5-9 Gordon Avenue, Chatswood

Noise and Vibration Impact Assessment

S220427RP1 Revision 0

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Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
Day	Between 7 am and 10 pm as defined in the Noise NPI
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of loudness.
dB(A)	Units of the A-weighted sound level.
DECCW	Department of Environment, Climate Change and Water NSW
D_W	Weighted Level Difference—the noise level difference or reduction between two enclosed spaces. It quantifies the acoustic separation between two spaces. It relates to the R_W rating of the separating building elements (such as walls and doors) and also includes all noise flanking paths (such as ceiling voids, joins and seals) and the acoustic absorption in the receiving space. The higher the D_W rating the better the acoustic separation.
EPA	NSW Environmental Protection Agency
Evening	Between 6.00 p.m. and 10 p.m. as defined in the INP.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second.
L_{A1}	A-weighted energy noise level exceeded for 1% of the 15 minute interval.
L_{A10}	A-weighted energy noise level exceeded for 10% of the 15 minute interval. Commonly referred to the average maximum noise level.
L_{A90}	A-weighted energy noise level exceeded for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration)
L_{Aeq}	Equivalent Noise Level— A-weighted energy averaged noise level over the measurement time.
$L_{Aeq,\ (15\ min)}$	A-weighted energy averaged noise level over a 15-minute period. Used in the EPA's *Noise Policy for Industry*.
L_{Amax}	The maximum instantaneous A-weighted energy noise level.
$L_{n,w}$	Weighted Normalised Impact Sound Pressure Level—A measure of the noise impact performance of a floor and ceiling. It is a laboratory tested result and is characterised by how much impact sound reaches the receiving room via the floor and ceiling construction from a standard tapping machine test. The lower the $L_{n,w}$ rating the better the impact isolation.
$L_{n,w} + C_I$	A measure of the noise impact performance of a floor and ceiling with a C_I spectrum adaptation to account for foot fall noise.
Nigh-time	Between 10.00 p.m. on one day and 7.00 a.m. on the following day as defined in the NPI.

Noise source	Premises or a place at which an activity is undertaken, or a machine or device is operated, resulting in the emission of noise
NPI	NSW EPA Noise Policy for Industry 2017
RBL	Rating Background Levels: the overall single-figure A-weighted background level representing an assessment period (day/evening/night). For the short-term method, the RBL is simply the measured $L_{90,15min}$ noise level. For the long-term method it is the median value of all measured background levels during the relevant assessment period.
RNP	DECCW NSW Road Noise Policy 2011
R_W	Weighted Sound Reduction Index—A laboratory measured value of the acoustic separation provided by a single building element (such as a partition). The higher the R_W the better the noise isolation provided by a building element.
$R_W + C_{tr}$	A measure of the sound insulation performance of a building element with a C_{tr} spectrum adaptation term placing greater emphasis on the low frequency performance.
Reverberation Time (RT)	Of a room, for a sound of a given frequency or frequency band, the time that would be required for the reverberantly decaying sound pressure level in the room to decrease by 60 decibels.
Sound Power Level (SWL)	The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in *dB(A)*.
Sound Pressure Level (SPL)	The level of noise, usually expressed as SPL in *dB(A)*, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in *dB(A)* gives a close indication of the subjective loudness of the noise.
VDV	Vibration Dose Value – a unit used to measure and describe the amount, or dose, of vibration at a location over a period of time. It relates vibration magnitude to exposure time and is a calculated result that uses measured acceleration values that can be interpolated over a longer period of time.

Table of Contents

1 Introduction

Resonate Consultants (Resonate) has been engaged by LFD Chatswood Pty Ltd to undertake a noise and vibration impact assessment of the proposed mixed-use development (the Project) located at 5-9 Gordon Avenue, Chatswood. This acoustic assessment is based on the Architectural set prepared by FJC Studio (Reference: LFD5G, drawing: WIP Coordination set, dated 21 April 2023) as well as the results of the unattended noise monitoring and attended noise and vibration measurements. The noise and vibration surveys were conducted between the period of 10 March and 21 March, 2023.

This report covers four main aspects of acoustic study:

- Noise intrusion from external noise sources: rail noise from the north shore rail corridor and road traffic noise from Pacific Highway into sensitive internal spaces.
- Vibration intrusion from the adjacent rail corridor: a human comfort vibration study has been conducted to assess the potential for vibration intrusion into proposed residential spaces.
- Internal acoustic requirements in accordance with the Building Code of Australia (BCA) / National Construction Code (NCC).
- Noise emission requirements for mechanical plant items and other stationary noise sources.
- Road traffic noise generation in accordance with the requirements of the NSW Road Noise Policy (RNP).

The main body of this report provides a summary of relevant criteria and acoustic advice. Refer to Section 6 for a summary of advice.

2 Project description

The Project is to be located at 5–9 Gordon Avenue, Chatswood, which would consists of a 27-storey building comprising of a 2-storey commercial/retail podium and 25-storey tower above containing residential apartments and 1 level of common facilities for residents at the base of the tower. The site will be located approximately 650 m south of Chatswood CBD and Chatswood station, adjacent to the North Shore Railway line, and Pacific Highway. Therefore, the site may be subjected to noise and vibration impacts resulting from road traffic noise and from trains passbys.

The current land uses surrounding the site are summarised as follows:

- North: Chatswood Bowling Club and Residential Receivers
- South: Bounded by Gordon Avenue and beyond there are residential and commercial receivers
- East: Residential receivers and the North Shore Railway Line
- West: Bounded by Hammond Lane and beyond there are residential receivers and the Pacific Highway

The nearest and potentially most affected receivers have been identified and are presented in Table 1.

Table 1 Nearby representative affected receivers

Receiver	Address	Type	Direction
R1	1-3 Gordon Avenue, Chatswood	Residential	East
R2	2-8 Gordon Avenue, Chatswood	Residential	South
R3	10 Gordon Avenue, Chatswood	Residential	South
R4	641-653 Pacific Highway, Chatswood	Residential	West
R5	655A Pacific Highway, Chatswood	Residential	Northwest
C1	Chatswood Bowling Club: 655A Pacific Highway, Chatswood	Commercial	North
C2	Payless Tyres & Brakes: 639 Pacific Highway, Chatswood	Commercial	Southwest

The project site is shown in the context of the surrounding environment, and acoustically significant site features are identified in Figure 1.

Figure 1 – Proposed project site in context

3 Existing acoustic environment

3.1 Unattended noise monitoring

To characterise the existing acoustical environment of the study area, unattended noise monitoring was conducted between the period of 10 March and 21 March 2023 on the project site as shown in Figure 1 and described below:

- UM01: Noise intrusion (road traffic and rail noise) logging on the balcony of Unit 12.This location was selected as it had line of sight of Pacific Highway and the North Shore rail line with both noise sources being clearly audible at the monitoring location.
- UM02: Background noise monitoring on the ground floor (east) of the site.

Monitor locations were selected with consideration to other noise sources which may influence readings, security issues for noise monitoring equipment and gaining permission for access from landowners.

Instrumentation for the survey comprised of two Rion NL-42 Type 2 environmental noise loggers with serial numbers 00946981 (UN01) and 00946983 (UN02) fitted with microphone windshields. Calibration of the loggers were checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dB(A). All equipment carried appropriate and current NATA (or manufacturer) calibration certificates. Measured data has been filtered to remove data measured during adverse weather conditions upon consultation with historical weather reports provided by the Bureau of Meteorology (BOM). The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10}, L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions).

Table 2 below presents the Rating Background Level (RBL) and average total noise level for the surrounding environment of Logger 1. These noise levels were used to establish the relevant noise criteria in accordance with the NSW EPA *Noise Policy for Industry* (NPI) 2017.

Table 2 Measured noise levels at background noise logging location (UN02)

Description	Noise Level during Period – dB(A)		
	Daytime 07:00 – 18:00	Evening 18:00 – 22:00	Night-time 22:00 – 07:00
Rating background level (L_{A90})	44	43	37

An additional logger location identified as 'UN01'' (see Figure 1) has been used to establish road traffic and rail noise levels incident upon the proposed facades of the Project. Noise levels were measured and calculated back to the proposed facade locations using acoustic modelling software SoundPLAN v8.2. The measured data has been processed to determine energy average noise (L_{Aeq}) levels during each of the following periods:

- Daytime (7 am to 10 pm);
- Night-time (10 pm to 7 am); and
- The highest one hour in each of these periods.

Table 3 Measured noise levels at noise traffic noise logging location (UN01)

Location	Noise Level during Period – dB(A)			
	Daytime (15 hour) 07:00 – 22:00	Daytime (1 hour) 07:00 – 22:00	Night-time (9 hour) 22:00 – 07:00	Night-time (1 hour) 22:00 – 07:00
Ambient noise level (L_{Aeq})	56	57	54	56

A detailed summary of the noise survey is provided in Appendix A and daily noise logging graphs are presented in Appendix B.

3.2 Attended noise measurements

Operator attended noise measurements were conducted at the noise logging locations and near pacific highway on 10 March and 21 March 2023. Instrumentation for the surveys comprised of a Brüel and Kjaer (serial number 3028219) and Rion NL-52 (serial number 820994) sound level meter with both fitted with a microphone windshield.

Pre and post calibration measurement reference signals were applied with no shift recorded. The instrument set is within manufacturers' calibration (calibration certification can be provided upon request). Meteorological conditions during the attended noise measurements were observed to be satisfactory, with calm conditions determined to not have an adverse effect or influence on measured noise levels.

The results of the attended measurements are presented in **Error! Reference source not found.**.

Table 4 Operator attended noise measurements

Location(1)	Date	Start and end time	Measured noise levels, dB(A)(1)			
			L_{max}	L_{eq}	L_{10}	L_{90}
AN01 – balcony of Unit 12 at 5-9 Gordon Avenue, Chatswood	21/03/2022	03:56 pm to 04:11 pm	78	51	53	45
AN02 – east boundary of 5-9 Gordon Avenue, Chatswood	10/03/2022	10:07 am to 10:22 am	69	55	58	49
AN03 – Pacific Highway (3m from the kerb)	10/03/2022	09:34 am to 09:49 am	80	72	75	66

(1) Measurement locations are shown in Figure 1.

(2) All values expressed as dB(A) and rounded off to nearest 1 dB(A).

4 Criteria

4.1 Willoughby Development Control Plan

Willoughby Council's *Willoughby Development Control Plan* (DCP) provides some guidance with regard to acoustic amenity. Part E 3.7 of the DCP, specifically Section 6 'Amenity' provides the following guidance:

> ***Performance Criteria***
>
> - *Ensure visual and acoustic privacy of residential units in the development and adjoining properties.*
>
> ***Controls***
>
> - *A detailed Acoustic Assessment shall be submitted at Development Application Stage.*
> - *Residential units shall be designed to maximise solar access, cross ventilation, visual and acoustic privacy.*

The DCP does not specify quantitative requirements to assess mix-used residential type developments.

4.2 Road and rail noise intrusion

Due to transport noise levels measured on site and the Project proximity to the Pacific Highway and North Shore Rail Line it is appropriate to establish noise intrusion criteria to safeguard the internal residential acoustic amenity in accordance with the requirements of the State Environmental Planning Policy (Transport and Infrastructure) 2021 ('Transport and Infrastructure SEPP').

The NSW Department of Planning (DoP) in their document titled *Development Near Rail Corridors and Busy Roads–Interim Guideline* (DNRCBR) outlines a summary of internal noise level criteria to satisfy the requirements of the Transport and Infrastructure SEPP.

A summary of the internal noise level criteria outlined in the DNRCBR is presented in Table 5. It is noted in the DNRCBR that:

- Airborne noise levels are calculated as $L_{eq\ (15\ hour)}$ for the day time period and $L_{eq\ (9\ hour)}$ for the night time period.
- When the "windows open" noise levels are excessive, which is defined as when the "windows open" noise level exceeds the "windows closed" criterion by more than 10 dB(A), the occupants should be able to *"leave their windows closed, if they so desire, and also meet the ventilation requirements of the Building Code of Australia (BCA).* Therefore, where the open windows noise levels are excessive, a supplementary form of ventilation (in addition to natural ventilation) should be provided to meet the intent of DNRCBR.
- Guidance on internal noise levels may be obtained from the Australian Standard (AS) 2107:2016: Acoustics – recommended design sound levels and reverberation times for building interiors design sound levels

Table 5 Noise intrusion criteria

Type of occupancy/activity	Recommended design sound level (dB L_{Aeq})	Time period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excluding garages, kitchens, bathrooms and hallways)	40	At any time
Retail/commercial	50	When in use

4.3 Rail vibration intrusion

As described in Section 3.6.3 of the DNRCBR and due to the Project's proximity to an active rail corridor, vibration levels such as the intermittent vibration emitted by trains should comply with the criteria in *Assessing Vibration, A Technical Guideline DECC 2006*. Acceptable levels of intermittent vibration exposure are dependent on the time of day and duration of vibration, and are determined by the *Vibration Dose Value* (VDV) as described in *BS 6472-1992*. Acceptable values of vibration dose in residential areas are presented in Table 6.

Table 6 VDV criteria for residential type buildings - Assessing Vibration: a technical guideline

Location	Acceptable VDV for intermittent vibration ($m/s^{1.75}$)			
	Daytime (07:00 – 20:00)		Night-time (20:00 – 07:00)	
	Preferred	Maximum	Preferred	Maximum
Residences	0.2	0.4	0.13	0.26

(1) Daytime is specified as the period between 07:00 and 22:00. Night-time is specified as the period between 22:00 and 07:00.

4.4 Mechanical noise emission

Noise emissions from the site when operational should comply with the requirements of the NSW *EPA Noise Policy for Industry* (NPI, 2017).

The NPI sets two separate noise criteria to meet desirable environmental outcomes:

- Intrusiveness – steady-state noise from the site should be controlled to no more than 5 dB(A) above the background noise level in the area. In this case, the steady-state L_{eq} noise level should not exceed the background noise level measured for different time periods in the environment.
- Amenity – amenity criteria are set based on the land use of an area. It requires noise levels from new industrial noise sources to consider the existing industrial noise level such that the cumulative effect of multiple sources does not produce noise levels that would significantly exceed the amenity criteria.

Based upon an unattended noise survey summarised in Appendix A and the surrounding receivers from the project site, the project specific mechanical services noise emission criteria are provided in Table 7.

Table 7 Mechanical services noise emission criteria

Receiver	Assessment period	Project noise trigger level, dB(A) $L_{eq\ (15minute)}$
Residential premises	Daytime	**49**
	Evening	**48**
	Night	**42**
Commercial premises	When in use	**63**

Refer to Appendix A for further information on the derivation of the noise emission criteria.

4.4.1 Potential for sleep disturbance

In addition to the above, the NPI provides an assessment procedure for assessing the potential for sleep disturbances from maximum noise level events generated at the project site during the night time period (i.e. between 10:00 pm and 7:00 am). The term “sleep disturbance” is considered to be both awakenings and disturbance to sleep stages.

As recommended in Section 2.5 of the NPI, to assess the potential for sleep disturbances, two-stages are recommended to be carried out:

- Step 1 – Where the subject site/premises night-time noise levels at a residential location do not exceed the following then no mitigation is required to prevent sleep disturbances from the project:
  - $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
  - L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is greater,

From the above the average/maximum noise trigger levels have been determined for the Project and are presented below in Table 8. If the noise trigger levels are exceeded, then ‘Step 2’ which involves a detailed maximum noise level event assessment would be required.

Table 8 Project specific sleep disturbance noise trigger levels

Receiver	Night time rating background noise level, dB(A) $L_{90, (period)}$	Sleep disturbance noise trigger levels, dB(A)	
		$L_{eq\ (15\ minute)}$	L_{Fmax}
Residential premises	37	42	52

- Step 2 – A detailed maximum noise level event assessment is to be undertaken when the average/maximum noise trigger levels are exceeded and should cover the maximum noise level, the extent the maximum noise levels exceeds the RBL, and the number of occurrences during the night time period. As is recommended in the explanatory notes of the NPI, this more detailed sleep disturbance assessment is conducted using the current sleep disturbance research detailed in the EPA Road Noise Policy (RNP). The RNP sleep disturbance research concludes that:
  - Maximum internal noise levels below 50-55 dB(A) are unlikely to awaken people from sleep
  - One to two noise events per night with maximum internal noise levels of 60-75 dB(A) are not likely to affect health and wellbeing significantly.

4.5 Road traffic noise generation

The NSW Road Noise Policy (RNP) provides guidance, criteria and procedures for assessing noise impacts from existing, new and redeveloped roads and traffic generating developments. The assessment of road traffic noise impacts on public roads is assessed under the RNP.

The RNP details a number of noise assessment criteria for various road categories and land uses. Road access to the facility will be via Pacific Highway and Gordon Avenue. In the RNP, the Pacific Highway is classified as a freeway while Gordon Avenue road would be classified as a local road.

The Application Notes for the RNP states that:

> ‘For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.’

If road traffic noise during the Project operation is within 2 dB(A) of current levels, then the objectives of the RNP are met and no specific mitigation measures are required. Where the road traffic noise during the Project operation levels exceeds 2 dB(A) of current levels than the consideration should be given to the actual noise levels associated with the Projects operation road traffic and whether or not these levels comply with the RNP criteria as presented in Table 9.

Table 9 RNP residential road traffic noise criteria

Road category	Type of project/land use	Assessment criteria, dB(A)	
		Day 7:00 am – 10:00 pm	Night 10:00 pm – 7:00 am
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,\ (15\ hour)}$ 60 (external)[1]	$L_{Aeq,\ (9\ hour)}$ 55 (external)[1]
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{Aeq,\ (1\ hour)}$ 55 (external)[1]	$L_{Aeq,\ (1\ hour)}$ 50 (external)[1]

(1) The assessment criteria for external noise levels apply at 1 metre from the facade of any affected residential receiver.

4.6 Internal Acoustic Separation

The Project is classified as Class 2 under the BCA. Class 2 buildings must achieve the objectives outlined in Part F5 of the BCA *Sound Transmission and Insulation*. The acoustic requirements applicable to this Project are outlined in Table 10.

Table 10 BCA requirements for Class 2 and 3 buildings

Building element	Description	Impact noise requirements	Airborne noise criteria
Floors	Separating sole-occupancy units, or separating sole-occupancy units from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or a part of a different classification.	$L_{n,w} \leq 62$	$R_w + C_{tr} \geq 50$
Walls	Separating sole occupancy units.	—	$R_w + C_{tr} \geq 50$
	Separating a habitable room of a sole occupancy unit from a bathroom, sanitary compartment, laundry or kitchen in an adjacent sole occupancy unit.	Discontinuous construction(1)	$R_w + C_{tr} \geq 50$
	Separating a sole occupancy unit from a stairway, public corridor, public lobby or the like, or a parts of a different classification.	—	$R_w \geq 50$
	Separating a sole occupancy unit from a plant room or lift shaft.	Discontinuous construction(1)	$R_w \geq 50$
	A door between a sole occupancy unit and a stairway, public corridor, lobby or the like.	—	$R_w \geq 30$

Building element	Description	Impact noise requirements	Airborne noise criteria
Ducts, water supply, waste and soil pipes	A duct, soil, waste or water supply pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a habitable room (other than a kitchen)	—	$R_w + C_{tr} \geq 40$
	A duct, soil, waste or water supply pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a kitchen or any other room.	—	$R_w + C_{tr} \geq 25$
Stormwater pipes	If a storm water pipe passes through a habitable room (other than a kitchen).	—	$R_w + C_{tr} \geq 40$
	If a storm water pipe passes through a kitchen or any other room.	—	$R_w + C_{tr} \geq 25$
Services	A duct, soil, waste, water supply pipe and stormwater pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a habitable room (other than a kitchen(2))	—	$R_w + C_{tr} \geq 40$
	A duct, soil, waste, water supply pipe and stormwater pipe located in a wall or floor cavity, serves or passes through more than one sole occupancy unit if the adjacent room is a kitchen(2) or any other room.	—	$R_w + C_{tr} \geq 25$
Pumps	The point of connection between the service pipes in a building and any circulating or other pump.	A flexible coupling at the connection	—

(1) Discontinuous construction is defined such that walls are to have a minimum 20 mm gap between separate leaves. Cavity masonry walls are to have resilient wall ties or no wall ties. For other walls there are to be no mechanical linkages between wall leaves except at the wall periphery. A staggered stud wall is not deemed to be discontinuous.

(2) If the kitchen is open to the living area, the $R_W + C_{tr} \geq 40$ criterion is applicable rather than the $R_W + C_{tr} \geq 25$ criterion.

A wall that is required to have sound insulation is to continue to the underside of the floor or roof above. Alternatively, a ceiling that is adjacent to walls must be acoustically treated such that the sound isolation provided by the wall is not degraded.

5 Noise and vibration assessment

5.1 Road and rail noise intrusion

The daytime and night-time road traffic and rail noise levels at the Project's facades have been determined with a 3D noise model within the SoundPLAN v8.2 software package validated by the results of the noise measurements (see Section 5.1.1). The predicted façade noise levels at the Project calculated within the noise model are presented in Appendix C.

The SoundPLAN 3D noise model is depicted in Figure 2.

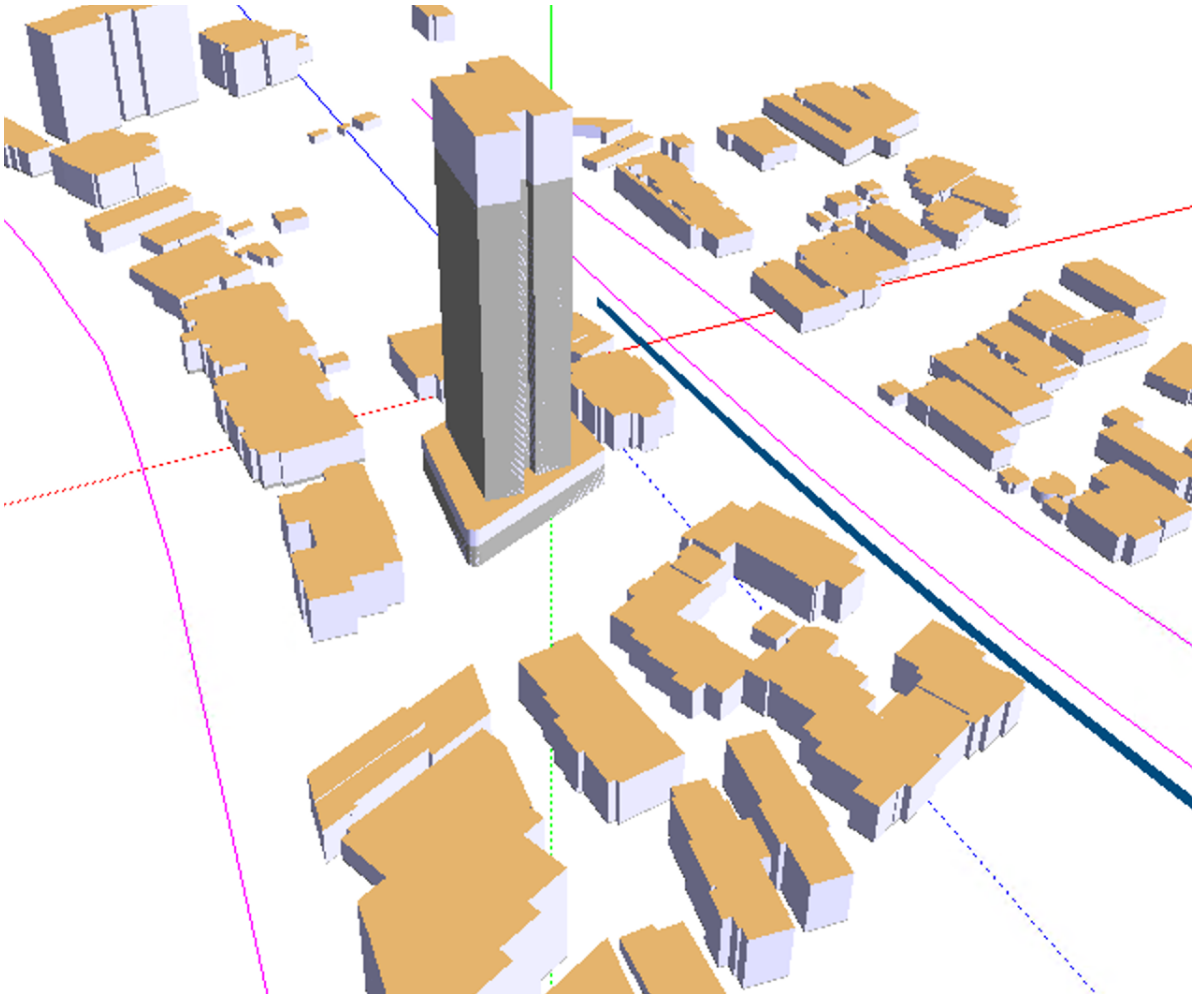


Figure 2 SoundPLAN 3D noise model

5.1.1 Noise model validation

A noise model of the proposal and surrounding area was developed based on the existing road alignments, rail corridor, and buildings as shown in Section 5.1.2. The predicted noise levels were compared to measured noise levels at the unattended noise monitoring and attended noise measurement locations with the results presented in Table 11.

This comparison was undertaken to confirm the noise sources within the noise model representing Pacific Highway and the North Shore rail corridor impacting the project site were modelled appropriately.

The following measurements and locations were chosen to validate the noise sources within the noise model:

- UN01 – having direct line of sight of Pacific Highway and North Shore rail corridor.
- AN03 – having direct line of sight of Pacific Highway.

Table 11 Road traffic and rail corridor noise model validation

Location(1)	Daytime road noise level, dB(A)(2)			Night-time road noise level, dB(A)(2)		
	Measured	Predicted	Difference	Measured	Predicted	Difference
UN01	57(3)	58	1	56(3)	57	1
AN03	72	72	0	-	-	-

(1) Measurement locations are shown in Figure 1.

(2) All values expressed as dB(A) and rounded off to nearest 1 dB(A).

(3) The highest one hour in each of the day and night periods was used.

The predicted and measured noise levels are within a tolerance of ±2 dB, which is considered a suitable level of accuracy for road traffic and rail noise models. Due to the good correlation between the measured and predicted noise levels, no additional calibration factors were required.

5.1.2 Noise modelling parameters

The parameters adopted in the noise modelling are presented in Table 12 below.

Table 12 Operational noise modelling parameters

Parameter	Noise model
Buildings	• Footprints taken from aerial photography • Typical building heights have been estimated from Google Street-view and site inspections as follows: per floor 3 m, pitched roof 3 metre • Number of floors taken from Google Street-view and site inspections • Project's site buildings have been incorporated from development plans.
Terrain	1 metre ground contours from NSW Spatial Services.
Noise wall	The existing noise wall along North Shore rail line to the east of the project site has been included in the noise model.
Ground surface / absorption	Ground coverage in the study area has been assumed to be 0.6 ground absorption for built up areas.
Receivers	Surrounding buildings have been digitised into the model. Ground floor receivers have been placed at an elevation of 1.5 m and first floor receivers at an elevation of 4.5 m or as adjusted for elevated ground floor situations based on site observations.
Sources	Pacific Highway and North Shore rail line (line source).
SoundPLAN module	ISO 9613-2: 1996
Noise results	A façade noise map for the proposed building on site.

Parameter	Noise model
Model validation	Refer to validation against measured data in Section 5.1.1.

5.1.3 Recommended glazing requirements

Glazing is typically the acoustic weak link in most facades. Consequently, the façade noise levels presented in Section 5.1 have been used to calculate required glazing types to ensure internal noise levels in residential spaces are compliant with the internal noise level criteria presented in Section 4.1.

In order to undertake these calculations, conceptual architectural drawings have been used as guidance in conjunction with the noise modelling. The following assumptions were used to inform the noise modelling:

- Predicted noise levels determined in the SoundPLAN noise model are presented in Appendix C.
- Habitable spaces have a mid-frequency reverberation time of approximately 0.7 seconds, and bedrooms have a mid-frequency reverberation time of approximately 0.5 seconds
- It is recommended that external noise intrusion should be designed to 3 dB(A) below the relevant internal noise criterion to allow a contribution from other steady-state noise sources (e.g. air conditioning).
- The external elements for new constructions should have a sound insulation rating (R_W) 50 or greater.

Any deviation from the above assumptions or changes to architectural drawings may alter the outcome of internal noise levels.

Table 13 presents the required acoustic performance for all glazed elements. These suggested glazing performances may change for typical room sizes or for glazed areas that are substantially different and if rooms are not carpeted as assumed. It is recommended that further acoustical modelling should be undertaken at the detailed design stage once development approval is granted to optimise glazing selections and the ventilation strategy.

Table 13 Glazing requirements

Floor	Unit reference	Room type	Facade	Glazing requirements (R_W)
Ground	-	Retail areas	All	R_W 30
Level 1	-	Commercial areas	All	R_W 30
Level 2	0201	Living room	All	R_W 30
		Bedroom	All	R_W 30
Level 3	0301	Living room	All	R_W 30
		Bedroom	West	R_W 35
			Remaining	R_W 30
	0302	Living room	All	R_W 30
		Bedroom	All	R_W 30
	0303	Living room	All	R_W 30
		Bedroom	All	R_W 30
Level 4	0401	Living room	All	R_W 35
		Bedroom	All	R_W 35
Level 4	0402	Living room	North	R_W 35

Floor	Unit reference	Room type	Facade	Glazing requirements (R_W)
			Remaining	R_W 30
		Bedroom	All	R_W 30
	0403	Living room	All	R_W 30
		Bedroom	All	R_W 30
Level 5	0501	Living room	All	R_W 35
		Bedroom	All	R_W 35
	0502	Living room	North	R_W 35
			Remaining	R_W 30
		Bedroom	All	R_W 30
	0503	Living room	All	R_W 30
		Bedroom	All	R_W 30
Level 6	0601	Living room	All	R_W 35
		Bedroom	All	R_W 35
	0602	Living room	North	R_W 35
			Remaining	R_W 30
		Bedroom	All	R_W 30
	0603	Living room	All	R_W 30
		Bedroom	All	R_W 30
Level 7	0701	Living room	All	R_W 35
		Bedroom	All	R_W 35
	0702	Living room	North	R_W 35
			Remaining	R_W 30
		Bedroom	North	R_W 35
			Remaining	R_W 30
	0703	Living room	All	R_W 30
		Bedroom	All	R_W 30
Level 8	0801	Living room	All	R_W 35
		Bedroom	All	R_W 35
	0802	Living room	All	R_W 35
		Bedroom	North	R_W 40
			Remaining	R_W 30
Level 8	0803	Living room	All	R_W 30

Floor	Unit reference	Room type	Facade	Glazing requirements (R_W)
		Bedroom	All	R_W 30
Level 21	2101	Living room	All	R_W 35
		Bedroom	All	R_W 35
	2102	Living room	All	R_W 35
		Bedroom	All	R_W 40
	2103	Living room	All	R_W 30
		Bedroom	South	R_W 35
			Remaining	R_W 30
Level 22	2201	Living room	All	R_W 35
		Bedroom	All	R_W 40
	2202	Living room	North	R_W 35
			Remaining	R_W 30
		Bedroom	South	R_W 35
			Remaining	R_W 30
Level 24	2401	Living room	North	R_W 35
			West	R_W 35
			Remaining	R_W 30
		Bedroom	All	R_W 35
Level 25	2501	Living room	North	R_W 35
			West	R_W 35
			Remaining	R_W 30
		Bedroom	All	R_W 35

The sound insulation performances specified in Table 13 apply to the entire glazed window/door system which includes the glass, frame and seals. Thermal or other non-acoustic considerations may determine glazing requirements of a higher standard than those stated above, and the final glazing system selection should be coordinated with the needs of other disciplines. Typical glazing constructions are presented in Table 8, however, acoustic performances should be confirmed by the window/door supplier to ensure compliance will be met.

Table 14 Typical glazing constructions

Sound insulation rating (R_W)	Typical glazing construction
R_W 30	• 6.38 mm laminate glazing • Aluminium frame • Compressible rubber perimeter seals • Sliding doors to have acoustic seals on the door perimeter, jamb and interlock
R_W 35	• 10.38 mm laminate glazing • Aluminium frame • Compressible rubber perimeter seals • Sliding doors to have acoustic seals on the door perimeter, jamb and interlock
R_W 40	• 6.38 mm laminated glass / 15 mm air gap / 10.38 mm laminated glass, OR proprietary glazing system 12.5 mm VLam Hush glazing • Aluminium frame • Compressible rubber perimeter seals • Proprietary sliding door system with acoustic seals on the door perimeter, jamb and interlock

5.1.4 Ventilation

It is commonly accepted that a window that is partially open to allow for natural ventilation to a room would provide a 10 dB(A) noise reduction from outside to inside. On this basis, internal noise levels in all of the proposed residential spaces will exceed the internal noise criteria specified in Section 4.2 Consequently, windows must be closed to ensure internal noise criteria can be satisfied. It is therefore recommended that an alternative means of ventilation is required to be provided for all Sole Occupancy Units.

An alternative means of ventilation may take the form of:

- Air conditioning with an outside/fresh air component (not a conventional 'split' system).
- Mechanical ventilation drawn from a 'quiet' side of the building and/or with an acoustically attenuated intake path.
- Proprietary acoustically treated ventilation intakes such as 'SilenceAir', with air drawn through by the operation of the apartment's own toilet exhaust fan or another fan to a mechanical engineer's design.

5.2 Railway vibration intrusion

Vertical vibration velocity measurements were carried out on 21 March 2023 using a calibrated Brüel and Kjaer 2250 sound level meter (serial number 3028219) with a low frequency vibration module setup. A Wilcoxon 731-207 accelerometer (serial number: 992) with a nominal sensitivity 10 V/g.

The measurement location was on the ground level at the south eastern boundary of the project site, which is considered to be representative of the proposed nearest residential façade to the rail corridor.

The results of the attended vibration measurements, expressed as vibration dose values (VDV) are summarised in Table 15.

Table 15 Measured rail vibration levels

Location[(1)]	Date	Time	VDV m/s
AV01 – south eastern site boundary of project site	21/03/2023	3:14 pm	0.03
		3:18 pm	0.03
		3:22 pm	0.02
		3:31 pm	0.04
		3:34 pm	0.03
		3:41 pm	0.04
		3:49 pm	0.03
		3:52 pm	0.03
		3:56 pm	0.03
		4:00 pm	0.03

(1) Measurement locations are shown in Figure 1.

VDVs for both the 15-hour day and 9-hour night periods as specified in *"Assessing Vibration: a technical guideline"* were calculated using the 95th percentile vibration level from the train pass-bys measured on site. It should be noted the estimated vibration dose values (eVDVs) calculated in accordance with BS6472-1:2008 as a screening method. Calculated eVDV results are compared against the specified vibration criteria in Table 16.

The following train pass-by assumptions have been used to predict the rail vibration dose values:

- An estimated 357 train pass-bys occur during daytime hours and 95 passenger train pass-bys occur during night-time hours.

Table 16 Assessment of vibration dose values in accordance with BS 6472

Time Period	Calculated Vibration Dose (eVDV) m/s1.75	Criteria $m/s^{1.75}$		Compliance (Yes / No)
		Preferred	Maximum	
Daytime	0.02	0.2	0.40	Yes
Night-time	0.02	0.13	0.26	Yes

(1) Daytime is specified as the period between 07:00 and 22:00. Night-time is specified as the period between 22:00 and 07:00.

The predicted eVDVs comply with the established criteria.

Whilst the eVDVs are predicted to be less than the criteria, it is possible that individual train passbys would be perceptible with the classrooms on occasion.

Based on this vibration impact assessment, rail vibration mitigation measures will not be required for the proposed development.

5.3 Internal acoustic separation

5.3.1 Walls

Wall constructions have not been designed at this stage. Table 10 shall be referred to during the detailed design stage in order to ensure compliance with the BCA internal acoustic separation requirements.

It should be noted that when a kitchen and living room are contained in the same space in these units, separating elements should have an acoustic rating of $R_W + C_{tr} \geq 50$ and be of discontinuous construction. Some example wall constructions are presented in Table 17.

Table 17 Proposed wall types

Proposed wall construction	Nominated area	Criteria
Steel studs		
• Steel stud with resilient acoustic mount OR staggered steel studs • 2x13 mm fire rated plasterboard to both sides (minimum 10.5 kg/m^2) • Minimum 150 mm cavity • 75 mm, 14 kg/m^3 polyester insulation in the partition cavity	Between apartments (habitable areas)	$R_w + C_{tr} \geq 50$
• Two rows of 64 mm steel studs with minimum 20 mm gap between stud faces • 2x13 mm fire rated plasterboard to both sides (minimum 10.5 kg/m^2) • Minimum 148 mm cavity • 75 mm, 14 kg/m^3 polyester insulation in the partition cavity.	Between apartments—wet area to habitable area	$R_w + C_{tr} \geq 50$ & discontinuous
• 64 mm steel stud • 2x13 mm fire rated plasterboard to both sides • 50 mm, 14 kg/m^3 polyester insulation in the partition cavity	Apartment to stairway, public corridor, public lobby or the like, or a parts of a different classification.	$R_W \geq 50$
• Two rows of 64 mm steel studs with minimum 20 mm gap between stud faces • 1x13 mm fire rated plasterboard to both sides (minimum 10.5 kg/m^2) • Minimum 148 mm cavity • 50 mm, 14 kg/m^3 polyester insulation in the partition cavity. OR • Lift core • Row of 64 mm steel studs set 20 mm from lift core • 1x13 mm fire rated plasterboard to studs (minimum 10.5 kg/m^2) • 50 mm, 14 kg/m^3 polyester insulation in the partition cavity.	Apartment to lift core & plant room	$R_W \geq 50$ and Discontinuous construction

The proposed wall constructions will meet the requirements of the BCA/NCC if the walls are extended full height, past the ceiling to the underside of the slab or roof deck above.

5.3.2 Sole occupancy unit entry doors

Sole Occupancy Unit doors are to have a R_W 30 rating, in accordance with BCA requirements, which can be achieved with the following or equivalent construction:

- 40 mm thick solid core door
- high quality rubber contact seals for the head and the jambs acoustically equivalent to Kilargo IS7095si or Raven RP24
- dropdown seal at the bottom acoustically equivalent to Kilargo IS8090si or Raven RP38.

5.3.3 Floors and ceilings

The BCA/NCC airborne sound insulation requirement of the separating floors is achieved with a minimum 180 mm thick concrete slab.

Impact sound insulation between floors such as footfall is strongly dependent on the floor finishes. The following floor/ceiling systems are recommended:

- flooring:
  - direct stick timber with acoustic underlay
  - carpet in bedrooms
  - tiles in bathrooms
- 200 mm concrete slab
- 120 mm ceiling cavity
- 13 mm plasterboard ceiling on a suspended light grid system

To improve the impact and airborne noise through this system, we recommend including 50 mm glasswool insulation in the ceiling cavity in all rooms (including bathrooms, kitchens & laundry's) of the sole occupancy units with a minimum density of 14 kg/m^3. Alternatively, approved acoustic underlay could be used for all hard floor finishes of the sole occupancy units.

With either floor or ceiling treatment the floor/ceiling system will meet both the airborne noise requirement of $R_w + C_{tr} \geq 50$ and the impact noise required of $L_{n,w} \leq 62$.

5.3.4 Services

The following service systems are required to be acoustically treated under the BCA/NCC, if they serve or pass through more than one tenancy:

- mechanical services ducts
- soil pipes
- waste pipes
- water supply pipes.

In addition, all stormwater pipes passing through a sole occupancy unit must be acoustically treated.

The required acoustic treatments for services are presented in Table 18 below.

Table 18 Minimum treatments for services

Location of services	BCA criterion	Minimum construction requirements
In wall or service riser passing through a bathroom/ensuite area or over bathroom/ensuite ceiling OR Stormwater pipe adjacent bathroom/ensuite	$R_W + C_{tr} \geq 25$	• 13 mm standard plasterboard (minimum 8.4kg/m^2) AND • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs; a suitable product is 75 mm Pink Batts 'Silencer'. The insulation is to extend a minimum of 1200 mm on either side of the duct/pipe. OR • Alternatively, acoustically tested pipe systems such as Raupiano Plus may be used in lieu of insulation.
In wall or service riser passing through a kitchen/living or over kitchen/living ceiling OR Stormwater pipe adjacent kitchen/living	$R_w + C_{tr} \geq 40$(1)	• 13 mm standard plasterboard (minimum 8.4kg/m^2) AND • 75 mm thick glasswool insulation with a minimum density of 14 kg/m^3 in between the studs; a suitable product is 75 mm Pink Batts 'Silencer'. The insulation is to extend a minimum of 1200 mm on either side of the duct/pipe. AND • Duct/Pipe is to be lagged with Pyrotek '4525C', Bradford 'Acoustilag 45' or equivalent. • Alternatively, acoustically tested pipe systems such as Raupiano Plus may be used in lieu of lagging.

(1) As the kitchens are typically open to the living area, the $R_w + C_{tr} \geq 40$ criterion is applicable rather than the $R_W + C_{tr} \geq 25$ criterion.

5.3.5 Access doors and panels

Access doors or panels must be:

- firmly fixed so as to overlap the frame or rebate of the frame by not less that 10 mm, and
- fitted with a sealing gasket along all edges, and
- constructed from:
  - wood, particleboard or blockboard not less that 33 mm thick, or
  - compressed fibre reinforced cement sheeting (CFC) not less than 9 mm thick, or
  - other suitable material with a mass per unit area not less than 24.4 kg/m^2.

5.3.6 Pipe supports

All pipes, including stormwater pipes, should be acoustically isolated at mounting points and penetrations. Pipe insulation (Bradflex), 6 mm thick neoprene, closed cell foam or 'unicushion' is required between all pipes and pipe clamps; alternatively provide neoprene element vibration isolation hangars to pipe supports or mounting points.

Also ensure there is no direct contact between waste pipes and surrounding elements. A 20 mm clearance to all other building elements is required.

5.3.7 Water supply pipes

Water supply pipes in walls are to be installed:

- In the cavity of a discontinuous wall cavity; and
- Have a clearance of at least 10 mm to the wall leaf of the adjacent sole-occupancy wall.

5.3.8 Pumps

A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump.

5.3.9 Electrical outlets

Electrical outlets must be offset from each other:

- in masonry walling, not less than 100 mm; and
- in timber or steel framed walling, not less than 300 mm.

5.4 Mechanical services noise emission

Mechanical services plant has not been selected at this stage of the project and therefore predictions have been made to assume a maximum allowable sound power level from mechanical plant.

In-principle methods of controlling mechanical services noise emission, to be considered at the design stage are:

- Selecting the quietest plant for a given task.
- Judicious location and orientation.
- Use larger fans at a slower speed rather than smaller fans at a higher speed.
- Using variable speed drives to lower fan speed in response to lower duty/load requirements.
- Use of barriers, both incidental and purpose designed.
- Internally lined ducts and bends, external duct and equipment wrapping, silencers.
- A combined maximum Sound Power Level (SWL) of 65 dB(A) for the outdoor condenser units proposed to be located on the southern side of each floor level. Additional acoustic treatments (such as the use of a noise barrier/enclosure or acoustic louvres) would be required if this SWL is to be exceeded.

Given the above methods of noise emission control are adopted, no exceedance of the NPI criteria are expected. A full assessment of mechanical plant noise emission is recommended once the location and specification of mechanical services for the Project has been determined.

5.5 Road traffic noise generation

This section assesses noise impacts from the additional road traffic due to the Project. Varga Traffic Planning's traffic report (Reference: 21146, dated 24 March 2021) provides the existing peak hour road traffic volumes on surrounding roads and are presented below:

- southbound traffic flows in the Pacific Highway past the site frontage are typically 1,700-1,800 vehicles per hour (vph) during the morning commuter peak period, decreasing to approximately 1,000-1,100 vph during the afternoon peak period.
- two-way traffic flows in Gordon Avenue are typically 10 - 20 vph during the weekday commuter peak periods.

The projected traffic generation for AM/PM peak vehicle trips have been calculated based on the RMS guidelines and the proposed 64 apartments, and found to be:

- 37 vph (AM)
- 28 vph (PM)

Based on the above, the anticipated noise level contributions of traffic generation from the Project on surrounding roads have been assessed and presented in Table 19 using the TfNSW Road Traffic Noise Estimator.

Table 19 Operational road traffic noise assessment

Location	AM / PM	Existing peak hourly traffic volume	Additional peak hourly traffic volume due to Project	Project total peak hourly traffic volume	Increase in total noise level – dB(A)
Pacific Highway (South)	AM	1,800	+37	1,837	< 1
	PM	1,100	+28	1,137	< 1
Gordon Avenue (Both directions)	AM	20	+37	57	2
	PM	20	+28	48	2

The Table 19 presents the increase in noise levels due to additional vehicles on Pacific Highway and Gordon Avenue from the traffic generation due to the Project. The increase in noise levels are predicted to be no greater than the 2 dB(A) screening test of the RNP and therefore no further assessment or mitigation is required.

6 Conclusion

A summary of key points from our assessments and analysis are presented in this section.

6.1 External noise intrusion

Typical glazing types have been suggested to control road traffic noise intrusion to the worst affected building facades to achieve compliant internal noise levels. It is recommended that a detailed assessment is carried out during the design stage to optimise glazing sound insulation performances.

6.2 Railway vibration intrusion

A human comfort vibration intrusion study was conducted. Vibration produced by rail corridor activity was found to be below the recommended levels outlined in Section 4.3.

6.3 Internal acoustic requirements

Table 10 shall be referred to during the detailed design phase in order to ensure compliance with the Building Code of Australia internal acoustic separation requirements. Indicative recommendations have been provided in Sections 5.3 and 5.3.4 of this report.

6.4 Mechanical services noise emission

Mechanical services noise from equipment servicing the Project shall be designed to comply with the criteria summarised in Section 4.4.

It is important to note that mechanical services design should take into account the future likely contribution of other nearby proposed developments and their associated mechanical services noise contribution.

In-principle noise controls have been recommended in Section 5.4. A detailed review of mechanical plant noise emission should be carried out by a qualified acoustic consultant during the detailed design stage when further information becomes available.

6.5 Road traffic generation

The increase in noise levels due to additional vehicles on Pacific Highway and Gordon Avenue from the traffic generation at the Project have been assessed in accordance with the RNP. The increase in noise levels is predicted to be no greater than the 2 dB(A) screening test of the RNP and therefore no further assessment or mitigation is required.

Appendix A – Noise survey

Unattended noise logging

An unattended noise survey was conducted during the period 10 March to 21 March 2023. Noise logging was conducted at the balcony of Unit 12 (UN01) and the east boundary of the project site as shown in Figure 1.

Equipment and set-up

Two Rion NL-42 sound level meters were used, serial numbers 00946981 (UN01) and 00946983 (UN02). Field calibration was conducted at the commencement and conclusion of the logging period and no significant calibration drift was observed.

The noise logger was configured to record all relevant noise indices, including background noise level (L_{A90}) and equivalent continuous noise levels (L_{Aeq}). Samples were accumulated at 15-minute intervals. The time response of the logger was set to 'fast'.

The noise measurements were taken in general accordance with AS1055.1[1]

Weather conditions

In order to provide an indication that noise data was obtained during suitable meteorological conditions, half-hourly weather data was obtained from the Bureau of Meteorology (BOM) Automatic Weather Station (AWS) 60800 at Sydney Observatory Hill.

Noise data has been excluded from the processed results if:

- Rain was observed during a measurement period, and/or
- Wind speed exceeded 5 m/s (18 km/h) at the measurement height of the noise logger. Wind data obtained from the BOM is presented as the value at 10 m above ground and adjusted to the measurement height of the noise logger.

Noise Policy for Industry

In order to determine mechanical services noise emission criteria, data from the unattended noise monitoring outlined in above was processed according to the procedures and time periods in the NSW Noise Policy for Industry (NPI) time periods as follows:

- Daytime: 7 am to 6 pm
- Evening: 6 pm to 10 pm
- Night-time: 10 pm to 7 am

It is necessary to establish a representative noise level for each of these time periods. The procedure set out in the NSW NPI has been used to derive a representative background noise level (Rating Background Level or RBL) for the daytime, evening and night-time periods. An RBL is the median of the lowest 10th percentile of the background L_{A90} samples for each daytime, evening and night-time measurement period.

Noise levels during the defined time periods are presented in Table 20.

[1] Australian Standard AS1055.1 1997: Description and measurement of environmental noise – Part 1: General Procedures

Table 20 Measured noise levels at background noise logging location (UN02)

Description	Noise level dB(A) during period		
	Daytime	Evening	Night-time
Rating Background Level (RBL)	44	43	37

This location was chosen to best represent the noise sensitive receivers close to the Project because the noise levels measured at the east of the Project are quieter and therefore, result in more conservative criteria.

Derivation of noise emission criteria

The NPI describes 'Project noise trigger levels' which indicate the noise level at which feasible and reasonable noise management measures should be considered. Two forms of noise criteria are provided – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses.

- The intrusiveness of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15 minutes, does not exceed the background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended amenity levels specified in the NPI for that particular land use.

The Project Noise Trigger Level (PNTL) is the lowest value of the intrusiveness or amenity noise level for each period and are shown as bold values within Table 21. For this assessment, the area surrounding the proposal is considered to be ''urban'.

Table 21 NPI noise criteria (urban amenity area)

Receiver	Assessment period	Noise level – dB(A)			
		Recommended amenity noise level $L_{eq\ (period)}$	Rating background noise level (RBL)(1)	Project noise trigger level (PNTL) $L_{eq\ (15minute)}$	
				Intrusiveness noise level	Project amenity noise level (2)(3)
Residential premises	Daytime	60	44	**49**	58
	Evening	50	43	**48**	48
	Night	45	37	**42**	43
Commercial premises	When in use	65	-	**-**	**63**

(1) Actual RBLs are below assumed NPI minimums, therefore the NPI minimum RBLs have been adopted.

(2) The project amenity noise level is the Rural amenity noise level minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level.

(3) The PNTL is the lowest of the intrusiveness and project amenity noise levels within each assessment period and has been bolded.

Development Near Rail Corridors and Busy Roads – Interim Guideline

The measured data has been processed to determine equivalent continuous (L_{Aeq}) noise levels during each of the following periods:

- Daytime (7 am to 10 pm),
- Night-time (10 pm to 7 am) and
- The highest one hour in each of these periods

These time periods are consistent with usual practice in NSW and the time periods in State Environmental Planning Policy (SEPP) and the NSW DoP Guidelines.

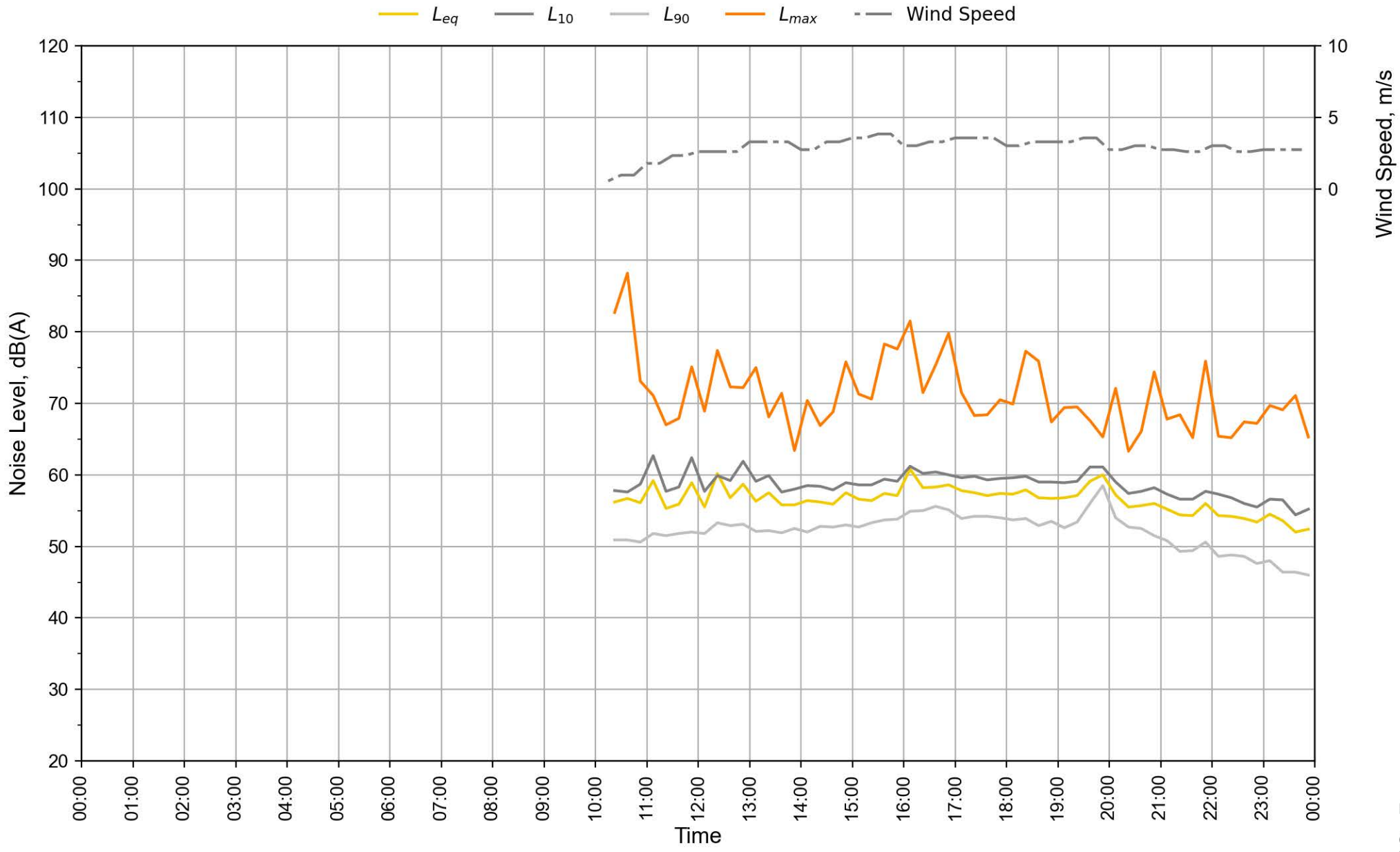
Table 22 Measured noise levels at traffic noise logging location (UN01)

Description	Noise level dB(A) during period			
	Daytime (15 hour) 07:00 – 22:00	Daytime (1 hour) 07:00 – 22:00	Night-time (9 hour) 22:00 – 07:00	Night-time (1 hour) 22:00 – 07:00
Average total noise level, L_{eq}	56	57	54	56

Appendix B – Noise monitoring graphs

Resonate

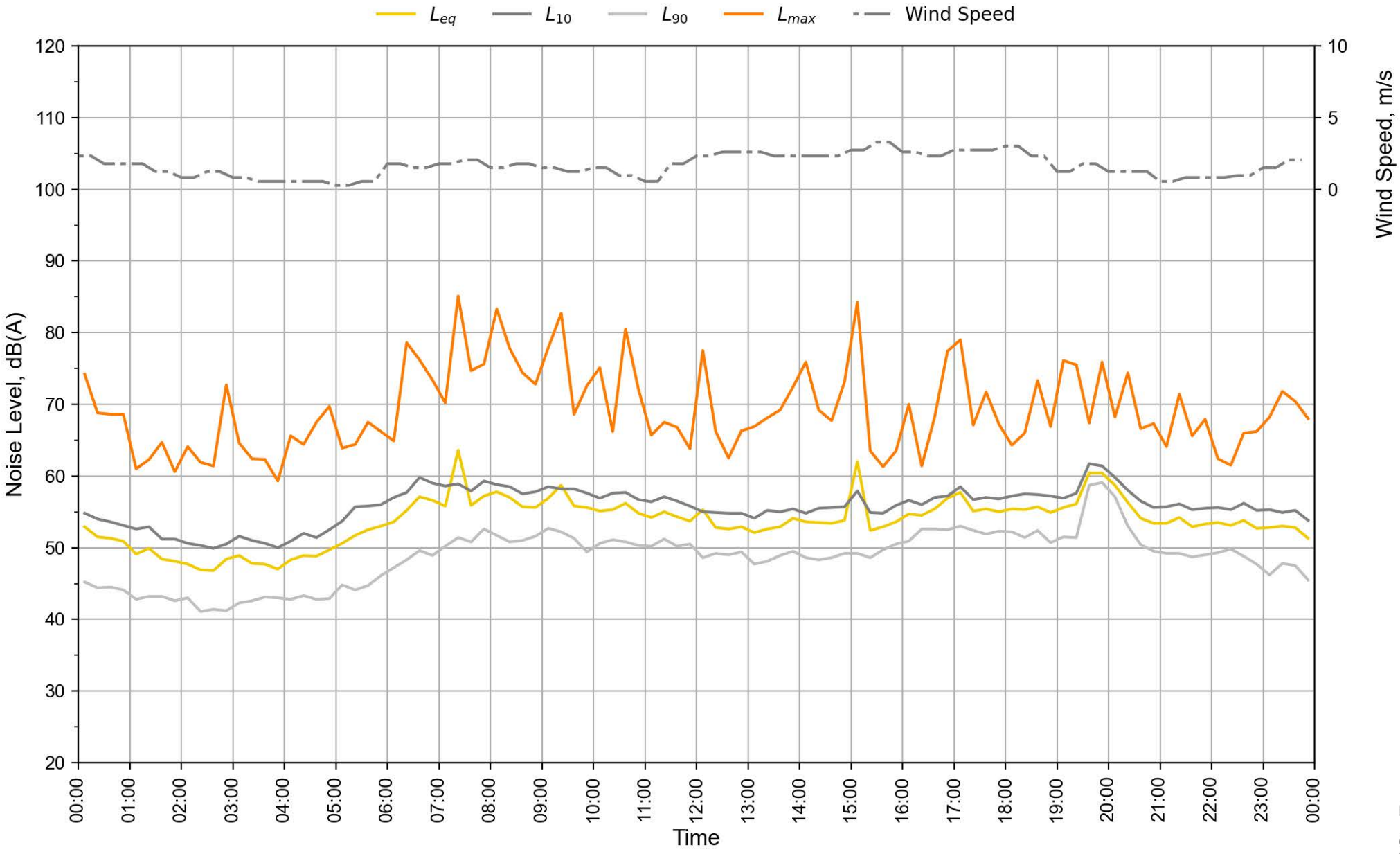
5-9 Gordon Avenue (Location 1) - Friday, 10 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

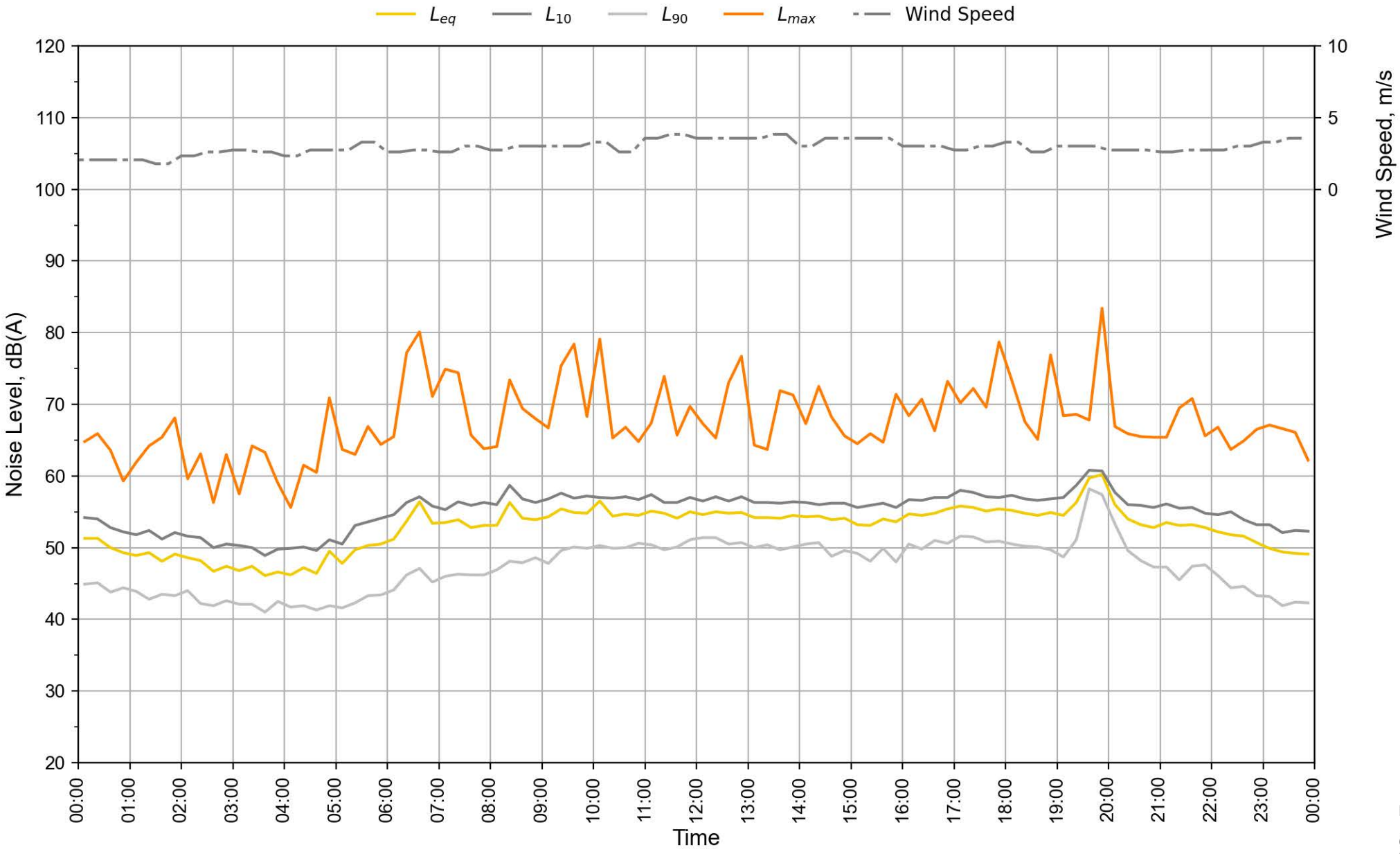
5-9 Gordon Avenue (Location 1) - Saturday, 11 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

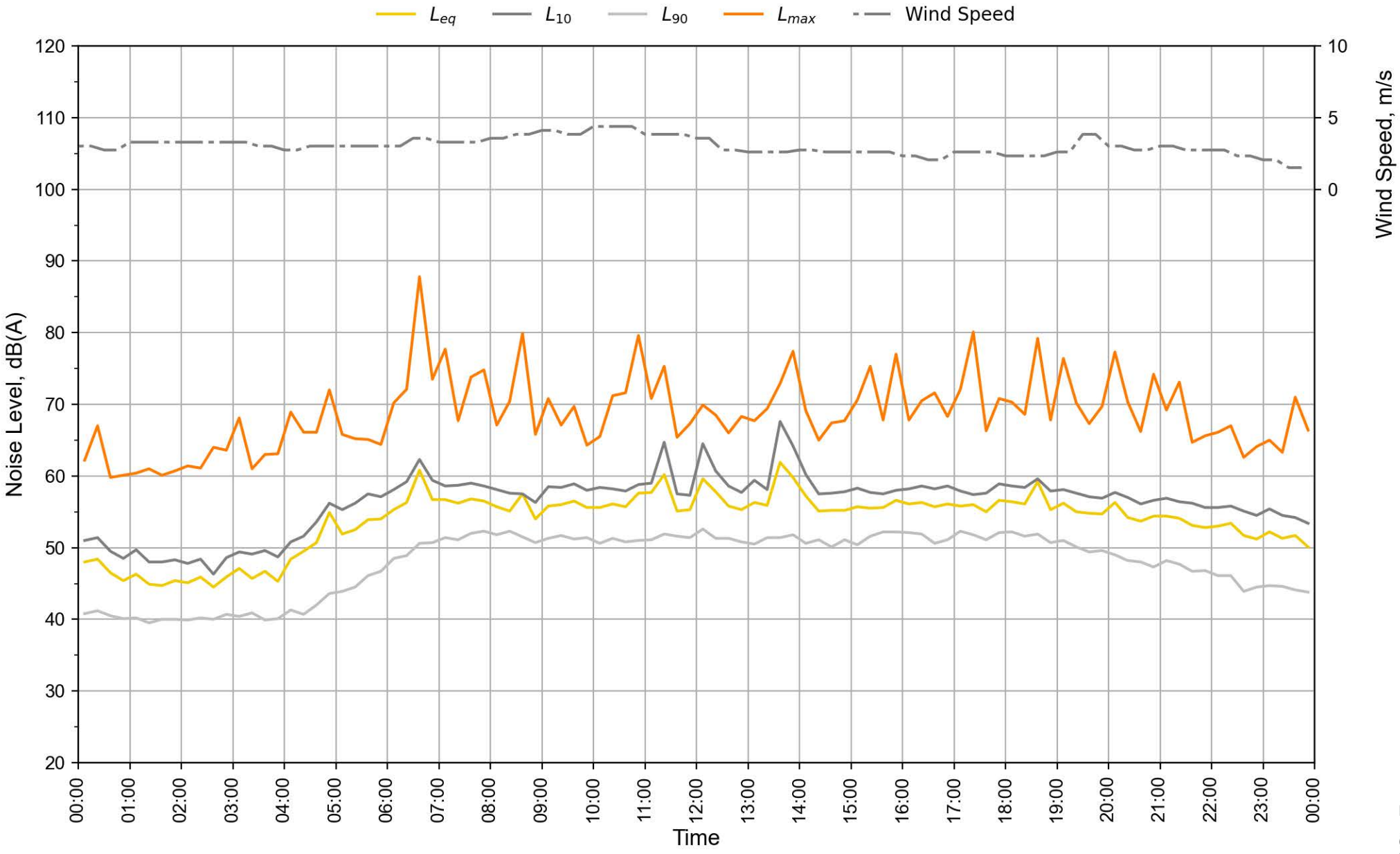
5-9 Gordon Avenue (Location 1) - Sunday, 12 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

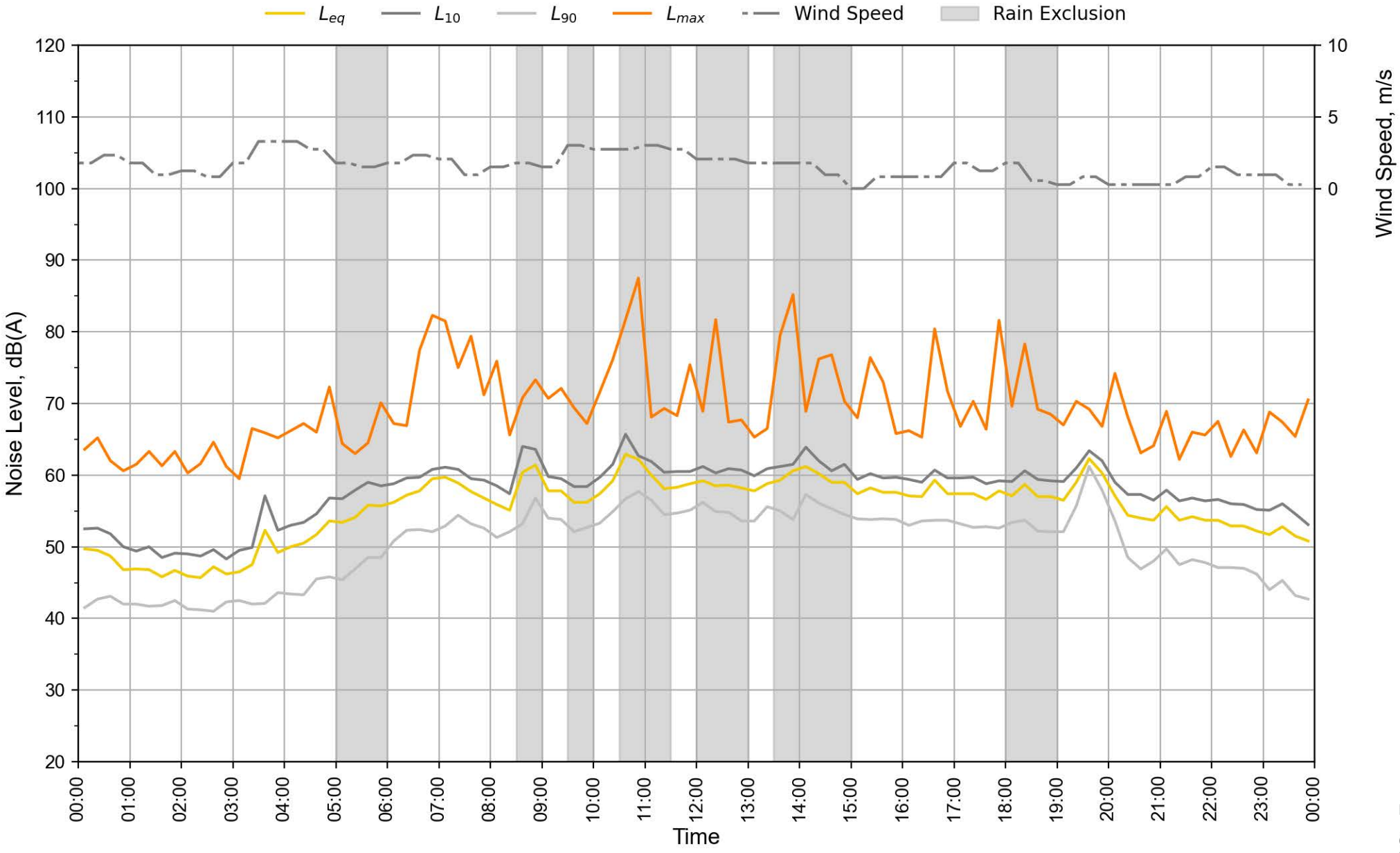
5-9 Gordon Avenue (Location 1) - Monday, 13 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

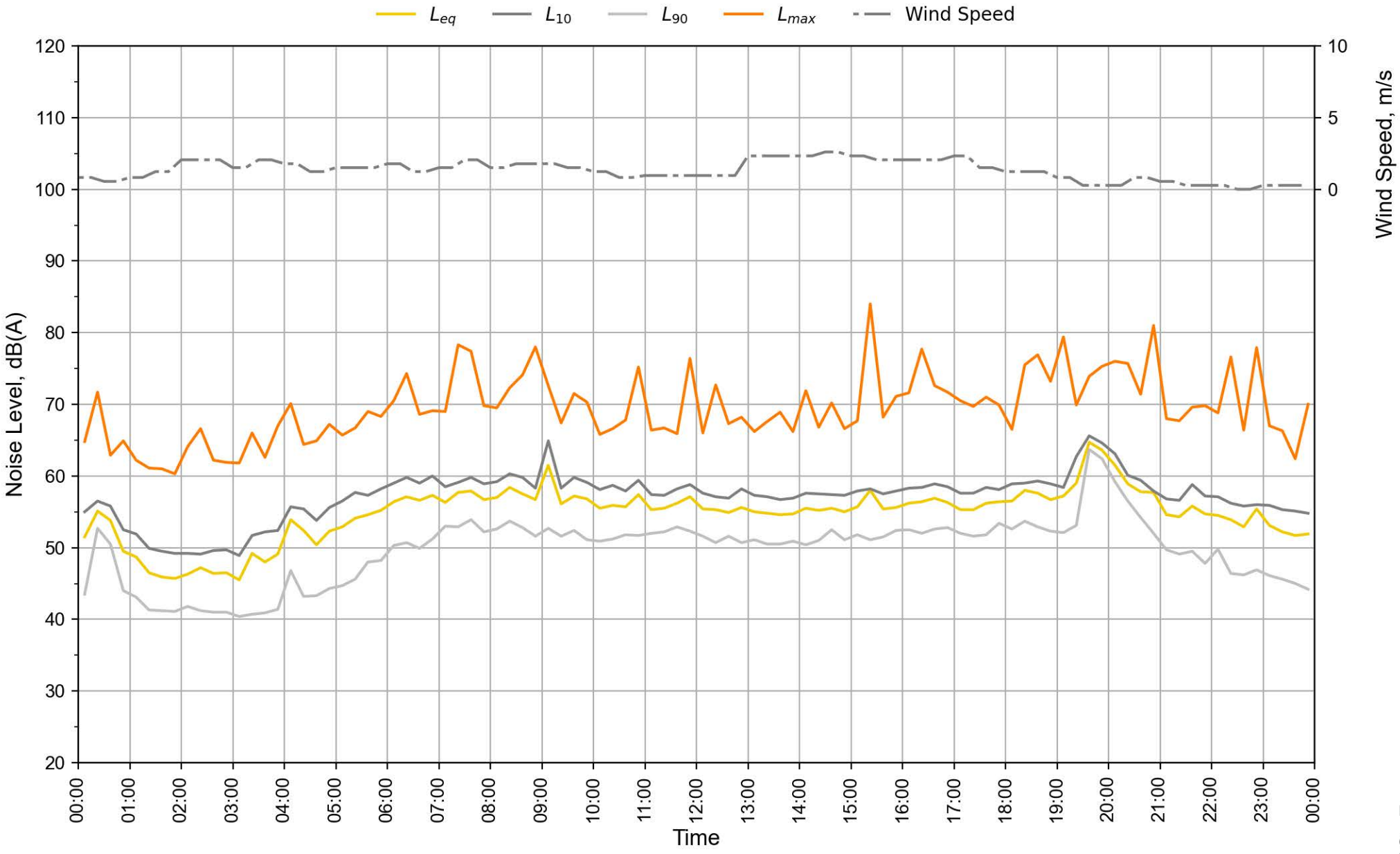
5-9 Gordon Avenue (Location 1) - Tuesday, 14 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

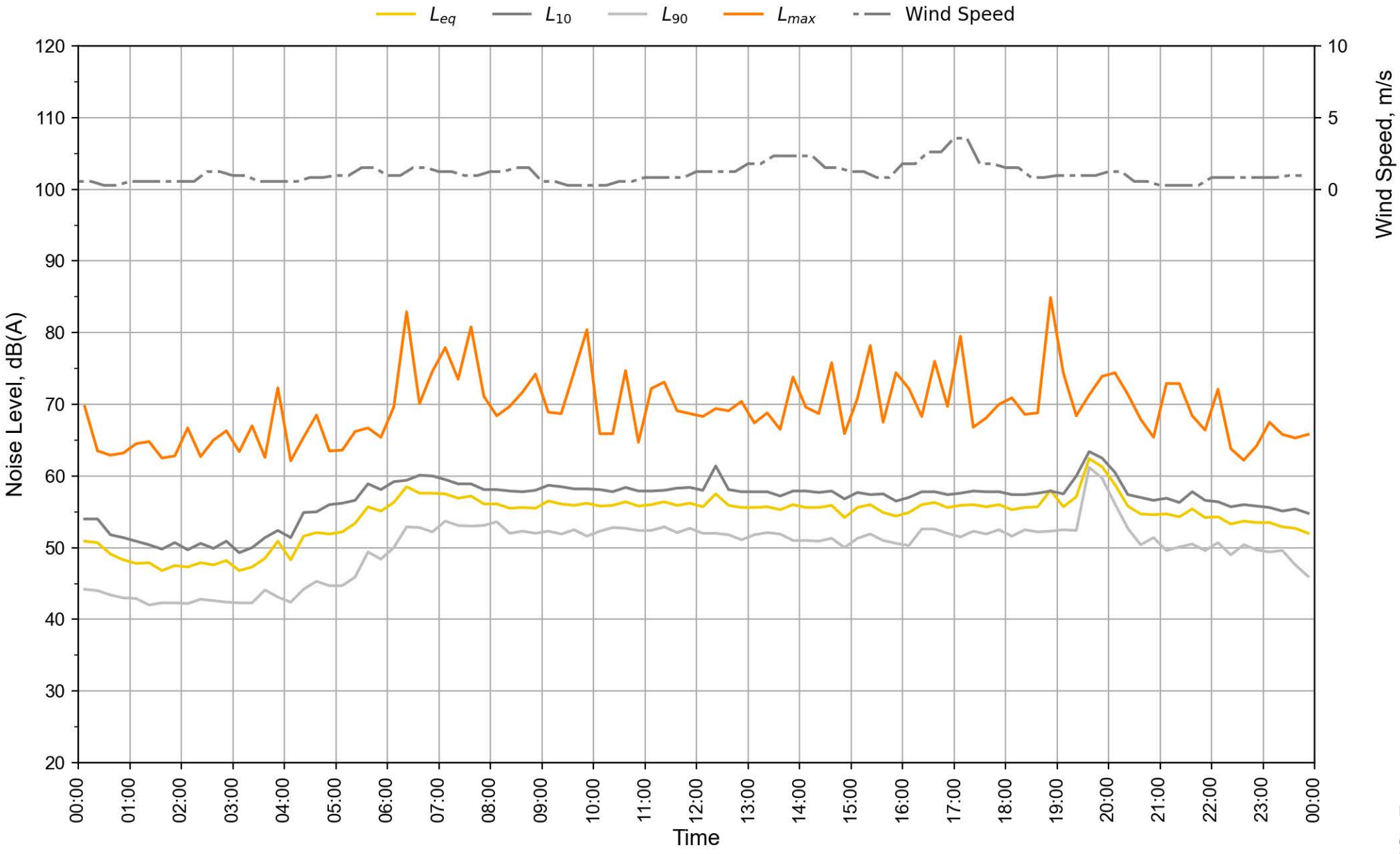
5-9 Gordon Avenue (Location 1) - Wednesday, 15 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

5-9 Gordon Avenue (Location 1) - Thursday, 16 March 2023



Rion NL-42
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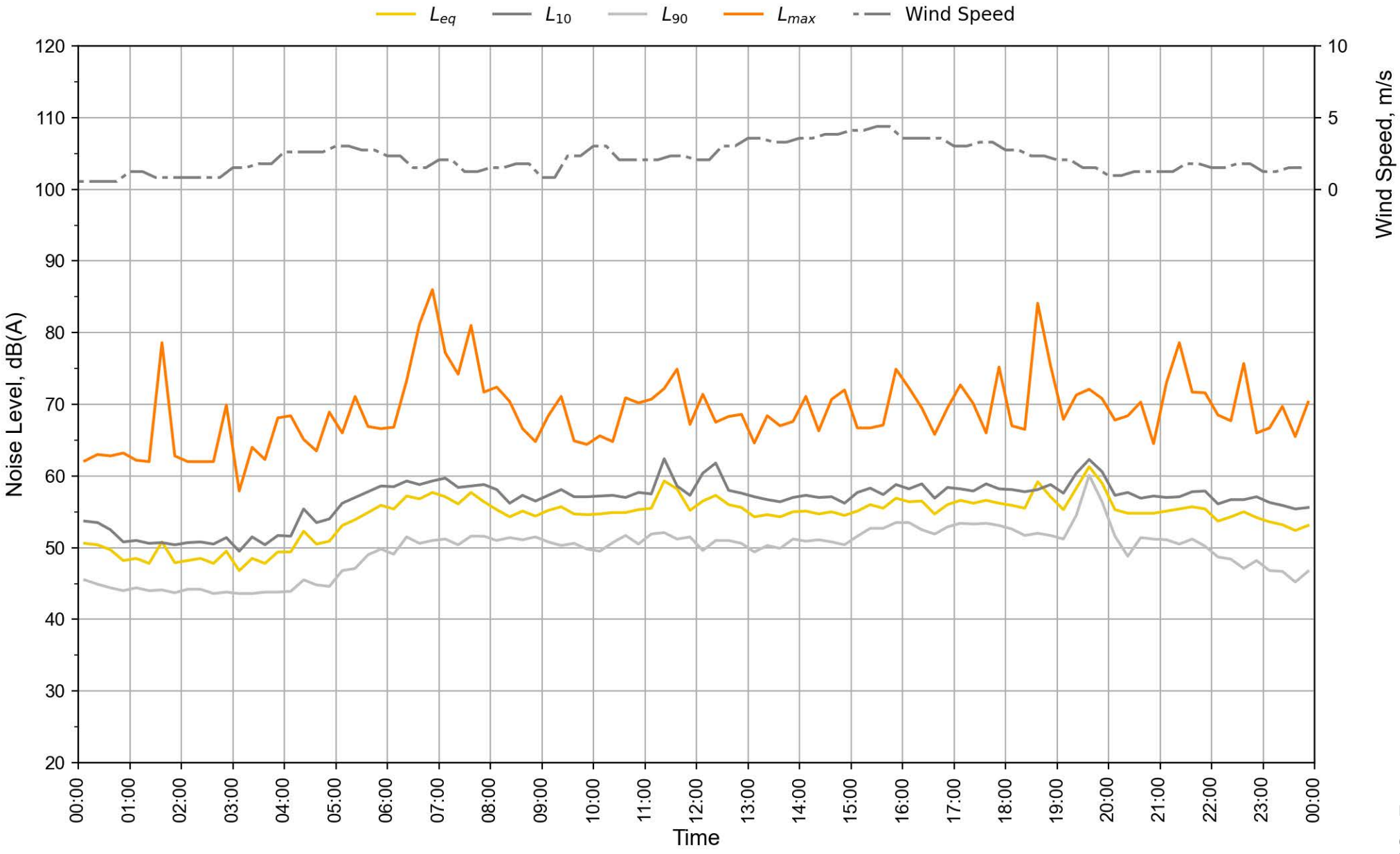
Calibration:
2022-01-30

Resonate

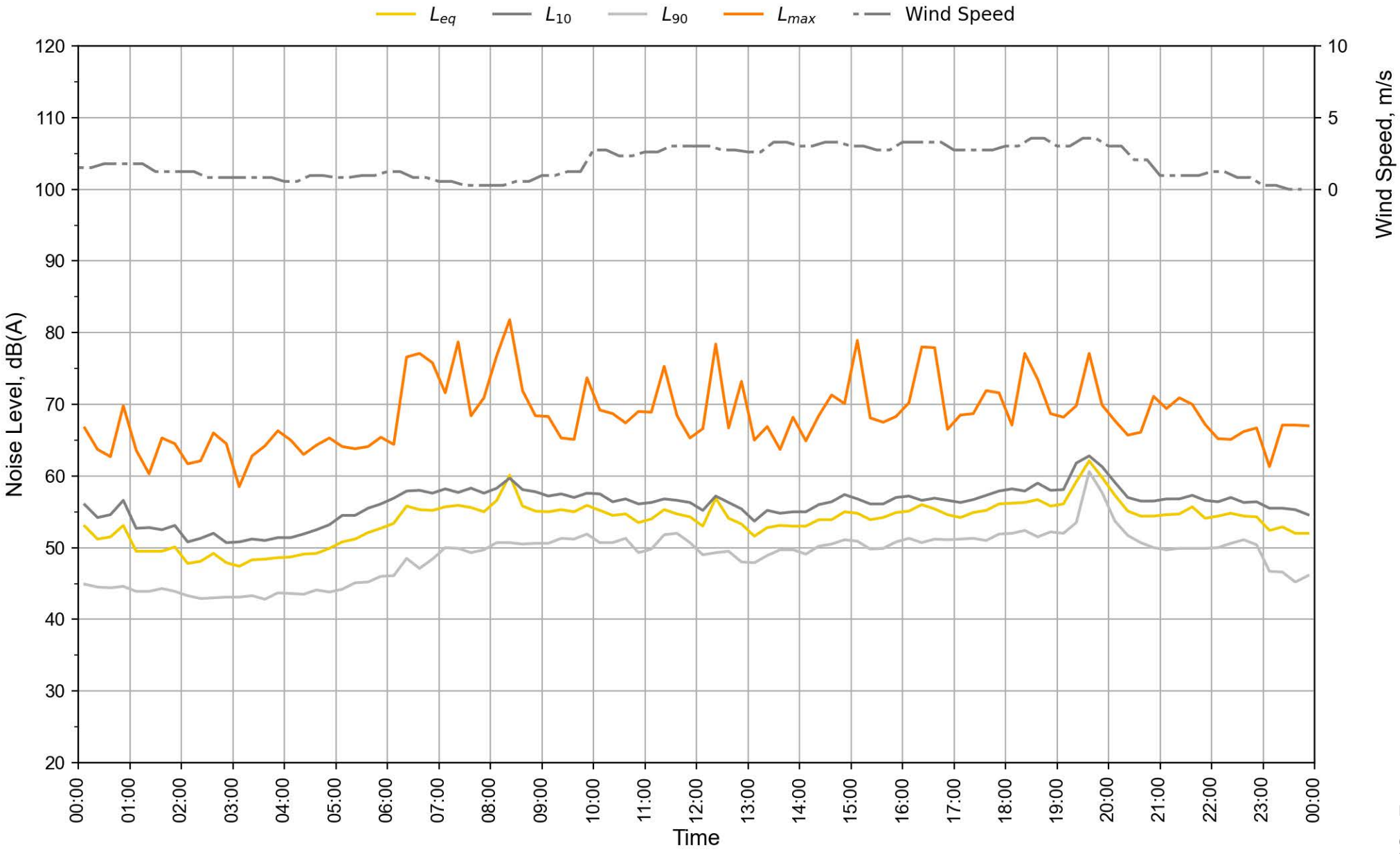
5-9 Gordon Avenue (Location 1) - Friday, 17 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

5-9 Gordon Avenue (Location 1) - Saturday, 18 March 2023



Rion NL-42
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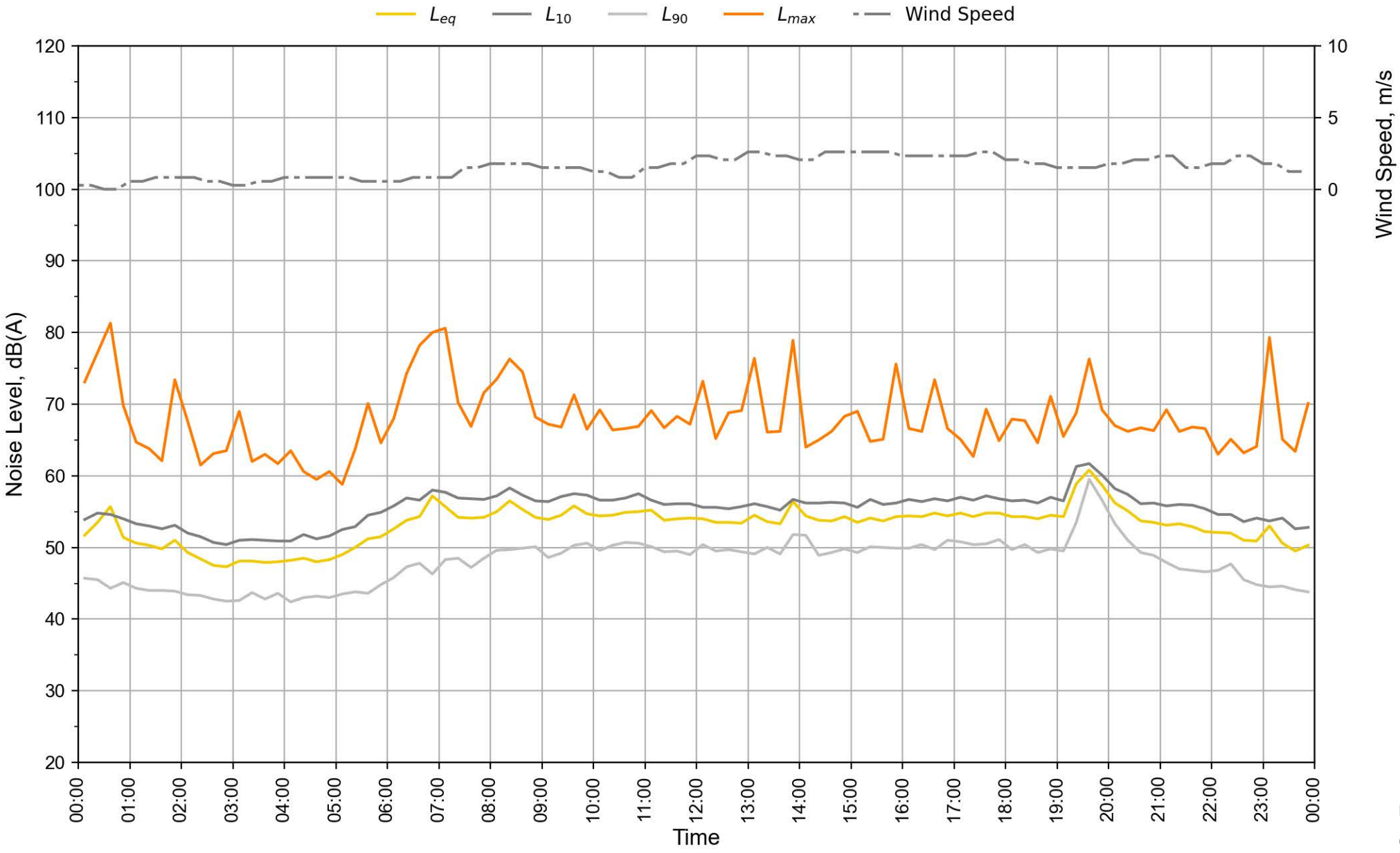
Calibration:
2022-01-30

Resonate

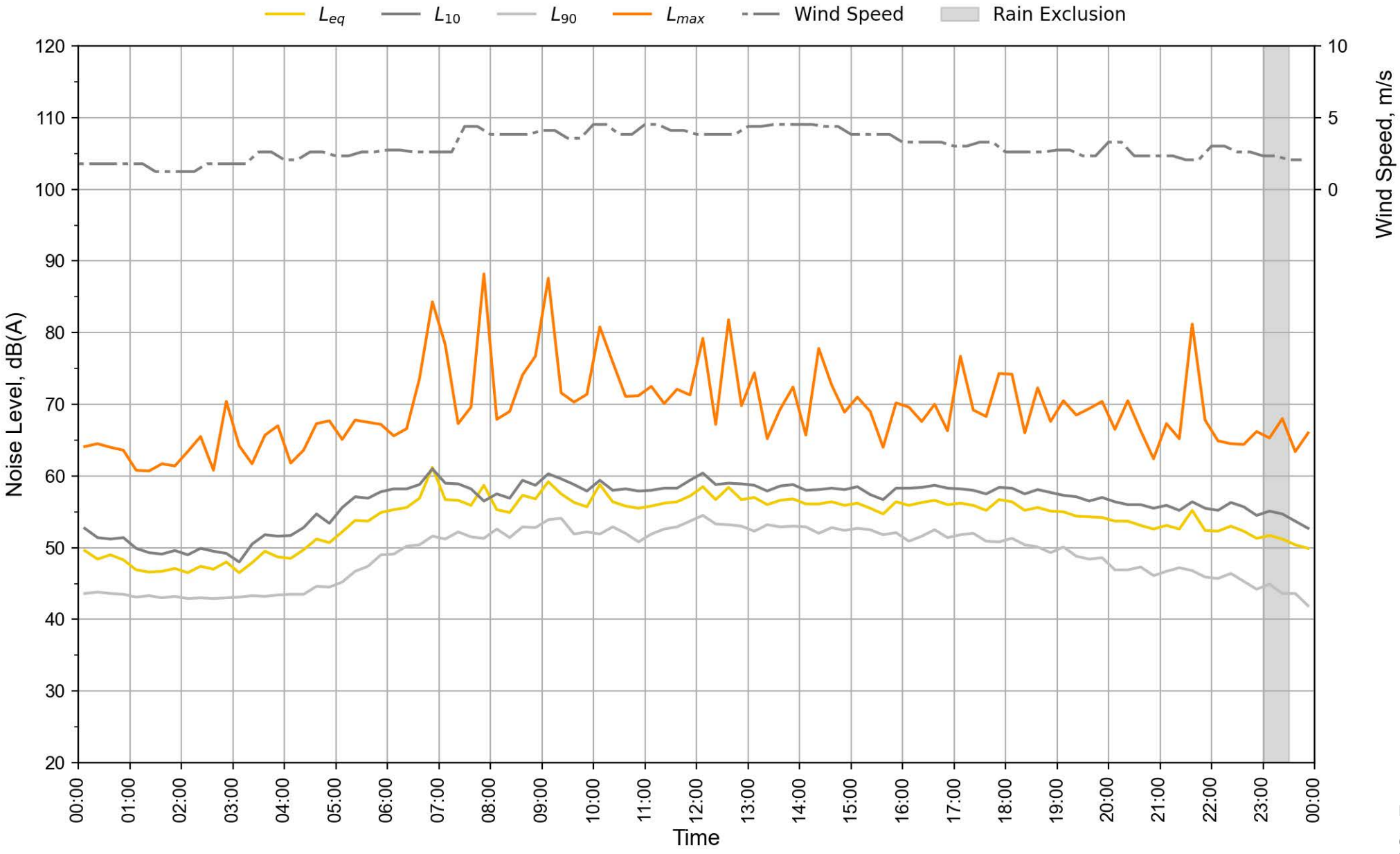
5-9 Gordon Avenue (Location 1) - Sunday, 19 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

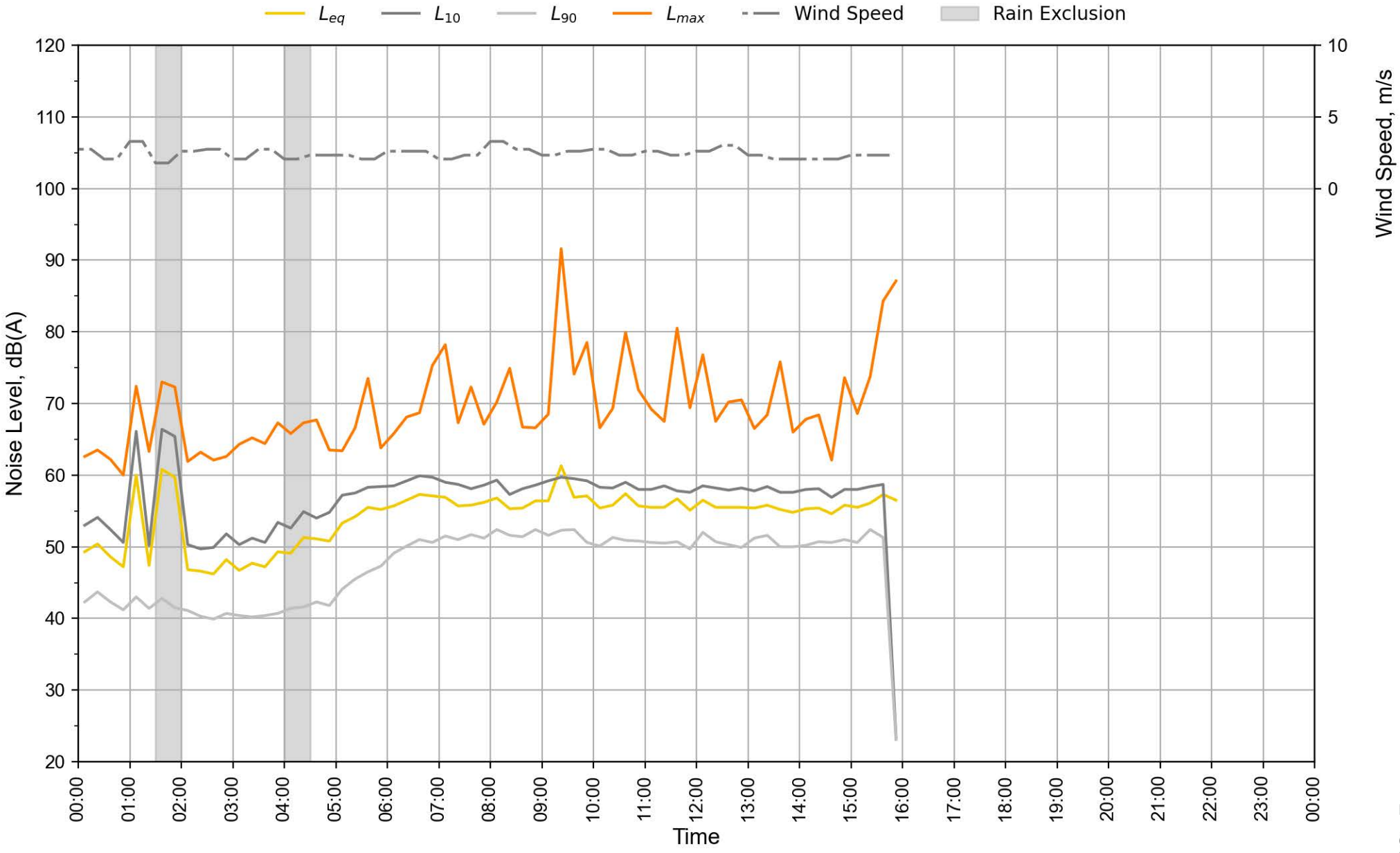
5-9 Gordon Avenue (Location 1) - Monday, 20 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

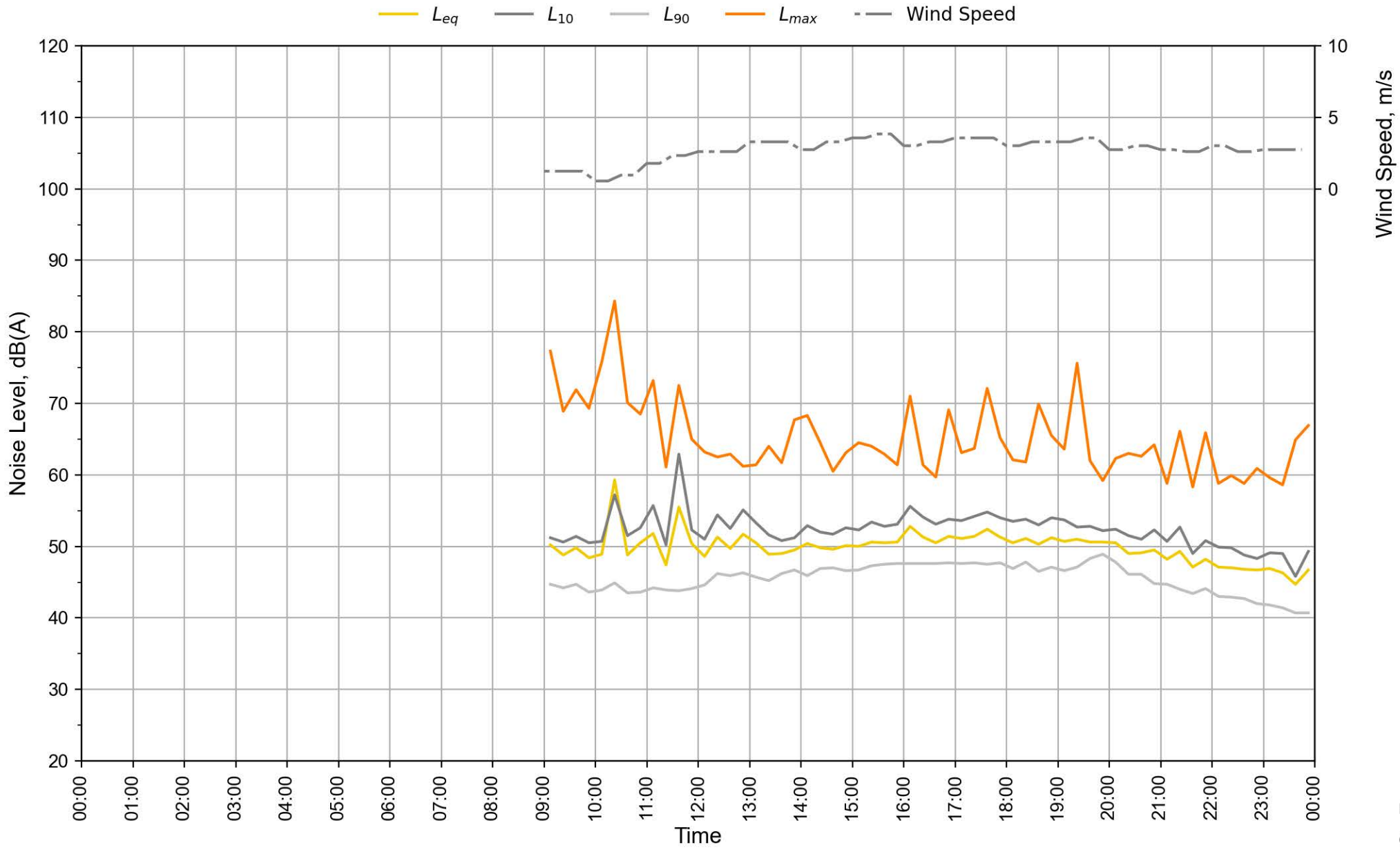
5-9 Gordon Avenue (Location 1) - Tuesday, 21 March 2023



Rion NL-42
946981
Calibration:
2022-01-30

Resonate

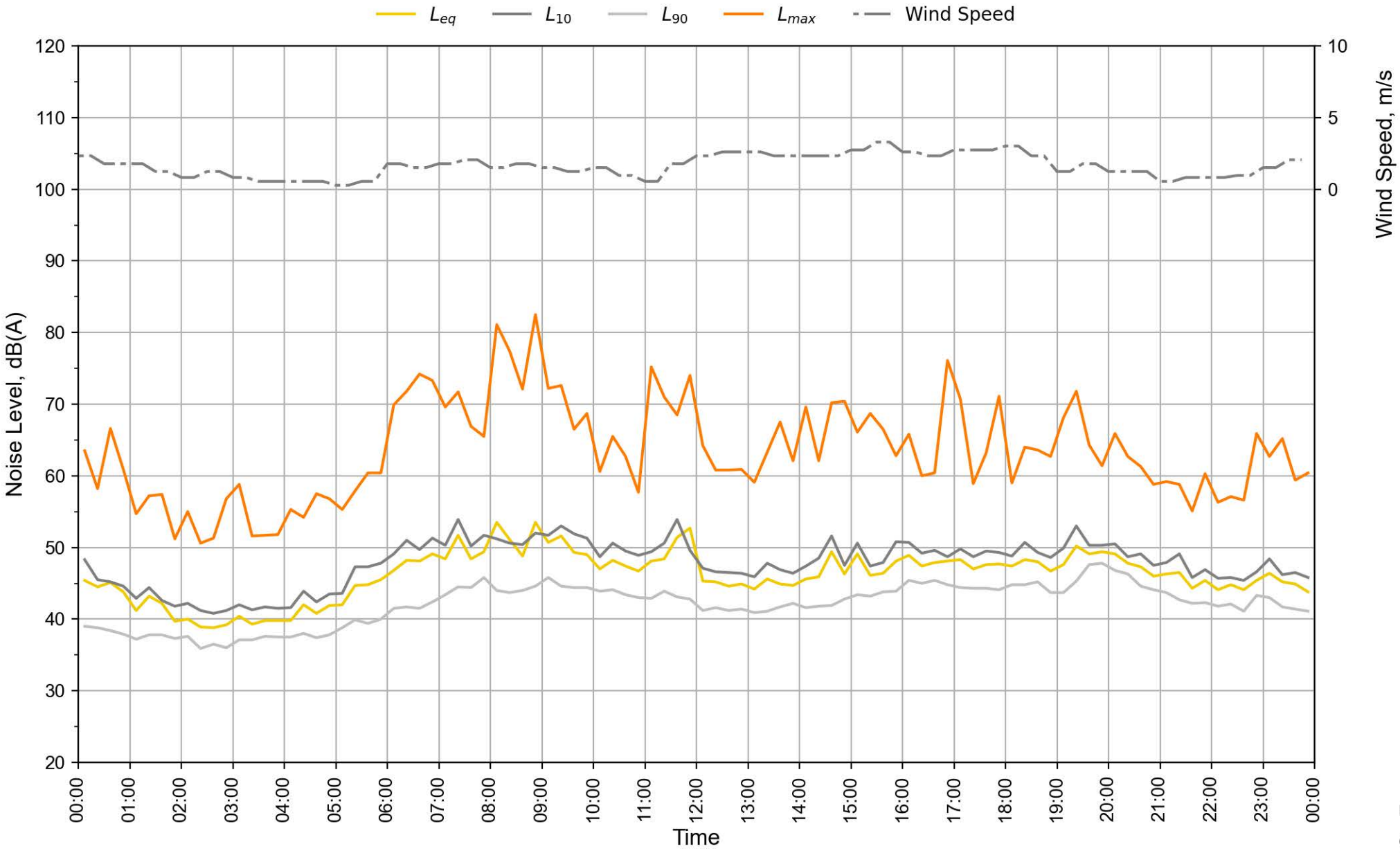
5-9 Gordon Avenue (Location 2) - Friday, 10 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

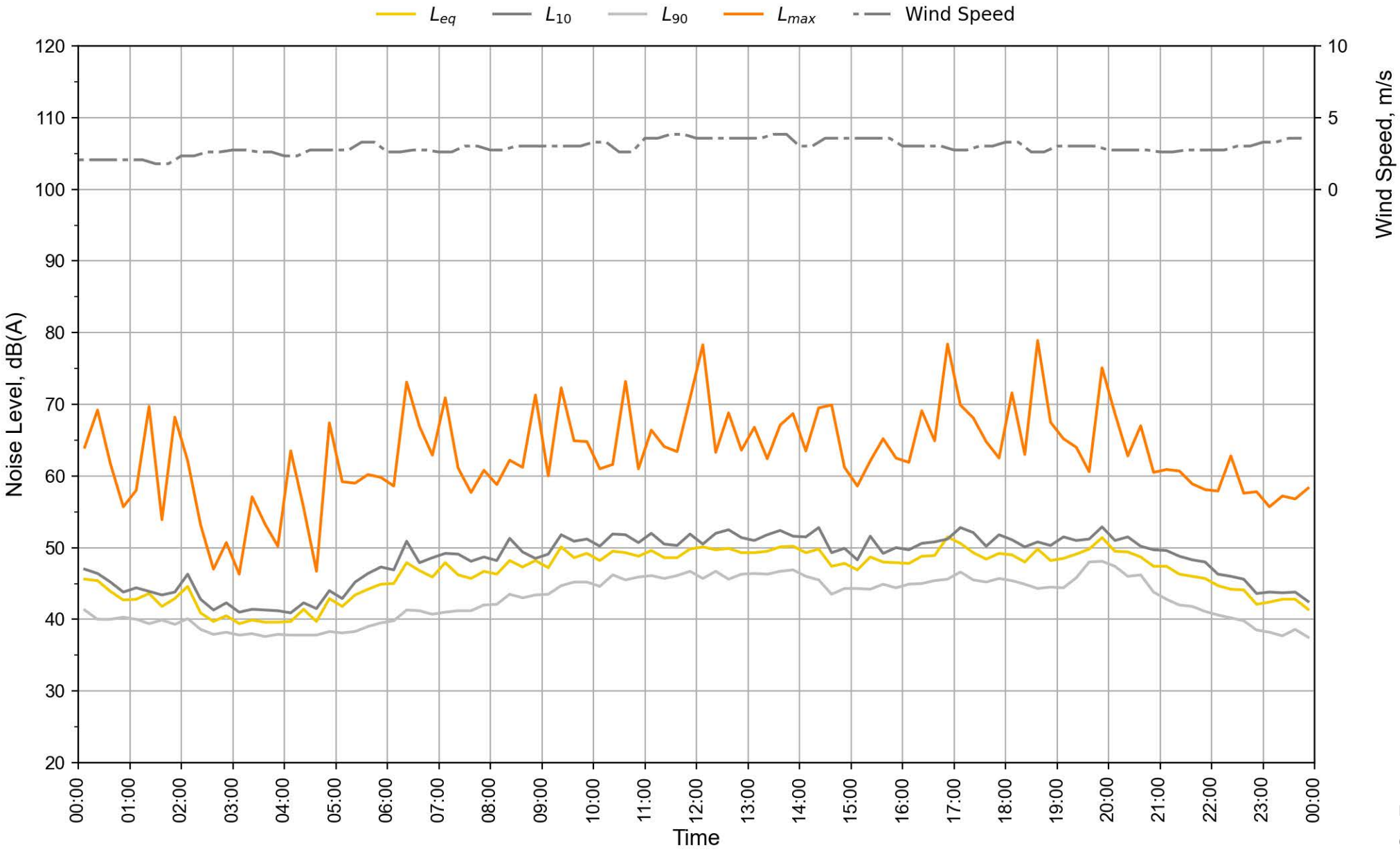
5-9 Gordon Avenue (Location 2) - Saturday, 11 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

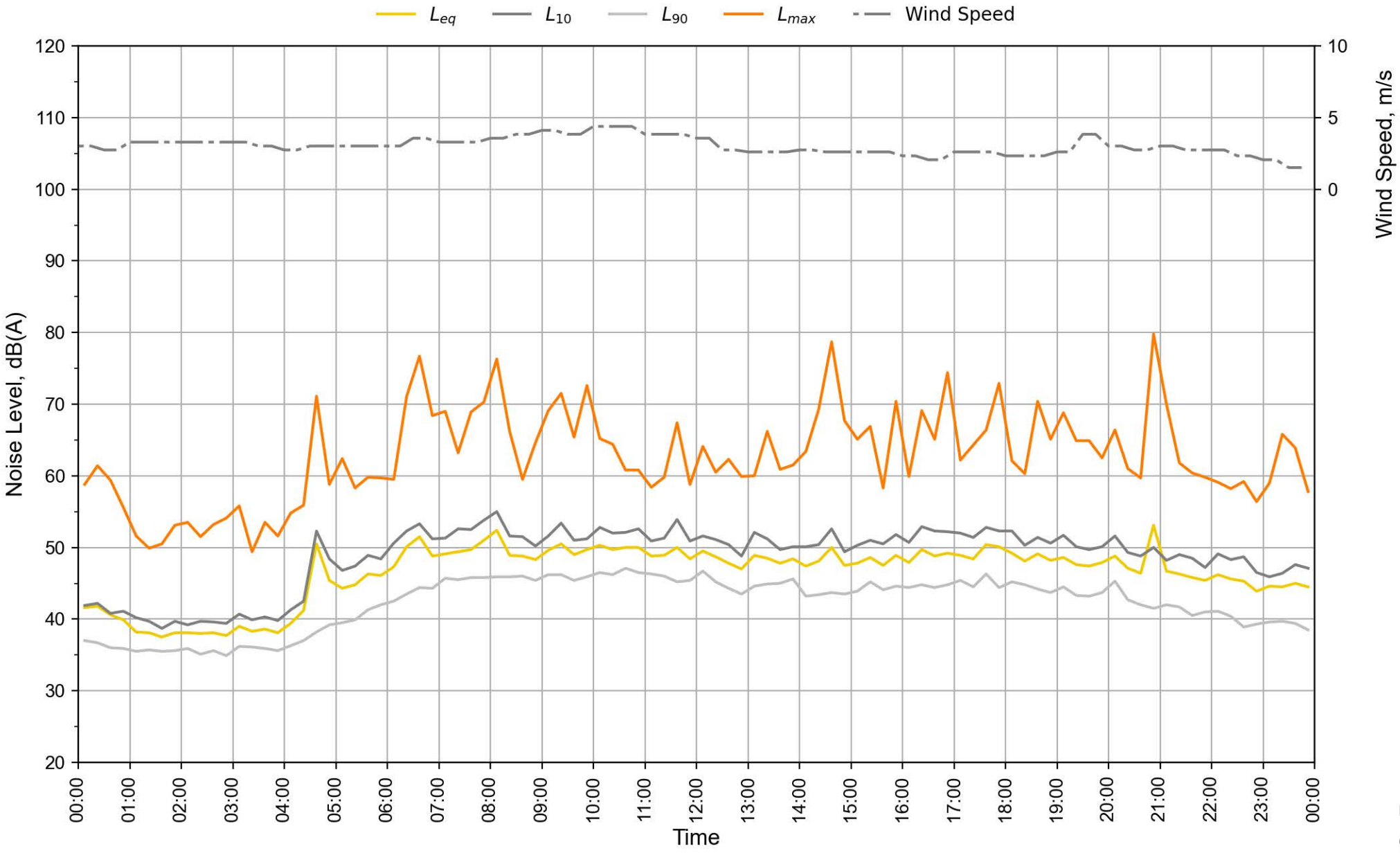
5-9 Gordon Avenue (Location 2) - Sunday, 12 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

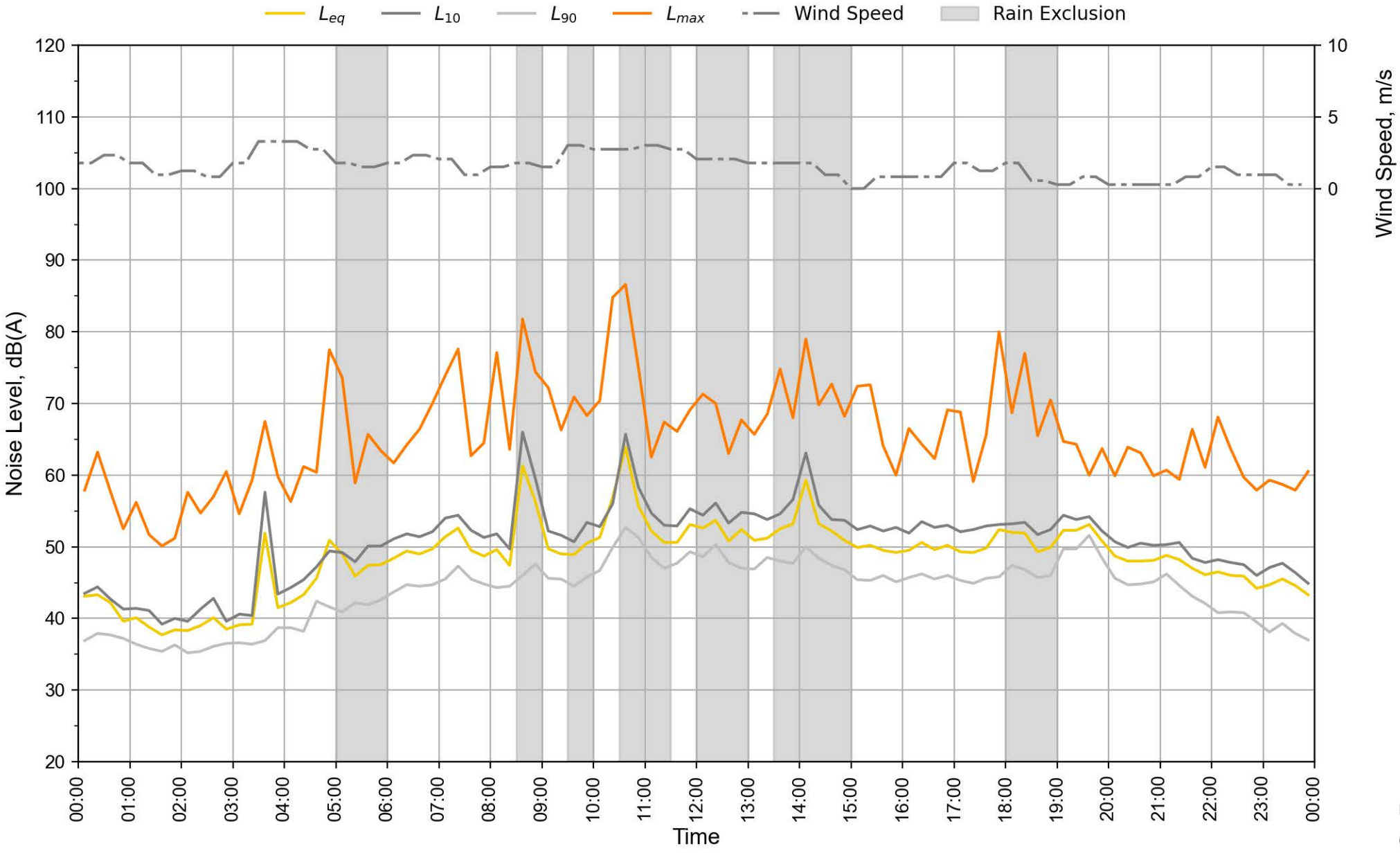
5-9 Gordon Avenue (Location 2) - Monday, 13 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

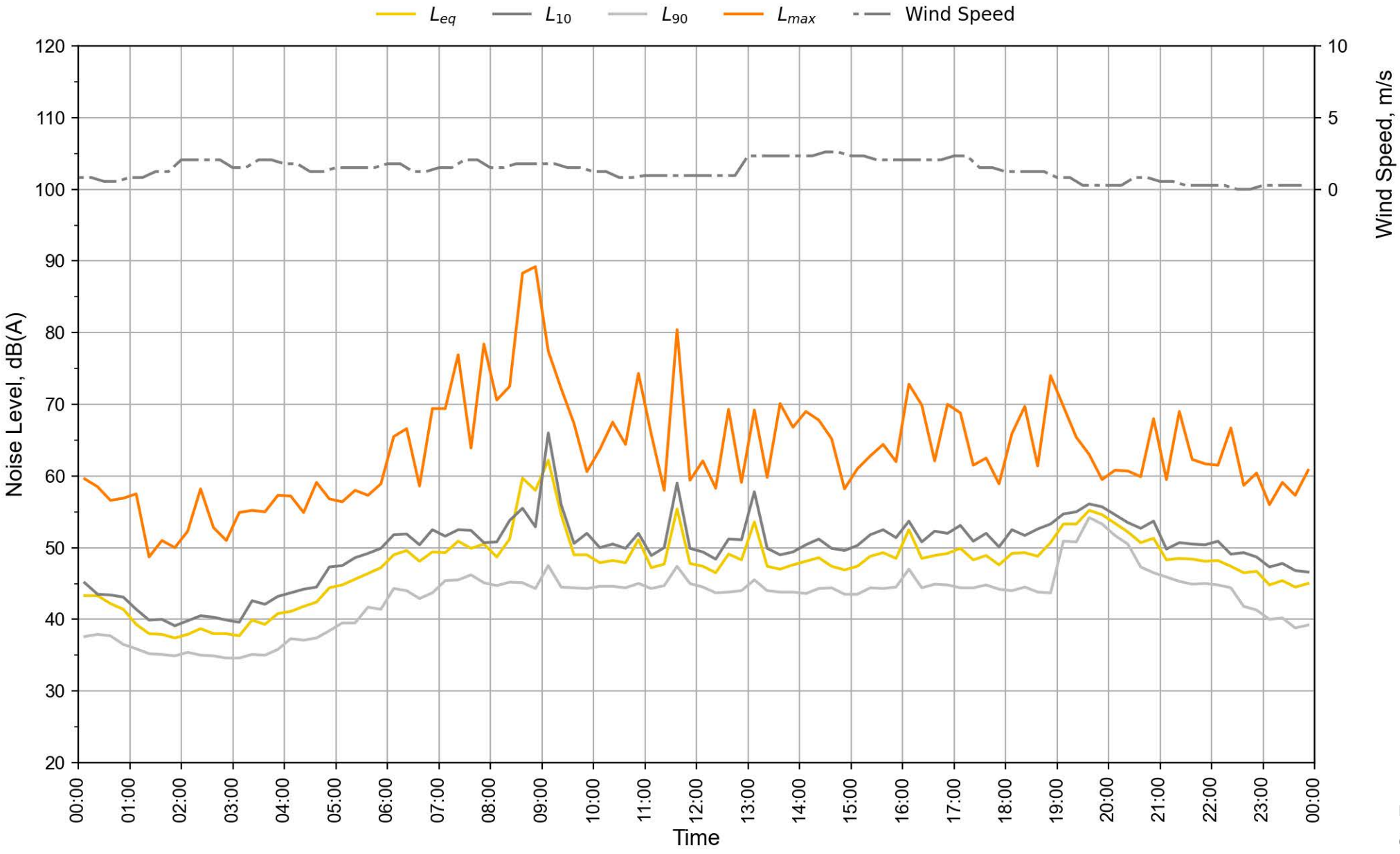
5-9 Gordon Avenue (Location 2) - Tuesday, 14 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

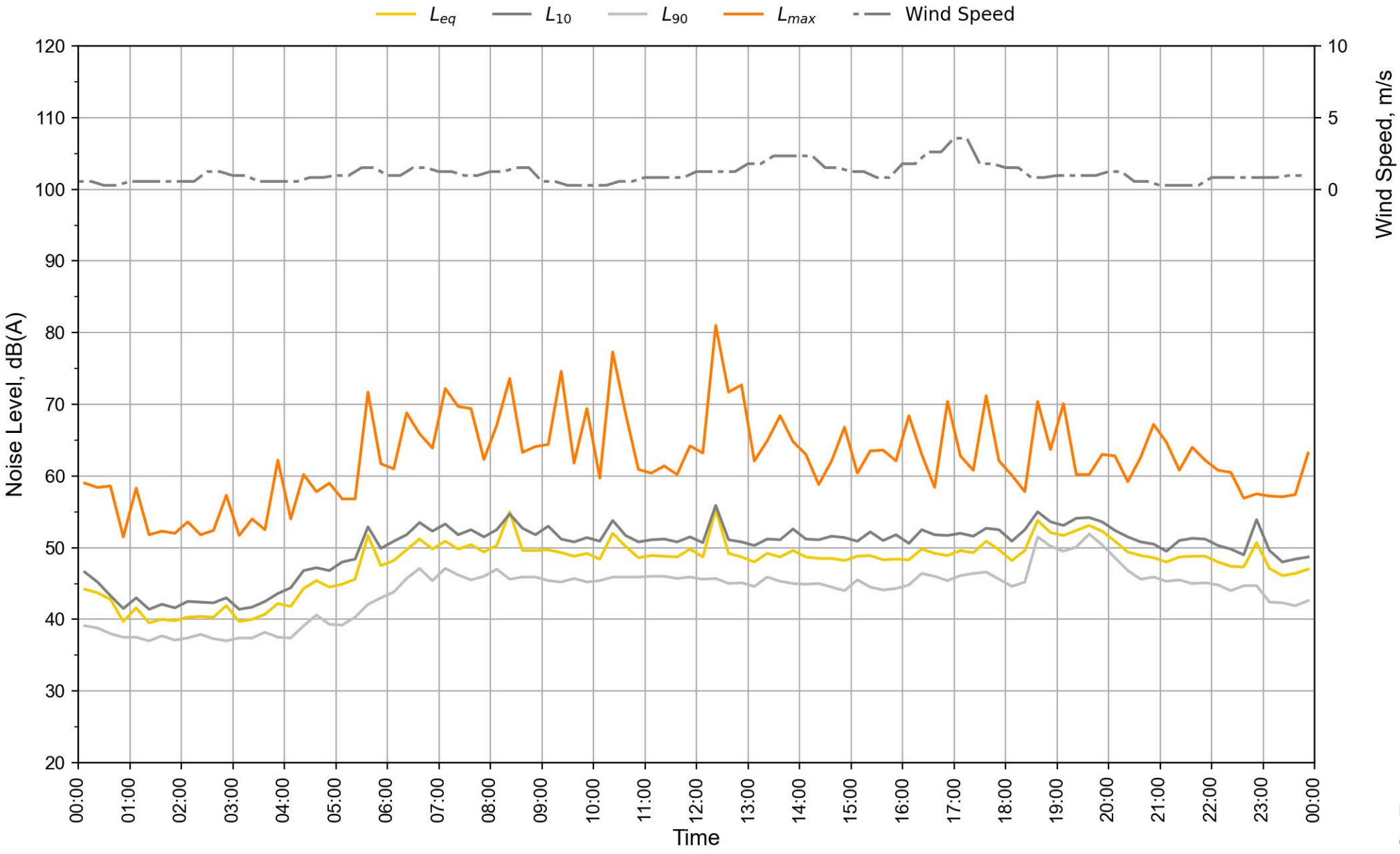
5-9 Gordon Avenue (Location 2) - Wednesday, 15 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

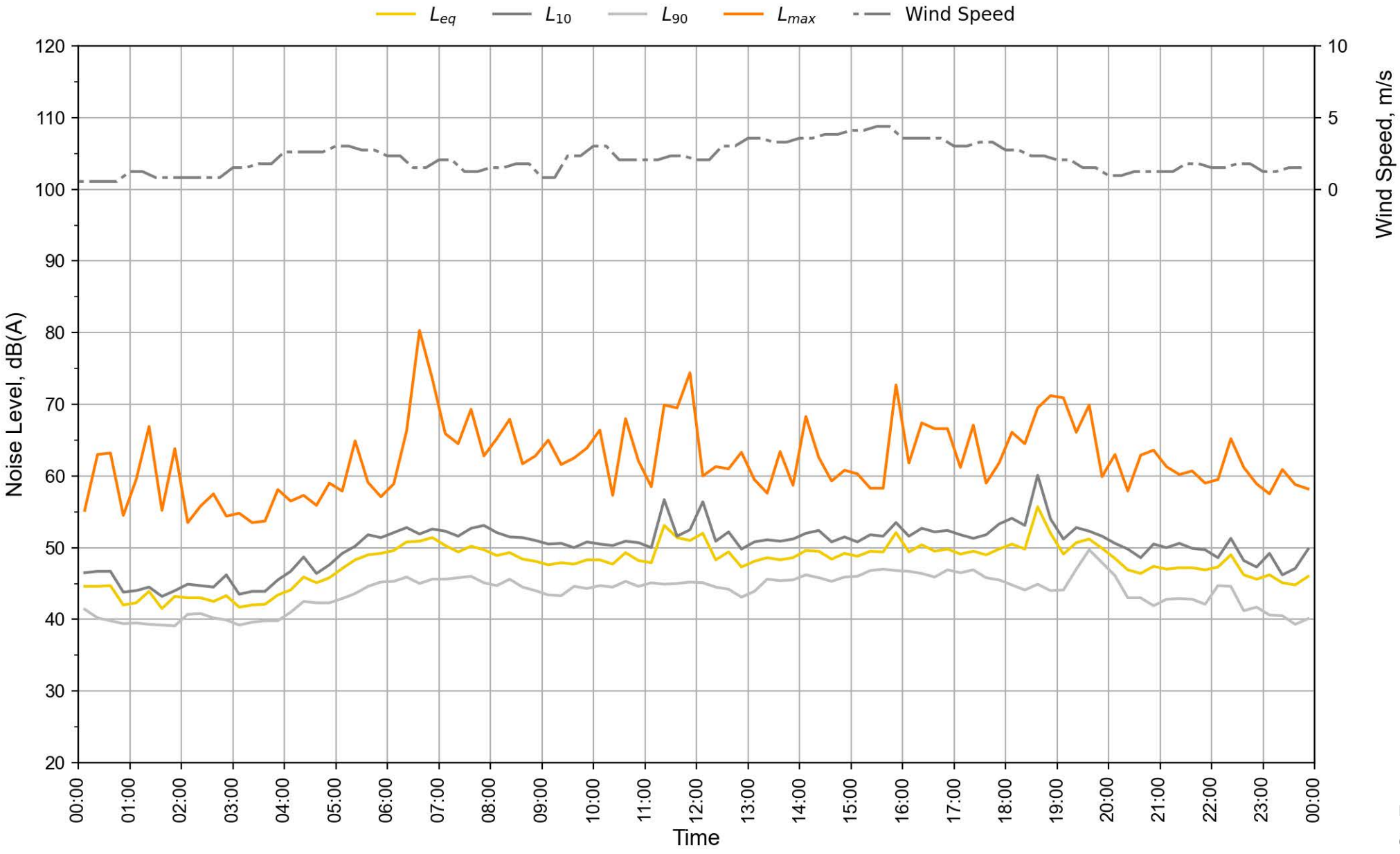
5-9 Gordon Avenue (Location 2) - Thursday, 16 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

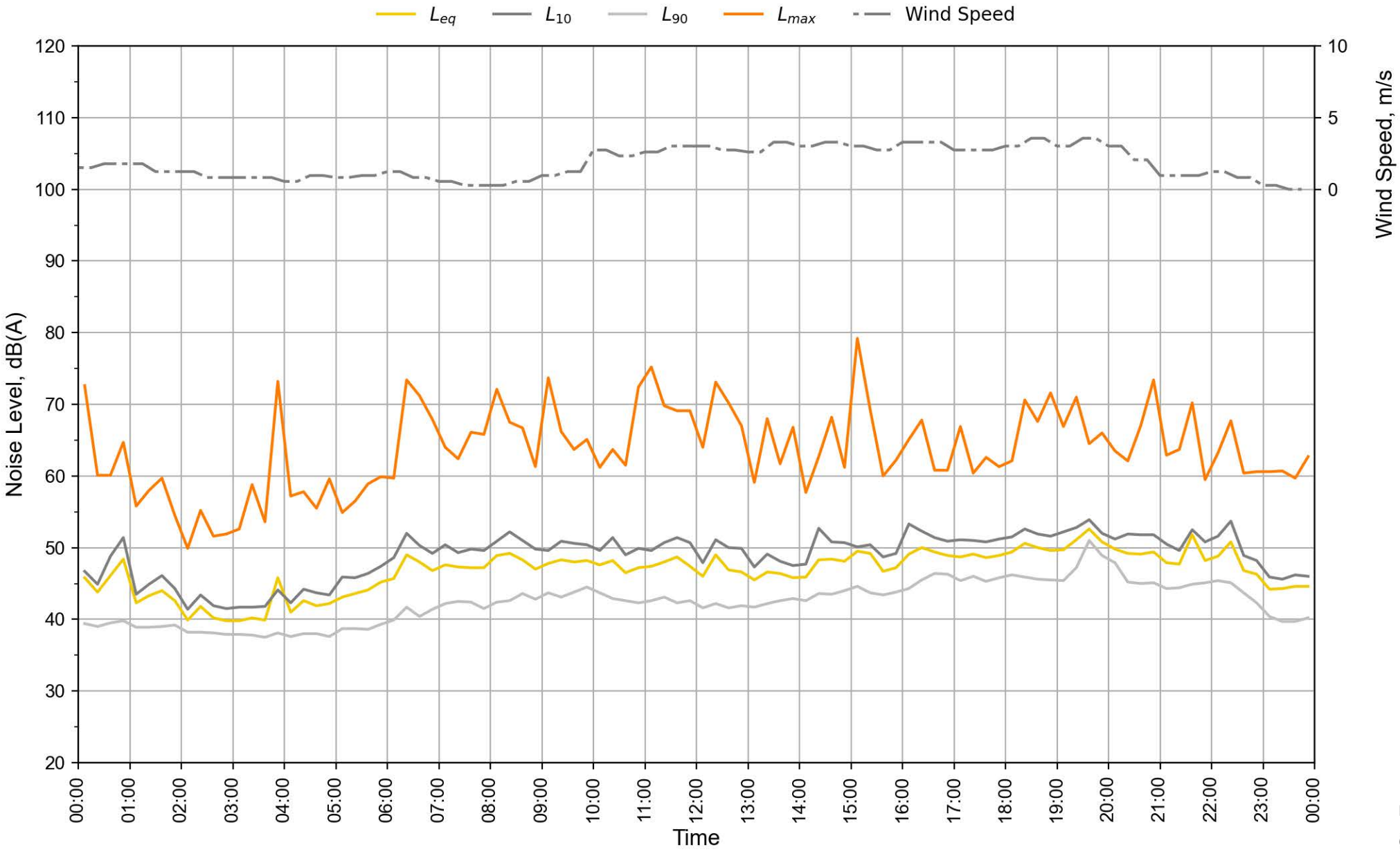
5-9 Gordon Avenue (Location 2) - Friday, 17 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

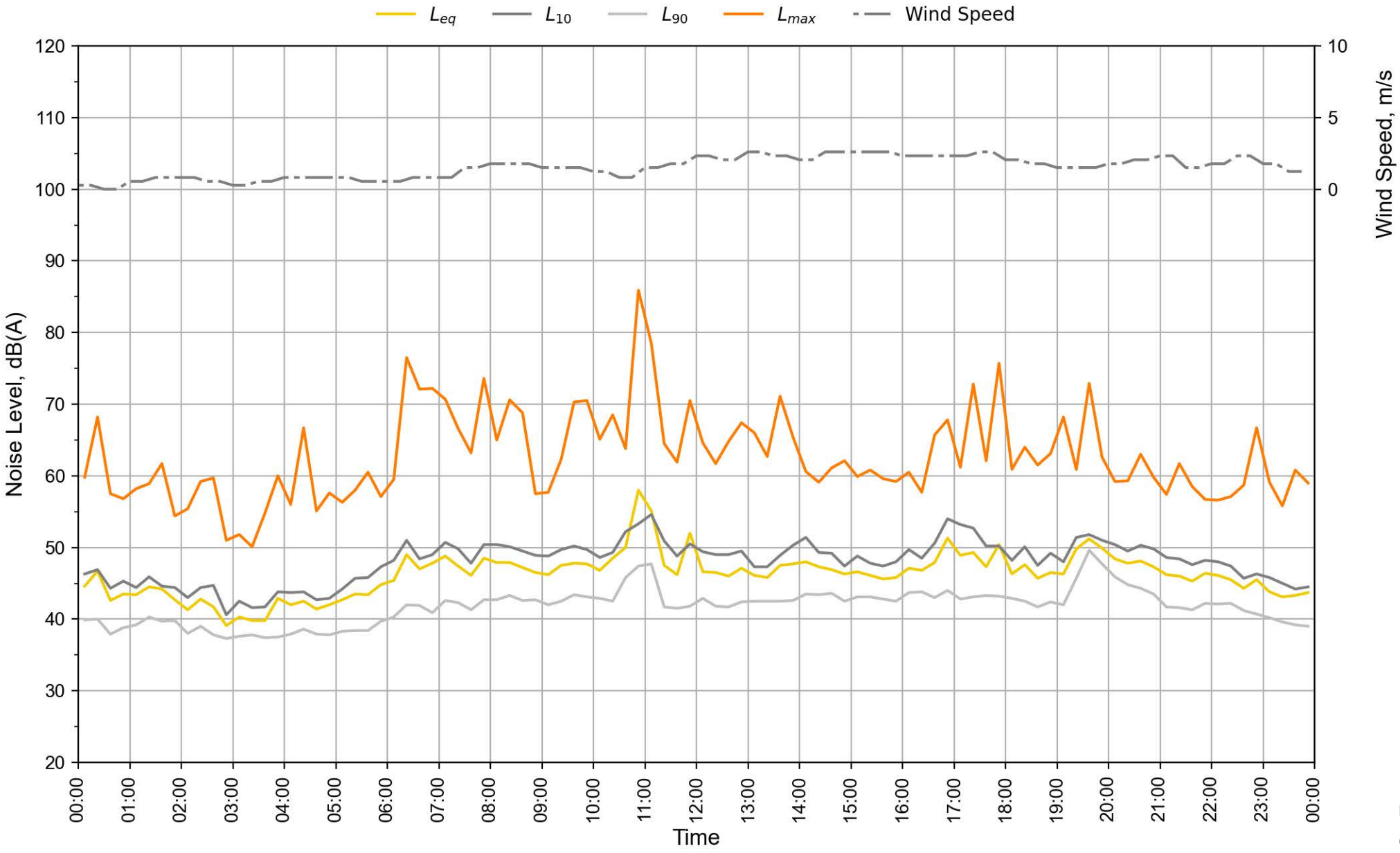
5-9 Gordon Avenue (Location 2) - Saturday, 18 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

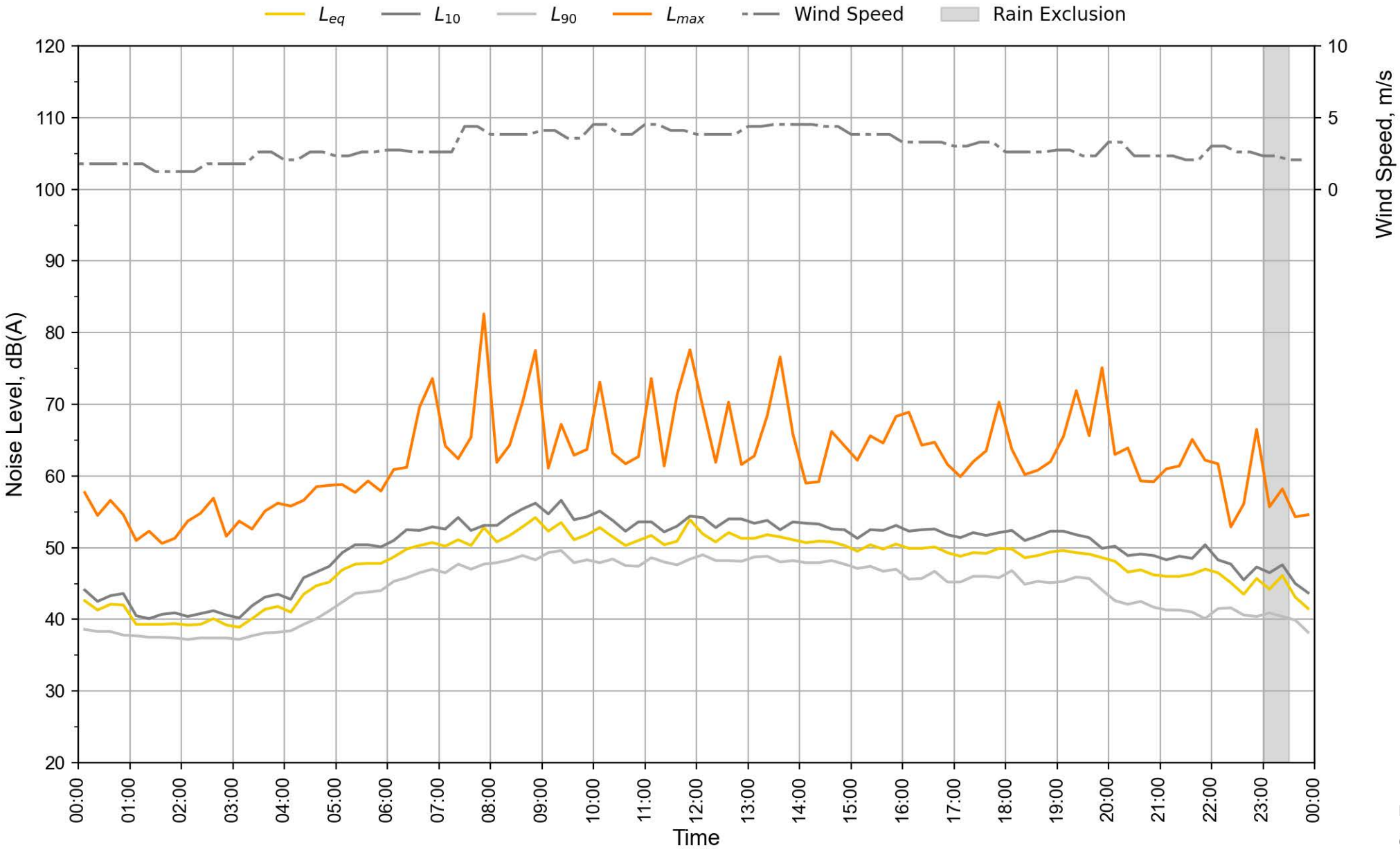
5-9 Gordon Avenue (Location 2) - Sunday, 19 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

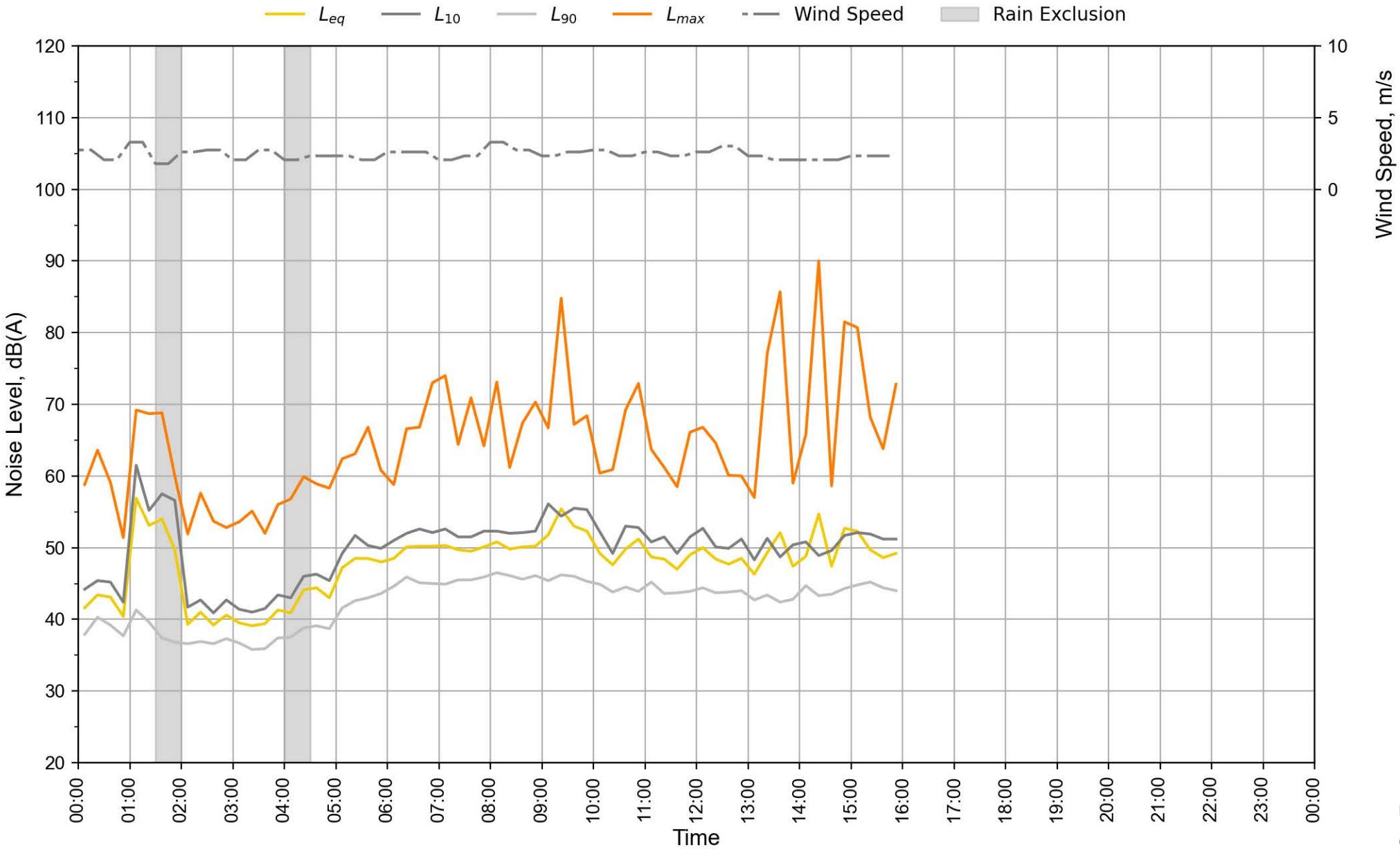
5-9 Gordon Avenue (Location 2) - Monday, 20 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Resonate

5-9 Gordon Avenue (Location 2) - Tuesday, 21 March 2023



Rion NL-42
946983
Calibration:
2022-11-30

Appendix C – Predicted noise modelling results

Table 23 Façade noise mapping results

Level	Façade facing	Daytime predicted façade noise levels	Night-time predicted façade noise levels(1)
Ground	East	45.6	43.6
	North	53.7	51.7
	South	57.4	55.4
	West	57.3	55.3
Level 1	East	48.4	46.4
	North	55.7	53.7
	South	59	57
	West	58.9	56.9
Level 2	East	50.8	48.8
	North	57.5	55.5
	South	57	55
	West	59.5	57.5
Level 3	East	52.6	50.6
	North	59.9	57.9
	South	58.9	56.9
	West	60.4	58.4
Level 4	East	53.7	51.7
	North	60.8	58.8
	South	59.4	57.4
	West	61.3	59.3
Level 5	East	54.6	52.6
	North	61.4	59.4
	South	60.4	58.4
	West	62.4	60.4
Level 6	East	55	53
	North	61.7	59.7
	South	61	59
	West	63.4	61.4

Level	Façade facing	Daytime predicted façade noise levels	Night-time predicted façade noise levels[1]
Level 7	East	55.7	53.7
	North	62.3	60.3
	South	61.6	59.6
	West	64.3	62.3
Level 8	East	56	54
	North	63.3	61.3
	South	61.9	59.9
	West	64.7	62.7
Level 9	East	56.2	54.2
	North	63.8	61.8
	South	62.3	60.3
	West	65.2	63.2
Level 10	East	56.1	54.1
	North	64	62
	South	62.8	60.8
	West	65.1	63.1
Level 11	East	56	54
	North	63.9	61.9
	South	62.7	60.7
	West	65	63
Level 12	East	55.9	53.9
	North	63.8	61.8
	South	62.8	60.8
	West	65	63
Level 13	East	55.8	53.8
	North	63.7	61.7
	South	62.7	60.7
	West	64.8	62.8
Level 14	East	55.6	53.6
	North	63.6	61.6
	South	62.6	60.6

Level	Façade facing	Daytime predicted façade noise levels	Night-time predicted façade noise levels[1]
	West	64.7	62.7
Level 15	East	55.2	53.2
	North	63.4	61.4
	South	62.4	60.4
	West	64.6	62.6
Level 16	East	55	53
	North	63.3	61.3
	South	62.3	60.3
	West	64.4	62.4
Level 17	East	54.9	52.9
	North	63.1	61.1
	South	62.1	60.1
	West	64.3	62.3
Level 18	East	54.7	52.7
	North	63	61
	South	62	60
	West	64.1	62.1
Level 19	East	54.6	52.6
	North	62.8	60.8
	South	61.9	59.9
	West	64	62
Level 20	East	54.4	52.4
	North	62.7	60.7
	South	61.8	59.8
	West	63.9	61.9
Level 21	East	54.3	52.3
	North	62.5	60.5
	South	61.6	59.6
	West	63.7	61.7
Level 22	East	54.1	52.1
	North	62.4	60.4

Level	Façade facing	Daytime predicted façade noise levels	Night-time predicted façade noise levels(1)
	South	61.5	59.5
	West	63.6	61.6
Level 23	East	53.8	51.8
	North	62	60
	South	61.2	59.2
	West	63.3	61.3
Level 24	East	53.6	51.6
	North	61.8	59.8
	South	61	59
	West	63.1	61.1
Level 25	East	53.4	51.4
	North	61.7	59.7
	South	60.9	58.9
	West	62.9	60.9

(1) 2 dB(A) reduction has been adopted for the façade predicted noise levels during the night-time period. This reduction was determined by the difference between the day (15 hour) and night time (9 hour) noise monitoring results for UN01 presented in Table 22.