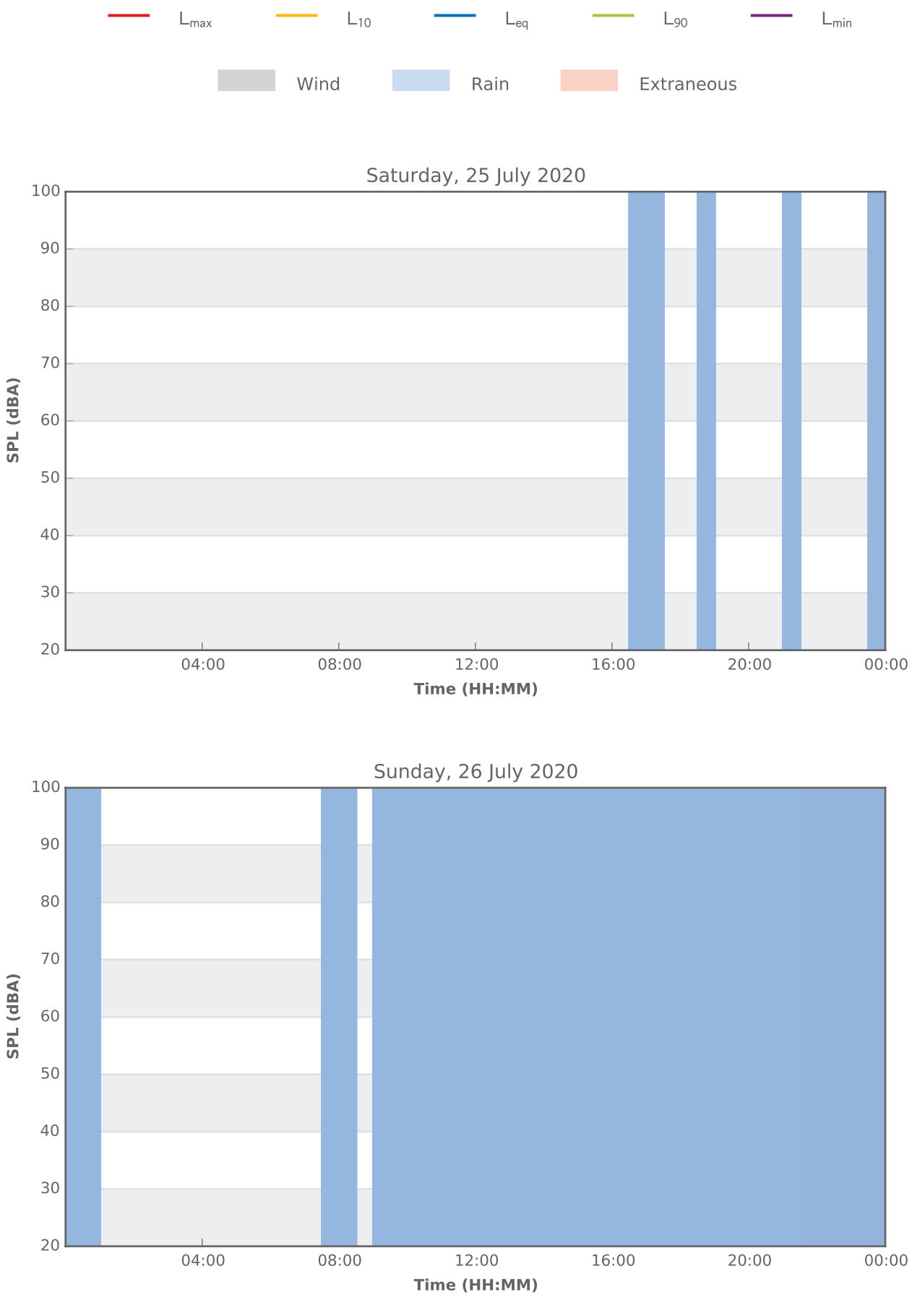

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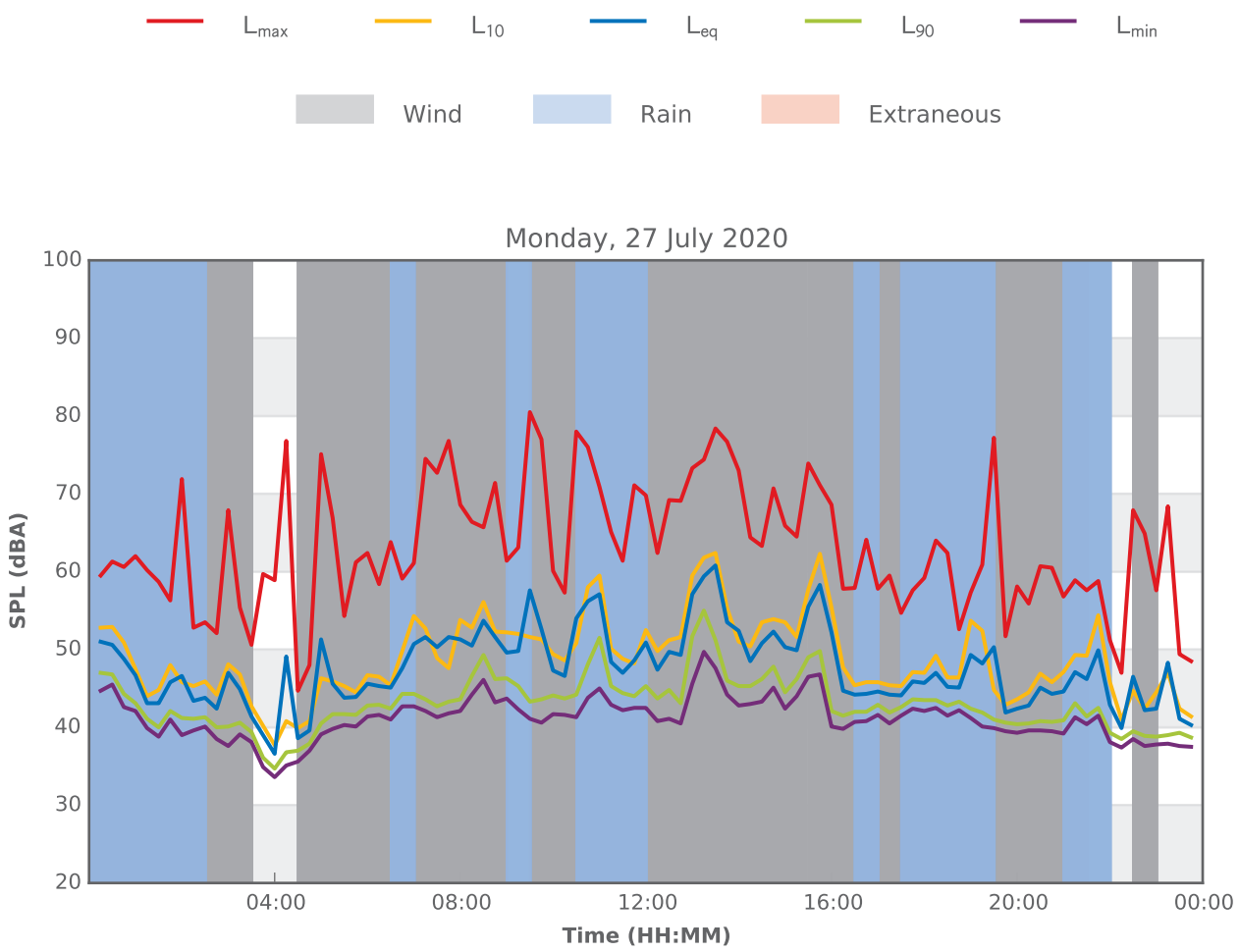

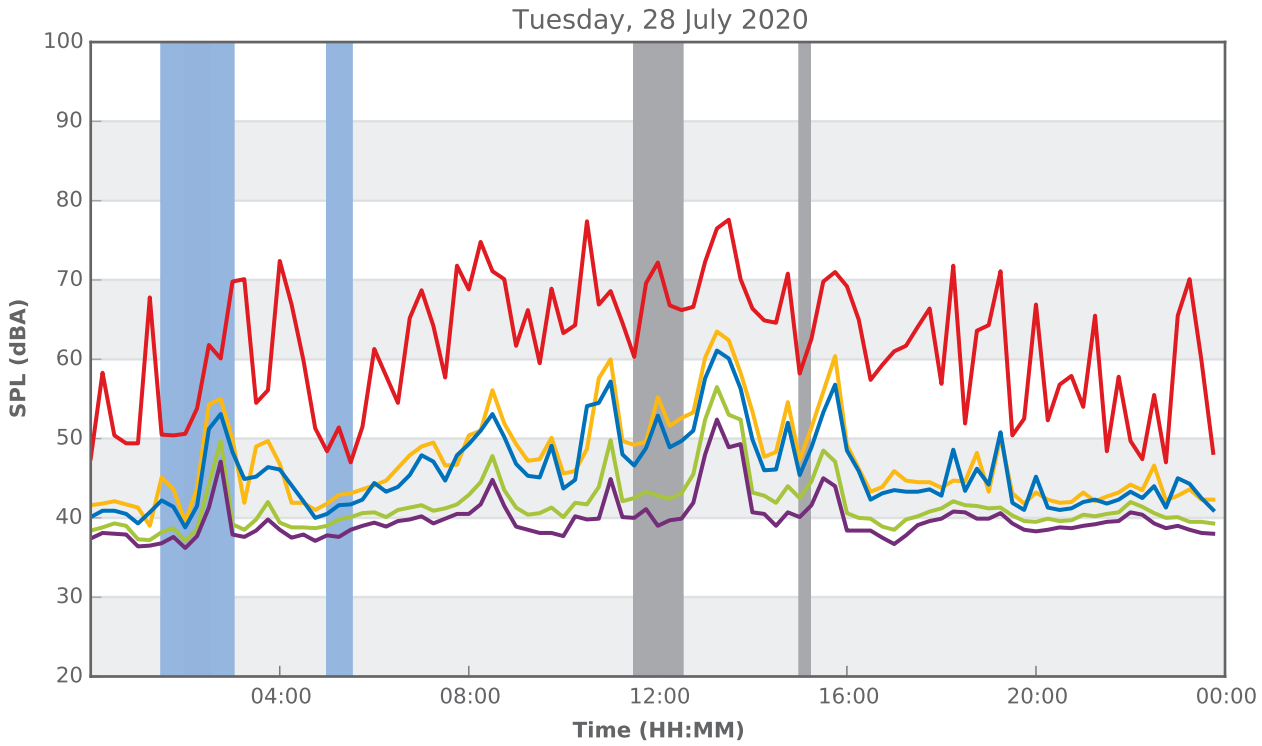

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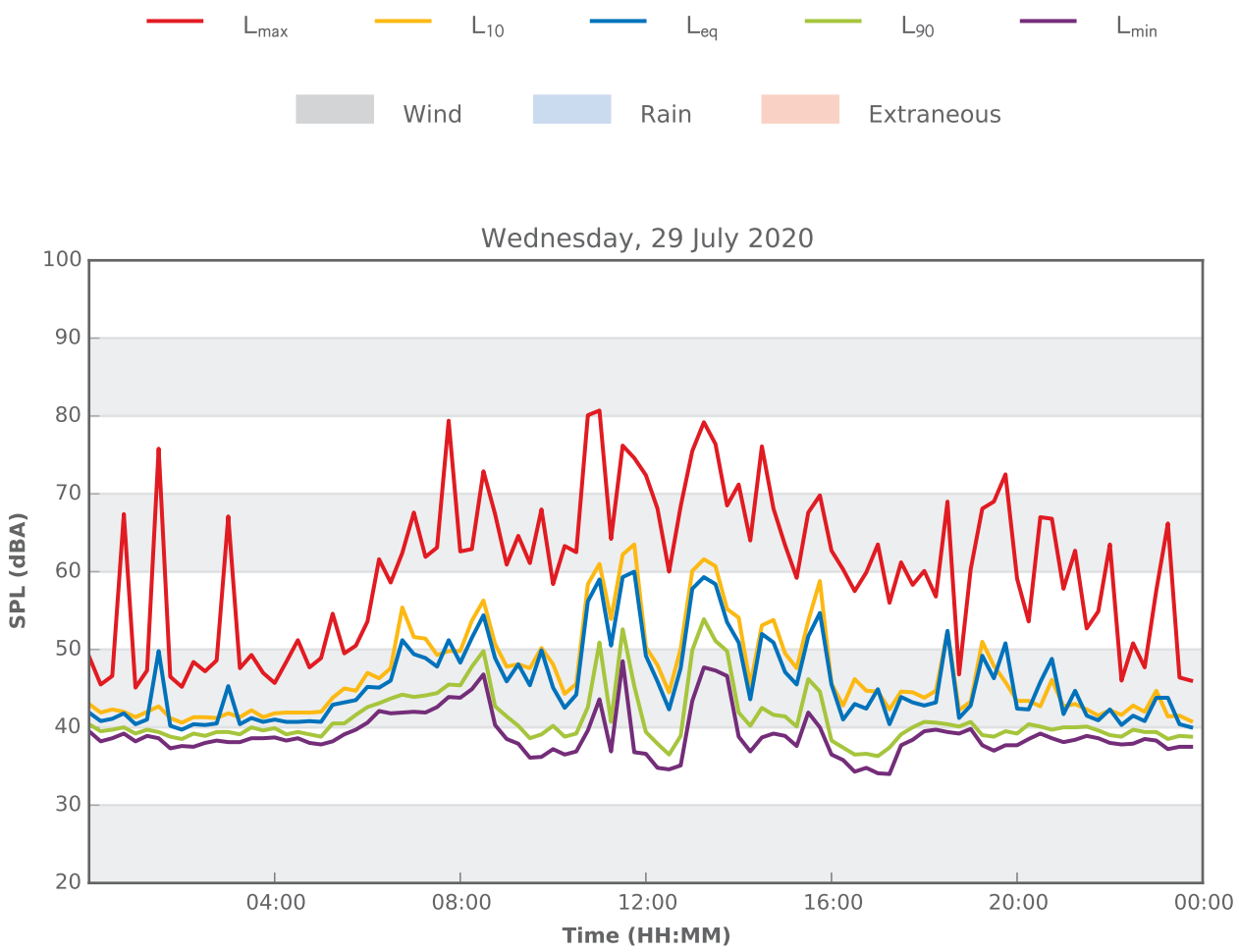

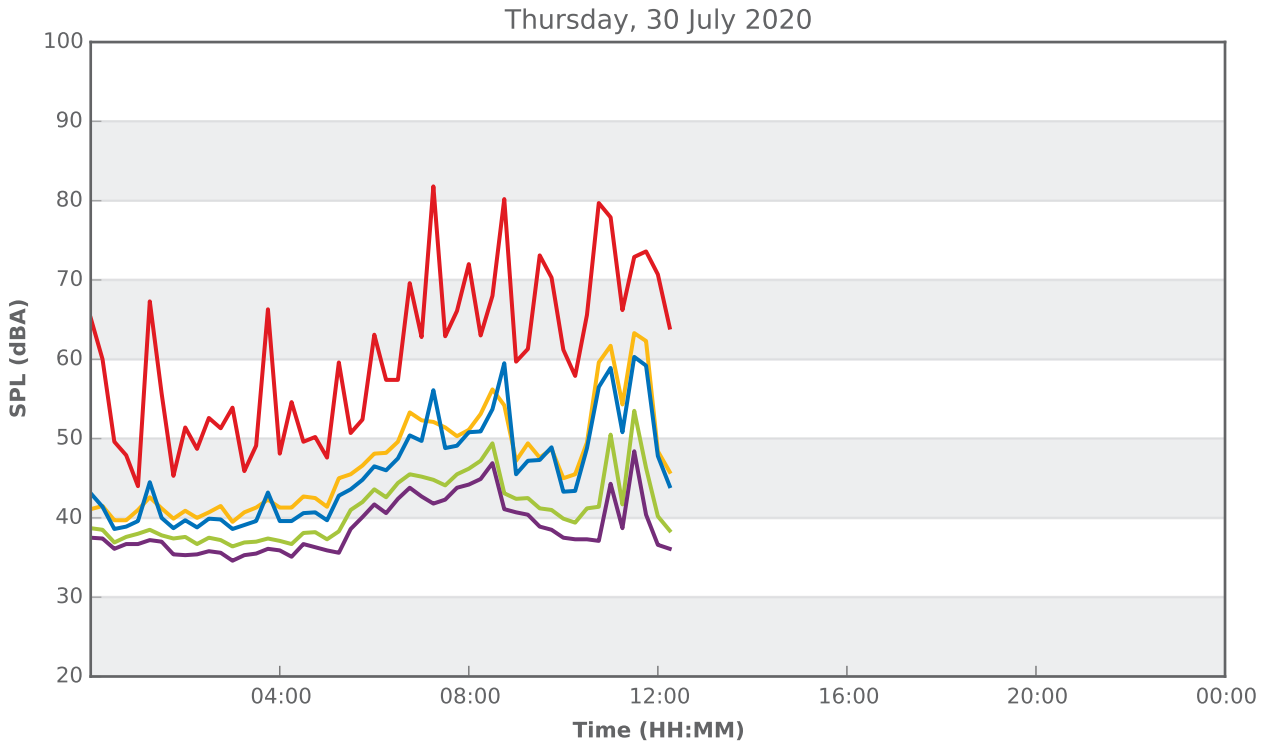

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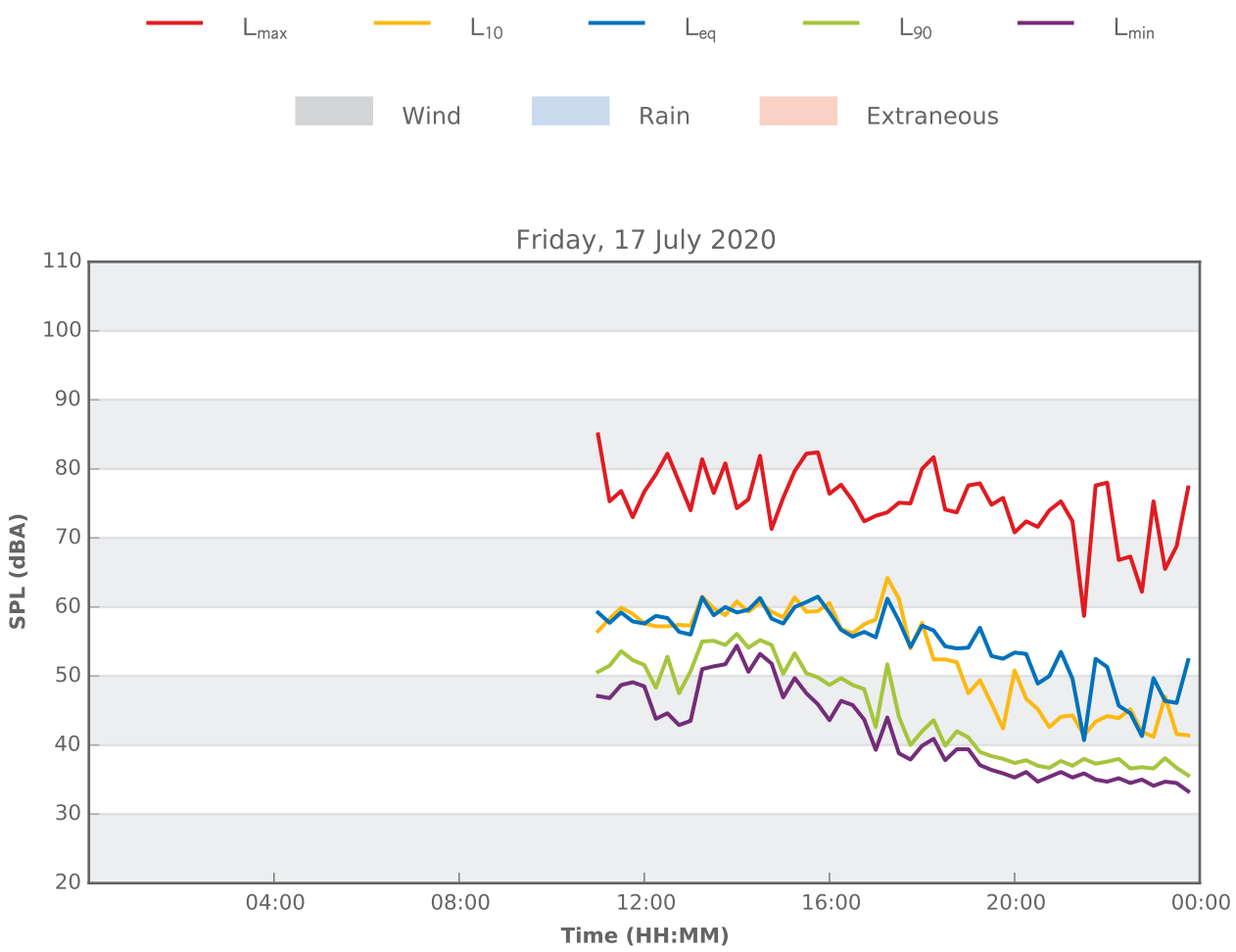

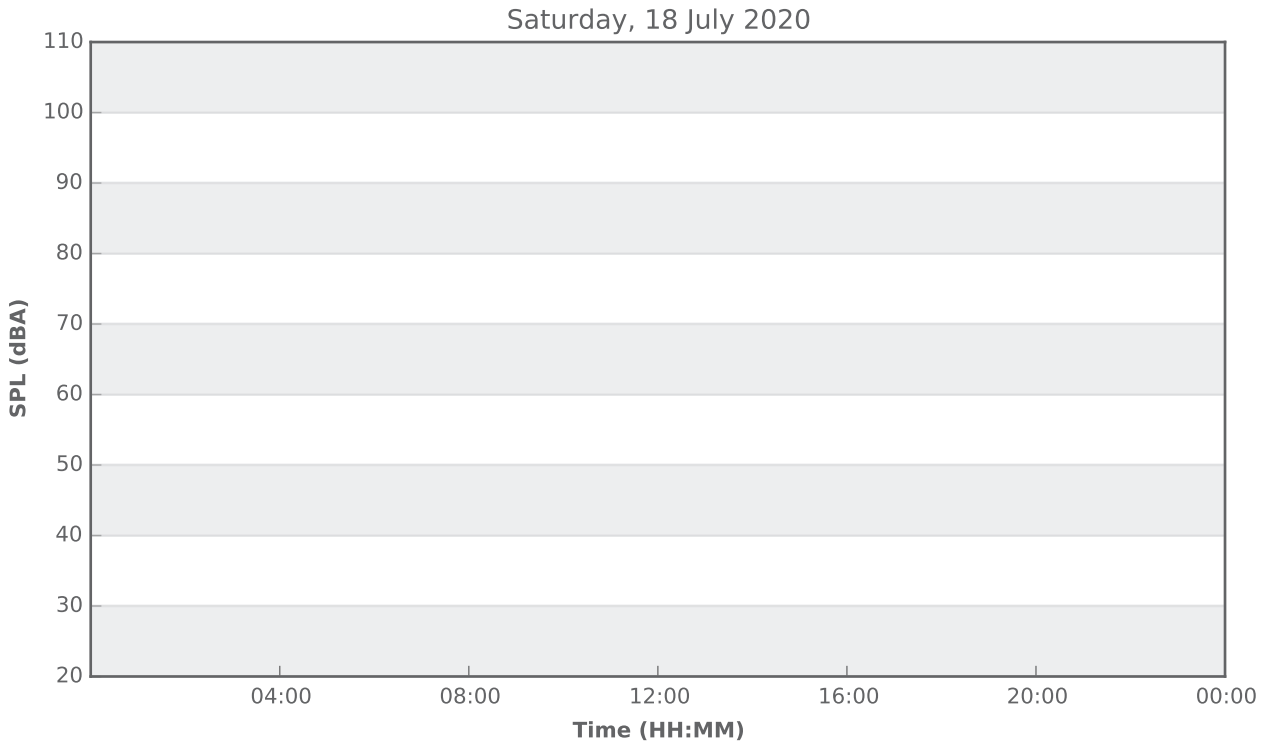

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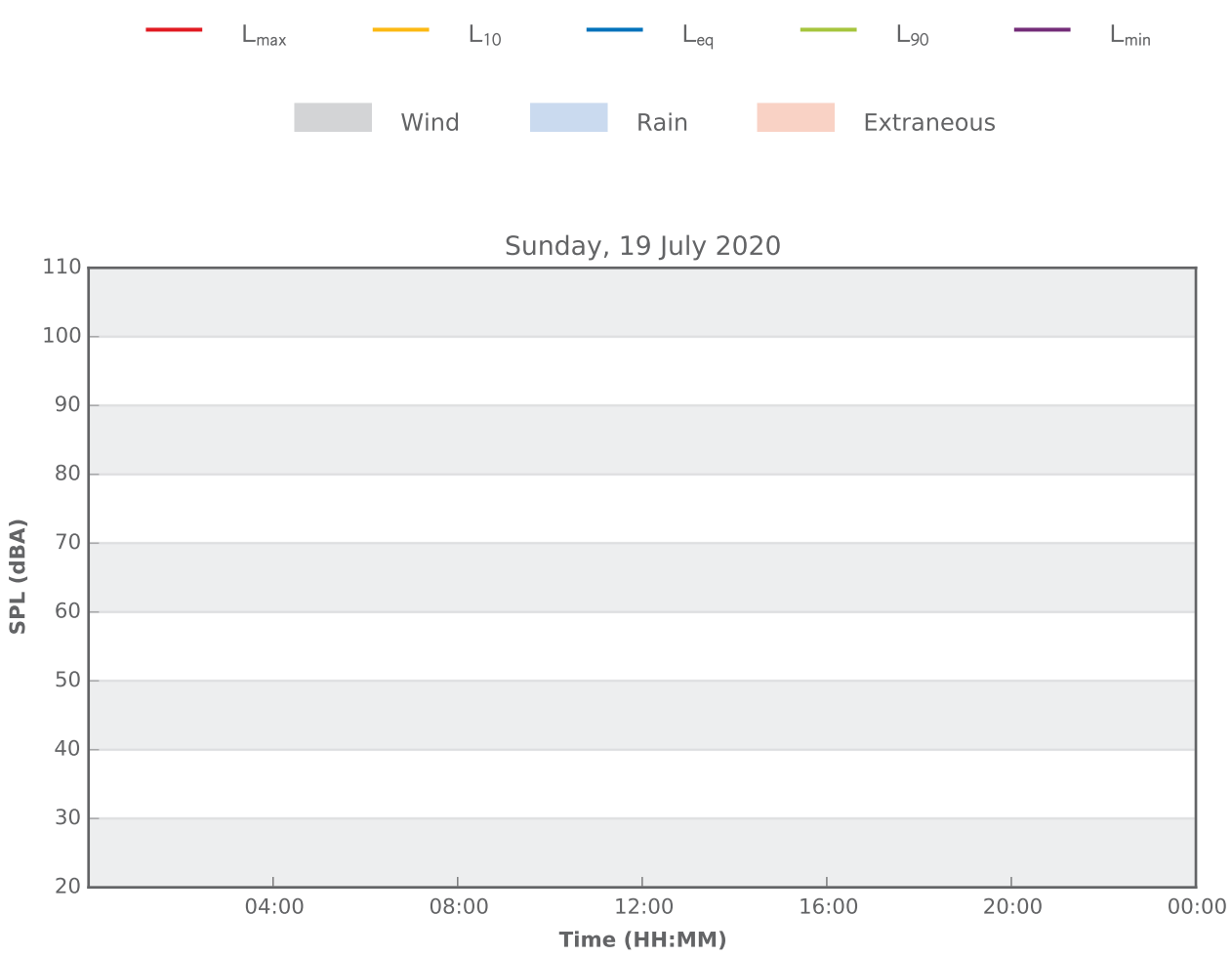

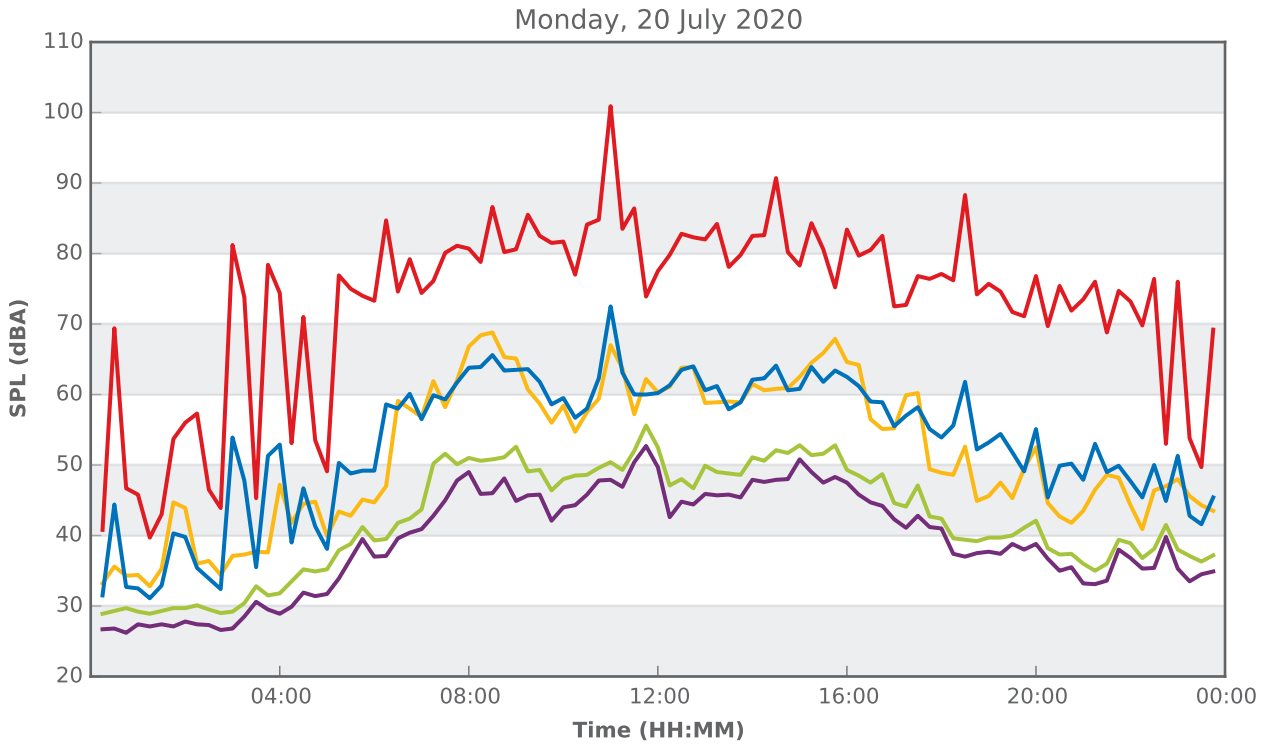

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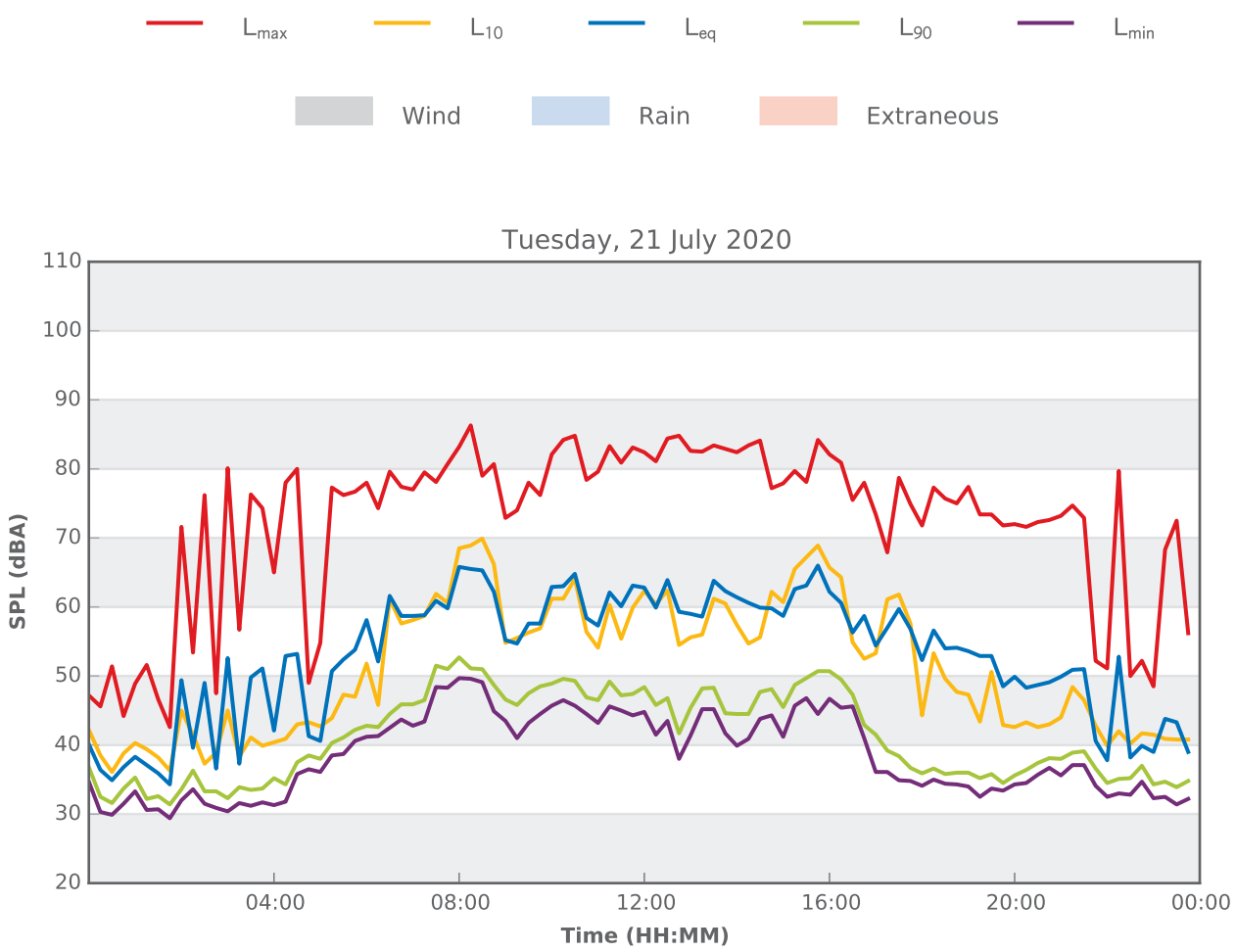

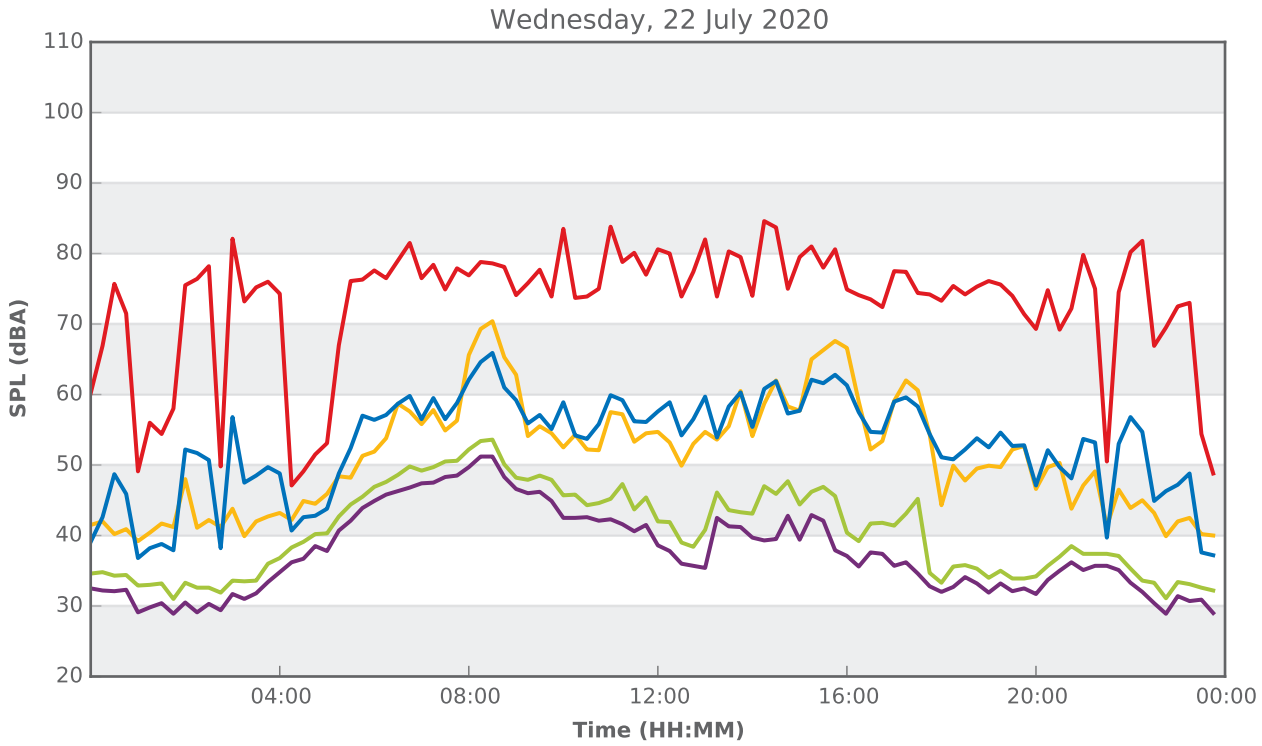

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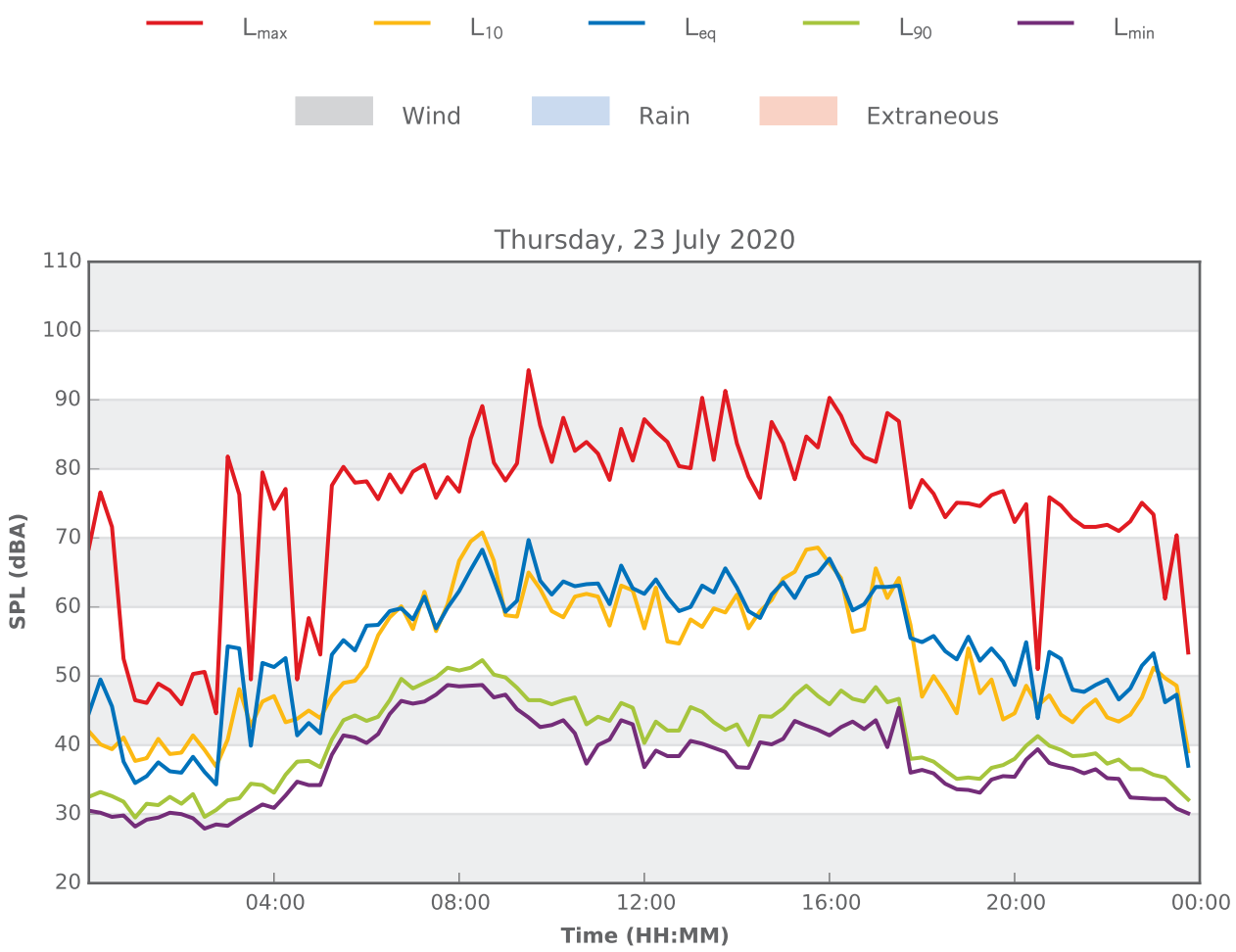

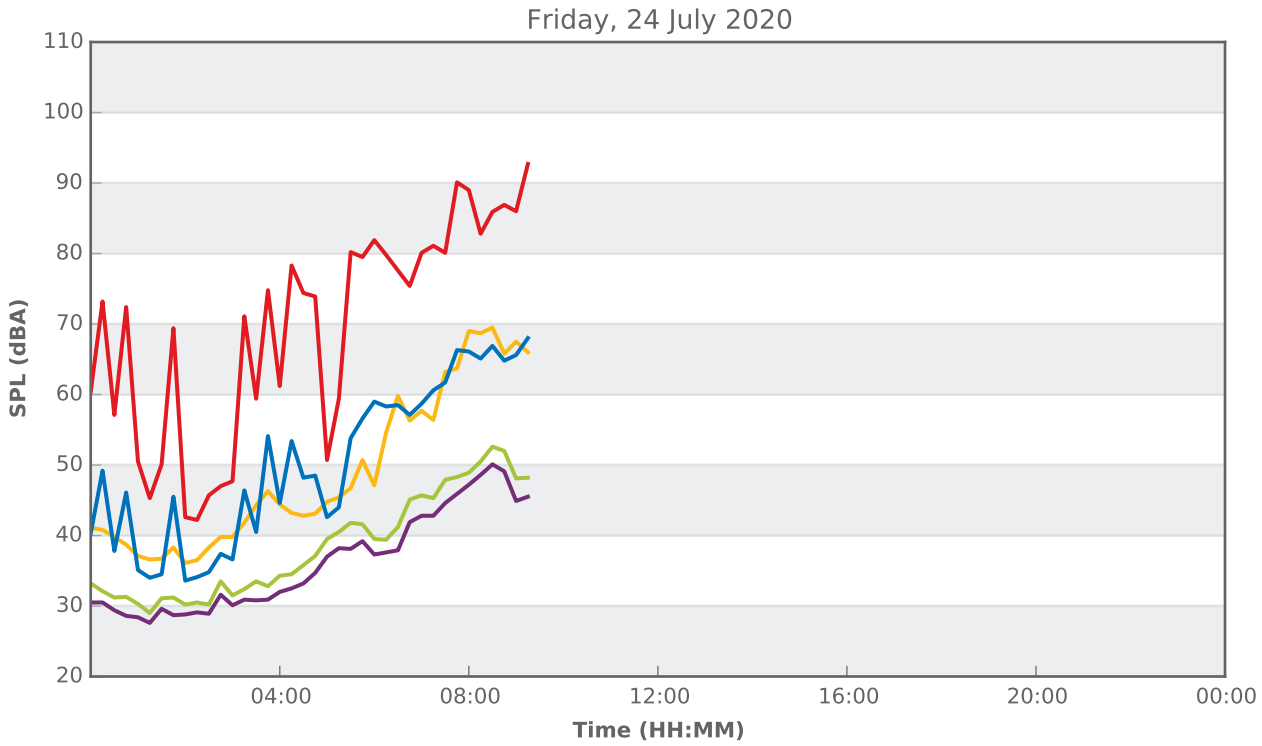

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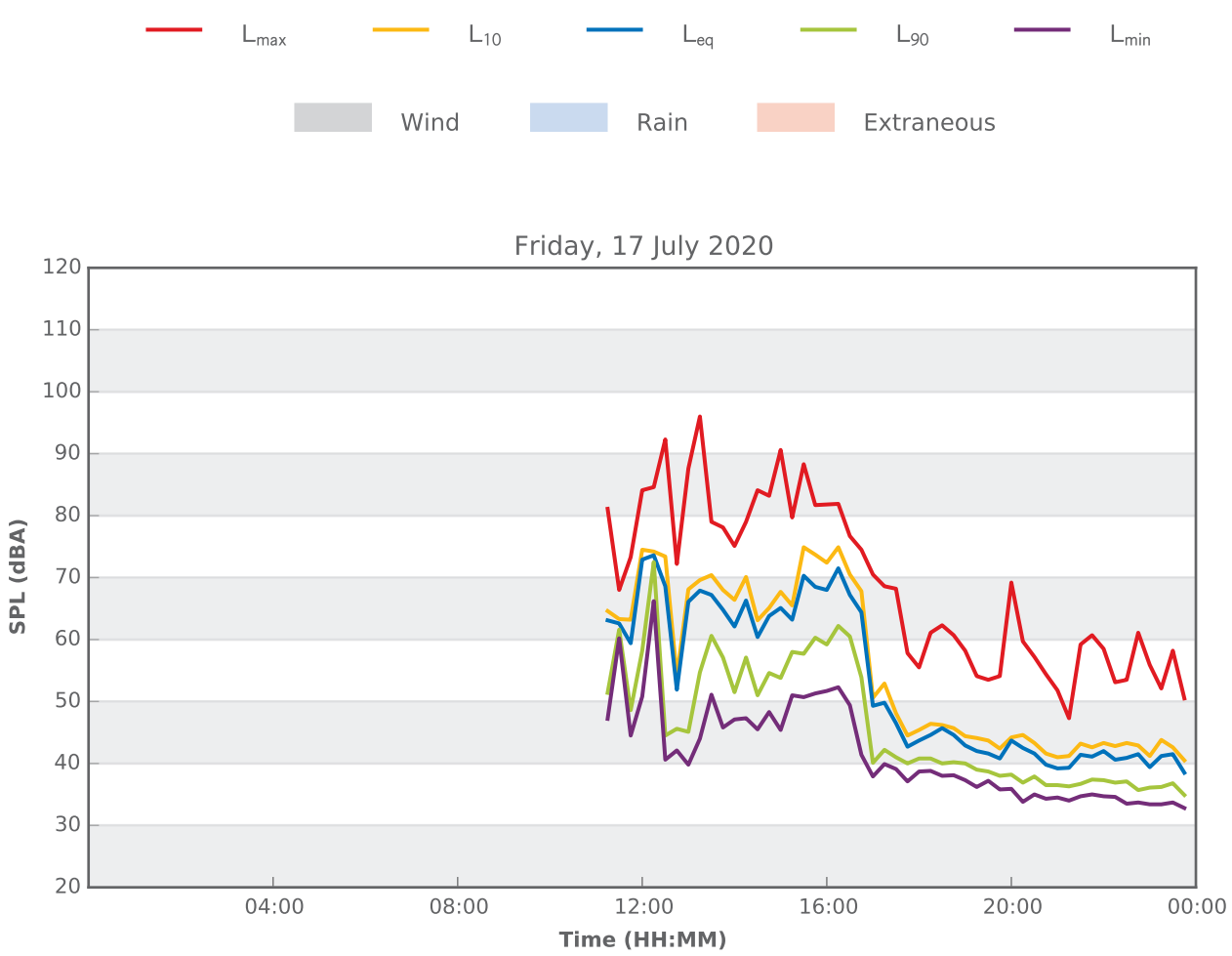

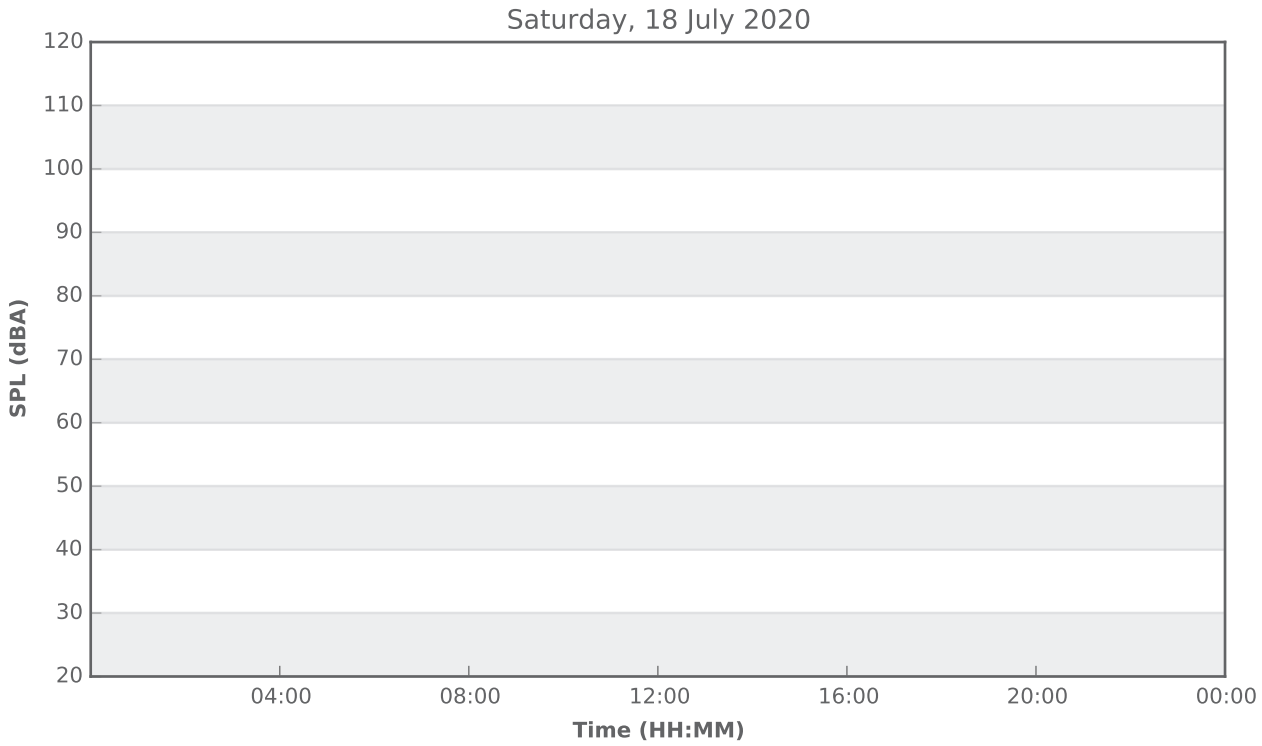

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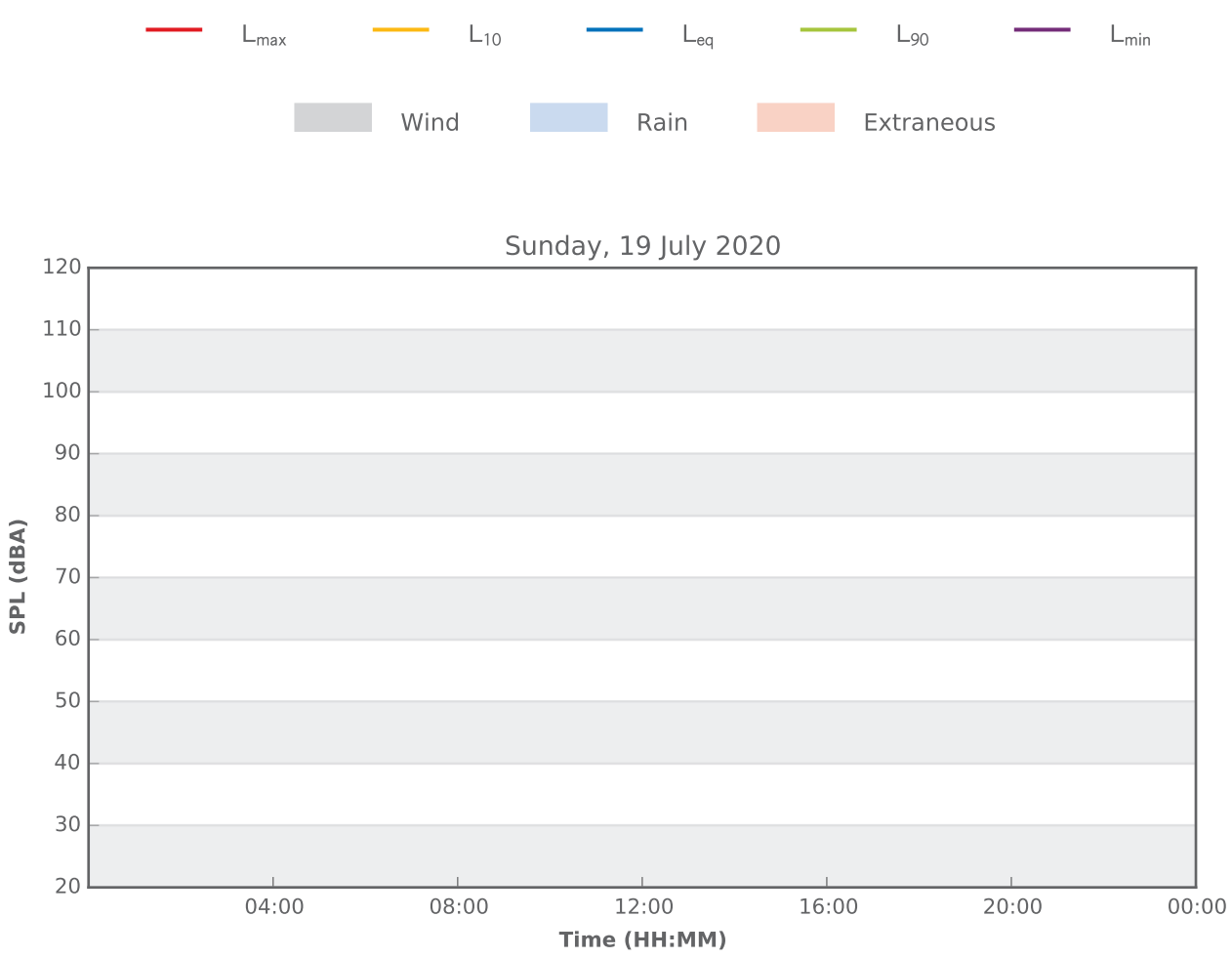

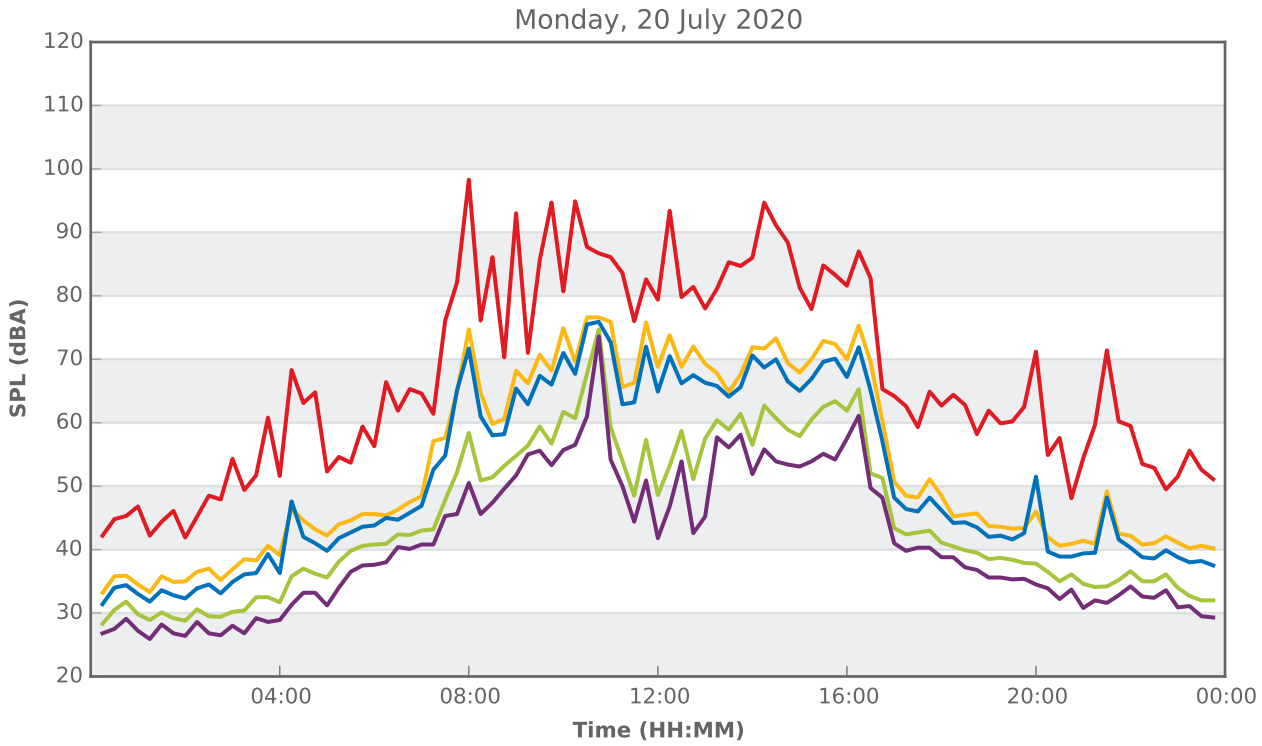

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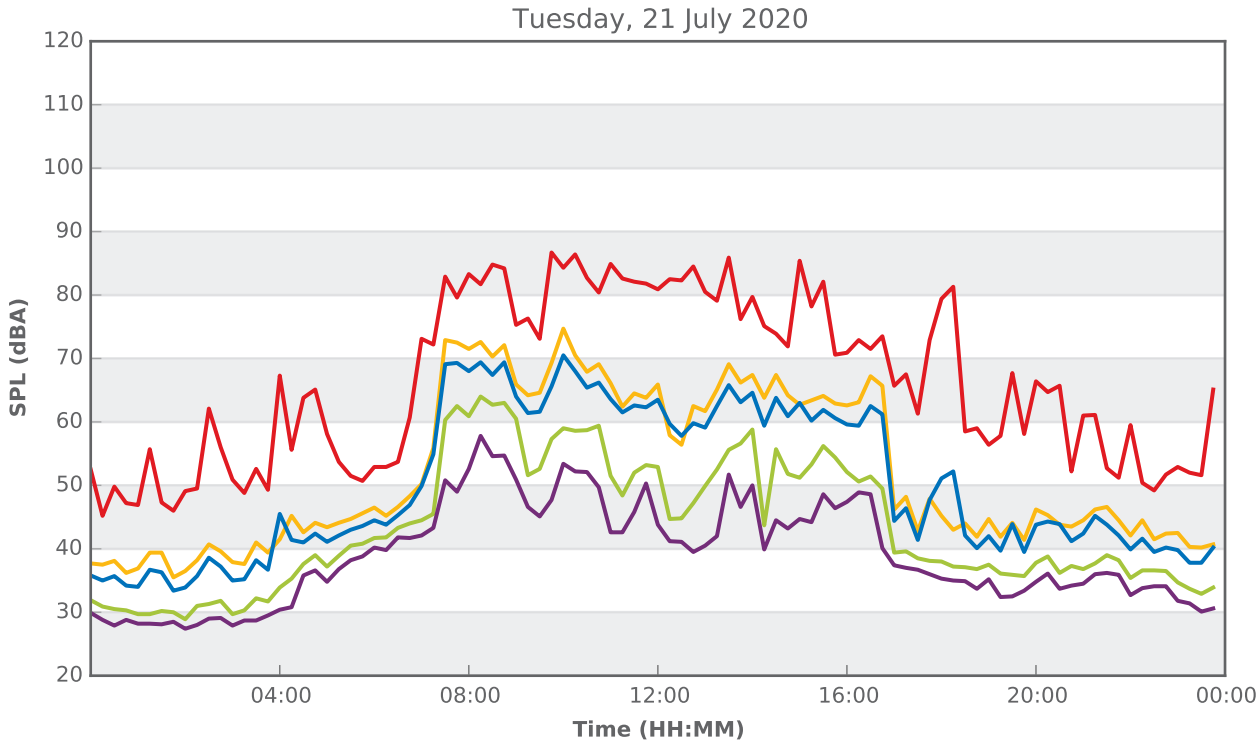

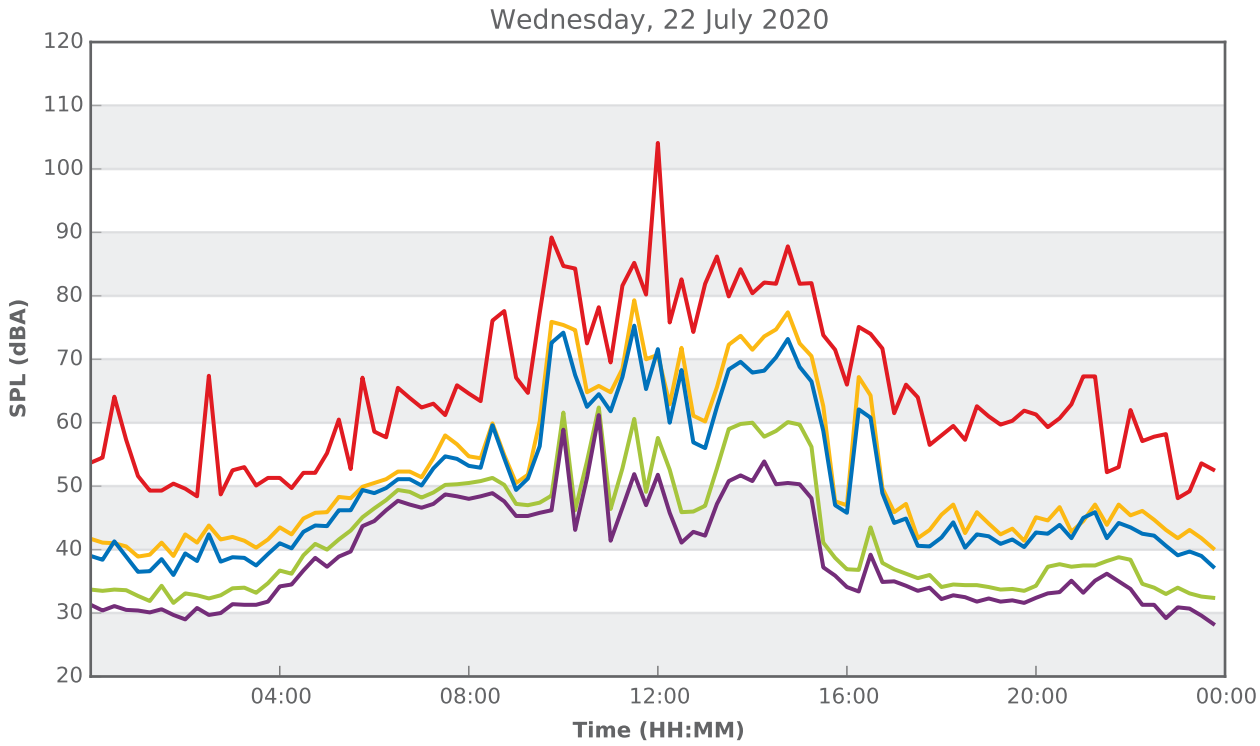

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