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Tamworth Mental Health Unit Acoustic REF Report

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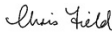
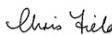
Tamworth Mental Health Unit Acoustic REF Report

Health Infrastructure NSW

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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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1 Introduction

WSP Australia Pty Ltd (WSP) has been engaged by Health Infrastructure (Client) to provide acoustic consultancy services to support the Review of Environmental Factors (REF) for the proposed Banksia Mental Health Unit located in Tamworth, NSW (the Project).

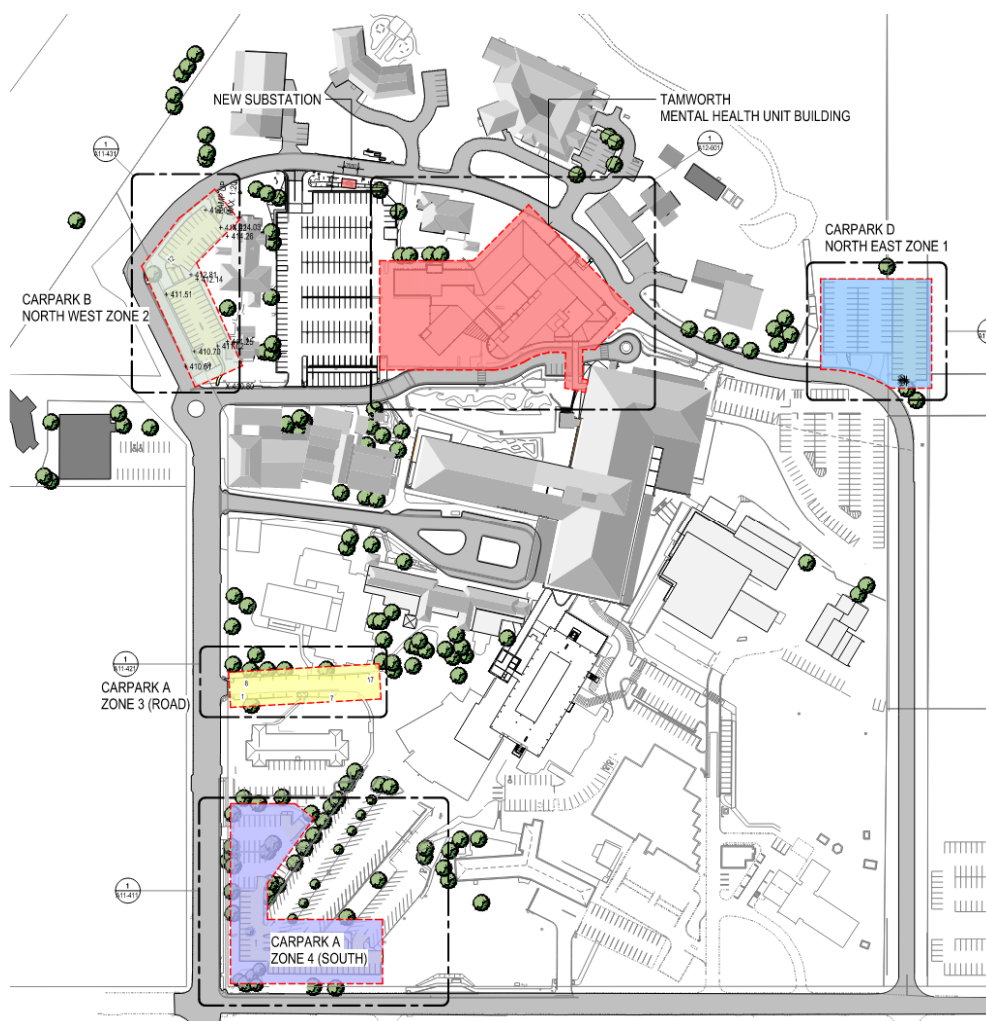
1.1 Site and project description

The Project site is located within the Tamworth Hospital site, located on Dean Street, North Tamworth, NSW. The proposed location for the Project is directly adjacent to the existing Acute Services Building, connected via a link bridge. The Project will include the construction of a new three-storey building comprising of:

- Staff areas, including meeting rooms and open plan workspace
- Patient bedrooms
- Treatment rooms
- Clinical workrooms
- Interview and consult room
- Sensory, seclusion and de-escalation rooms
- Media and multipurpose rooms
- Recreational/day therapy areas and exercise rooms
- Kitchen, dining areas and lounges
- Courtyard spaces
- Toilets, corridors and circulation spaces.

The development also includes the early works which includes the expansion and reconfiguration of car parking areas to address the parking demand of the Project as shown in Figure 1.1

Figure 1.1 Site plan of Main works scope - Tamworth Mental Health Unit Building (TMHUB) and Early works scope - Addition/expansion of Carparks A – Zone 3 & Zone 4, Carpark B Zone 2 and Carpark D Zone 1.



1.2 Information sources

This acoustic report is based on the following documentation provided via Aconex:

- Architectural drawings for REF Issue, dated 13/02/2023 (architectural documentation)
- Traffic Impact Assessment by GeoLINK Consulting Pty Ltd, issued 3/11/2022.

1.3 Scope of works

This noise and vibration assessment comprises of the following elements:

- Review of available data
- Onsite noise monitoring to evaluate the background noise environment in the vicinity of the works.
- Revision of site-specific noise criteria for construction and operations
- Noise assessment through desktop studies for assumed construction scenarios
- Vibration assessment at the nearest receivers and structures

- Where noise criteria are likely to be exceeded, recommendation of noise mitigation and management measures for construction activities

2 Existing noise environment

The following sections establish acoustic requirements for potential environmental noise emissions to nearby sensitive receivers.

2.1 Sensitive receivers

Table 2.1 identifies the nearest sensitive receivers and their classification and are shown on the site plan in Figure 2.1.

Table 2.1 Identified nearest noise sensitive receivers

RECEIVER/ LOCATION	ADDRESS	Type of receiver (as per NSW NPfl)
RC01	Ronald McDonald House	Hospital
RC02	Inala House	Hospital
RC03	Acute service building	Hospital
RC04	1883 Building	Hospital
RC05	Dean House Community Mental Health	Hospital
R1	131 – 147 Johnston St, North Tamworth NSW	Residential
R2	174 Johnston St, North Tamworth NSW	Residential
R3	117 Johnston St, North Tamworth NSW	Residential
R4	103 - 115 Johnston St & 26 Dean St, North Tamworth NSW	Residential
R5	7-11 Monteray St, North Tamworth NSW	Residential
E1	University of Newcastle Department of Rural Health Tamworth Education Centre: 114/148 Johnston St, North Tamworth NSW	Educational
E2	McCarthy Catholic College: Tribe St, North Tamworth NSW	Educational
E3	TAFE NSW Tamworth, North Tamworth NSW	Educational
C1	Tamworth Correctional Centre: 152-160 Johnston St, North Tamworth NSW	Commercial
C2	151-153 Johnston St, North Tamworth NSW	Commercial



Figure 2.1 Project site and sensitive receiver locations as detail in Table 2.1.

2.2 Existing environment

A noise survey was conducted to establish the external noise environment on site and to determine the existing background noise levels as is necessary for the noise emissions assessment to assess the extent of noise intrusion onto the Project. The prevailing background L_{A90} and ambient L_{Aeq} noise levels surrounding the site were determined in general accordance with the NSW *Noise Policy for Industry* (NPfI).

Unattended noise surveys were conducted from:

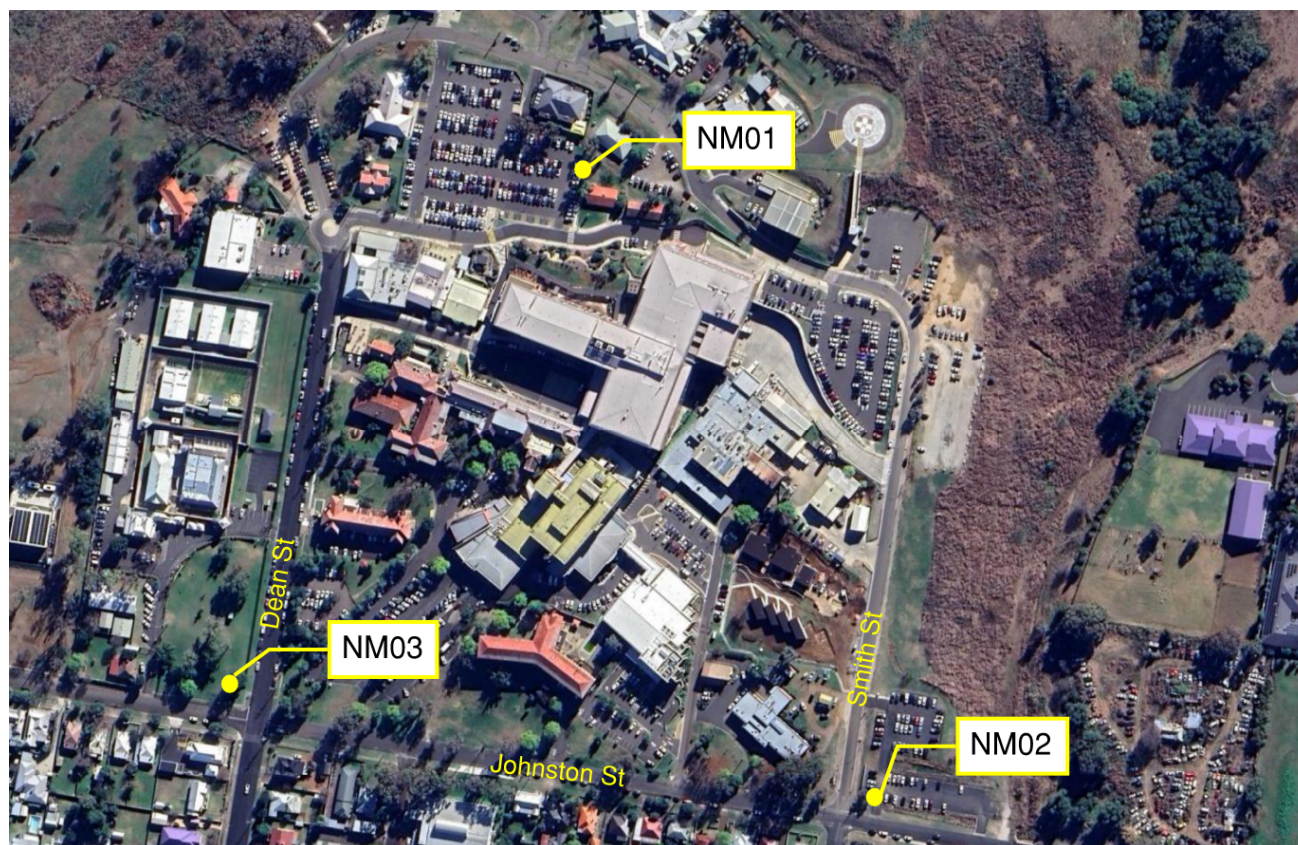
- Tuesday, 7 December 2021 to Friday, 17 December 2021; and
- Friday, 3 February 2023 to Friday, 10 February 2023.

The noise monitoring equipment was within calibration at the time the noise monitoring was undertaken as described in Table 2.2. The noise monitoring equipment was installed within the project site, marked as NM01, NM02 and NM03 as shown in Figure 2.2. In accordance with the NPfI, any noise monitoring results during adverse weather conditions have been excluded from the dataset.

Table 2.2 Equipment details and calibration

Equipment description, manufacturer, model no.	Logger ID	Serial no.	Calibration due date
Noise Logger, Ngara	NM01	878099	28/07/2023
Noise Logger, Ngara	NM02	87809B	11/01/2024
Noise Logger, Rion	NM03	296510	09/06/2023

Figure 2.2 Unattended Noise Monitoring Locations



The results of the noise survey were summarised in accordance with the NPfI and the existing external background and ambient noise levels on site are presented in Table 2.3. Noise logging graphs including periods where data has been excluded due to weather conditions and extraneous events, are presented in 0.

Table 2.3 Background and ambient noise levels

Logger Location	Period ⁽¹⁾	Background noise level, dBA L90	Ambient noise level, dBA Leq,15minute
NM01	Day	39	49
	Evening	39	46
	Night	37	44
NM02	Day	40	56
	Evening	40	51
	Night	38	49
NM03	Day	46	59
	Evening	40	56
	Night	45	56

(1) Day: the period from 7.00 am to 6.00 pm Monday to Saturday; or 8.00 am to 6.00 pm Sundays and public holidays; Evening: the period from 6.00 pm to 10.00 pm; Night: the remaining periods (as per the NPfI).

3 Project Criteria

The following sections provide an overview of the environmental noise criteria applicable to the Project. The acoustic criteria have been developed with reference to the following guidelines and standards.

- Tamworth Regional Council's Requirements (Tamworth Regional Development Control Plan 2010)
- Noise Policy for Industry (NPfI)
- NSW Road Noise Policy (RNP)

3.1 Tamworth regional development control plan

The Tamworth Regional Development Control Plan (DCP) 2010 does not have any specific criteria relating to acoustics. The following environmental noise controls are mentioned:

- *Environmental effects:*
 - *The application documentation shall identify any potential environmental impacts of the development and demonstrate how they will be mitigated. These impacts may relate to:*
 - *Noise emissions*
- *Noise:*
 - *Where relevant, applications are to contain information about likely noise generation and the method of mitigation.*

3.2 Noise Policy for Industry

3.2.1 Overview

The NPfI prescribes methods for determining the statutory environmental noise limits that apply to noise sensitive receivers (i.e. residences) with regards to noise due to individual noise sources only.

The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences
- Maintaining noise level amenity for particular land uses for residences and other land uses.

In assessing the noise impact of industrial sources, both components must be considered for residential receivers. In most cases, only one will become the limiting criterion and form the project-specific noise levels for the industrial source under assessment. The intrusive noise criteria do not apply to commercial receivers, instead an amenity criterion is applicable to these receivers.

In addition to the above, the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered.

3.2.2 Project Intrusiveness Noise Level

With regards to the assessment of intrusive noise due to industrial sources, the NPfI states:

The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold.

The intrusiveness criterion for residential receivers prescribed in the NPfI may be summarised as:

$$L_{Aeq, 15\text{-minute}} \leq \text{Rating Background Level (RBL), } L_{A90} + 5 \text{ dB}$$

The background noise levels measured at noise monitoring locations NM02 and NM03, as shown in Figure 2.2, is considered representative of the nearest noise sensitive residential receivers. Based on the background noise level measured during the day, evening and night periods, the RBL and intrusiveness criterion shown in Table 3.1 has been established for the proposed development in accordance with the NSW NPfI.

Table 3.1 Established Project Intrusiveness Noise Level, residential receivers only

Residential Receiver Location	Representative Noise Monitoring Location	NSW NPfI Time Period ⁽¹⁾	RBL dBA L_{90}	project intrusiveness noise level (RBL + 5 dB) dBA $L_{eq,15min}$
R1, R2, R5	NM02	Day	40	45
		Evening	40	45
		Night	38	43
R3, R4	NM03	Day	46	51
		Evening	40	45
		Night	45	50

(1) Day: the period from 7.00 am to 6.00 pm; Evening: the period from 6.00 pm to 10.00 pm; Night: the remaining periods.

3.2.3 Project Amenity Noise Level

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels prescribed in the NPfI where feasible and reasonable.

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

Project amenity noise level for industrial development = recommended amenity noise level (Table 2.2) minus 5 dBA

It is noted that, in order to standardise the time periods for the intrusiveness and amenity noise levels, the following conversion between $L_{eq,period}$ and $L_{eq,15minute}$ has been applied (as per Section 2.2 of the NSW NPfI):

$$L_{Aeq,15minute} = L_{Aeq, period} + 3 \text{ dB}$$

The amenity criterion has been established at the identified receivers based on the results of the unattended noise survey (refer to Section 2). The established amenity criteria applicable to the proposed development are presented in Table 3.3.

Table 3.2 Established Project Amenity Noise Level

Location	RECEIVER TYPE	NPfI Time Period ¹	Recommended Amenity noise level (ANL), dBA $L_{eq,period}$	Project Amenity noise level (ANL), dBA $L_{eq,period}$	Project Adjusted Amenity Noise level dBA $L_{eq,15min}$
Residential receivers	Residential	Day	55	50	53
		Evening	45	40	43

		Night	40	35	38
Hospital	Hospital ward	Noisiest 1-hour			
	— Internal		35	30	33
	— External		50	45	48
Commercial	Commercial	When in use	65	60	63
Schools	Education	Noisiest 1-hour			
	— Internal		35	30	33
	— External ²		45	40	43

(1) Day: the period from 7.00 am to 6.00 pm; Evening: the period from 6.00 pm to 10.00 pm; Night: the remaining periods.

(2) Where internal amenity noise levels are specified. In cases where gaining internal access for monitoring is difficult, a 10dBA correction is applied for external noise amenity levels.

3.2.4 Project Noise Trigger Level

In assessing the noise impact of the proposed development on surrounding residential receivers, the lower value of the project intrusiveness noise level and amenity noise level is selected as the project noise trigger level. Exceedance of the trigger level would indicate a potential noise impact on the community and ‘trigger’ a management response; for example, further investigation of mitigation measures.

As required in Section 2.2 of the NPfI, all project noise trigger levels and limits are expressed as $L_{Aeq,15min}$, unless otherwise expressed. A summary of all relevant criteria is presented in Table 3.3.

Table 3.3 Summary of NSW Noise Policy for Industry Project Noise Trigger Levels

Receiver type	NPfI Time Period ⁽¹⁾	NPfI Intrusive Criteria dBA $L_{eq,15min}$	Project Adjusted Amenity Noise level dBA $L_{eq,15min}$	Project Noise trigger Level dBA $L_{eq,15min}$
Residential Receivers (R1, R2, R5)	Day	45	52	45
	Evening	45	43	43
	Night	43	38	38
Residential Receivers (R3, R4)	Day	51	52	51
	Evening	45	43	43
	Night	50	38	38
Hospital ward	Noisiest 1-hour	-		
— Internal			33	33
— External			48	48
Commercial	When in use	-	63	63
Schools	Noisiest 1-hour	-		
— Internal			33	33
— External			43	43

- (1) Day: the period from 7.00 am to 6.00 pm Monday to Saturday; or 8.00 am to 6.00 pm Sundays and public holidays; Evening: the period from 6.00 pm to 10.00 pm; Night: the remaining periods.

3.2.5 Maximum noise level event criteria

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance encompasses both awakenings and disturbance to sleep stages.

Where the development night-time noise levels at a residential location exceed the following, a detailed maximum noise level event assessment should be undertaken.

- $L_{Aeq,15min}$ 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 the greater.

Table 3.4 summarises the maximum noise level event screening criteria for the proposed development.

Table 3.4 Maximum noise level event screening criteria

Nearest sensitive residential receivers	Provided Screening Criteria	RBL Based Screening Criteria	Proposal Screening Criteria
Residential Receivers (R1, R2, R5)	40 $L_{Aeq, 15 \text{ minute}}$ dBA	$(38 + 5)^1$ 43	43 $L_{eq, 15 \text{ minute}}$ dBA
	52 L_{AFmax} dBA	$(38 + 15)^2$ 53	53 L_{Fmax} dBA
Residential Receivers (R3, R4)	40 $L_{Aeq, 15 \text{ minute}}$ dBA	$(45 + 5)^1$ 50	50 $L_{eq, 15 \text{ minute}}$ dBA
	52 L_{AFmax} dBA	$(45 + 15)^2$ 60	60 L_{Fmax} dBA

- (1) RBL + 5 as outlined in the NPfI
 (2) RBL + 15 as outlined in the NPfI

3.3 Road Traffic Noise

The RNP provides guidance on the assessment of noise impacts from road traffic noise on sensitive receivers. Traffic associated with the project would access the site via Smith and Dean St, therefore local road criteria would apply for additional traffic from construction works.

Table 3.9 presents a summary of the applicable criteria for residential receivers.

Table 3.5 Road traffic noise criteria for residential receivers on existing roads affected by additional traffic from land use developments

Road type	Road Traffic Noise Criteria	
	Day (7am to 10pm)	Night (10pm to 7am)
Local Roads	55 dBA L_{eq} 1hr	50 dBA L_{eq} 1hr

The RNP application 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 dBA above that of the noise level without the development. This limit applies

wherever the noise level without the development is within 2 dBA of, or exceeds, the relevant day or night noise assessment criterion.’

Therefore, if the road traffic noise levels increase by more than 2 dBA as a result of the proposed construction traffic, and the criteria in Table 3.9 are exceeded, an investigation of mitigation options would be required.

3.4 Helicopter noise associated with hospital operations

It is noted that the project is located near a helipad and is subject to take off and landing noise from helicopter activity.

The NSW Health Guidelines’ recommended maximum design noise levels for helicopter internal noise levels and impact on the Project will be provided in the updated Design Development Submission.

We understand that the proposed Project will have minimal impact to the operation of the helipad and therefore no additional noise impact is expected to surrounding noise sensitive receivers. An assessment of noise impacts from helicopter noise will therefore not be necessary.

3.5 Construction Noise Management Levels

The Interim Construction Noise Guideline (ICNG) has been developed to aid the identification and understanding the impact of construction noise on sensitive land uses, and the application of reasonable and feasible management measures to minimise construction noise impacts.

As outlined in the ICNG, a quantitative assessment requires the development of Noise Management Levels (NML) based on existing Rating Background Levels (RBLs), and a comparison of predicted construction noise levels with the developed NMLs.

The recommended standard hours defined in the ICNG represent the times of the day when receivers are likely to be less sensitive to noise impacts. Where work is proposed outside of standard hours, justification is required and more stringent NMLs apply. For all other receiver types, the NMLs only apply when the receiver location is occupied / in use. Table 3.6 sets out the application of the management levels for noise at residences. In this case, no work outside of standard hours is proposed.

Table 3.6 Application of the ICNG noise management levels for residential receivers

TIME OF DAY	NML, dBA L_{eq} , 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 + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured L_{Aeq} (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected	The highly noise affected level represents the point above which there may be strong community reaction to noise.

TIME OF DAY	NML, dBA Leq, 15min	HOW TO APPLY
	75 dB(A)	Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Out-of-hours Work (OOHW)	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should consult with the community.

Table 3.7 presents the NMLs for representative residential receivers, based on RBLs from the noise monitoring described in Section 2.2.

Table 3.7 Noise management levels at residential receivers

Location	Time	RBL, dBA	Noise Management Level dBA Leq, 15min	Highly Noise Affected Level dBA Leq, 15min
Residential Receivers (R1, R2, R5)	Standard hours ¹	40	50	75
	OOHW Period 1 ²	40	45	75
	OOHW Period 2 ³	38	43	75
Residential Receivers (R3, R4)	Standard hours ¹	46	56	75
	OOHW Period 1 ²	41	46	75
	OOHW Period 2 ³	44	49	75

- (1) Standard hours are defined as Monday to Friday (7am – 6pm), Saturday (8am – 1pm).
- (2) OOHW Period 1 are defined as Monday to Friday (6pm – 10pm), Saturday (7am to 8am and 1pm to 10pm), Sunday/Public Holiday (8am to 6pm)
- (3) OOHW Period 2 are defined as Monday to Friday (10pm – 7am), Saturday (10pm to 8am), Sunday/Public Holiday (6pm to 7am)

Table 3.8 presents the NMLs for the nearest non-residential sensitive receivers.

Table 3.8

Noise management levels for non-residential sensitive receivers

Land Use	Noise Management Level (External)⁽¹⁾ dBA L_{eq}, 15 min
Commercial	70
Classrooms at schools and other educational institutions	55 ¹
Hospital wards and operating theatres	55 ¹

(1) ICNG Internal noise management level presented as external noise level based on 10 dB façade loss assumption.

Feasible and reasonable mitigation and management measures, as defined in the ICNG, are to be implemented where NMLs are exceeded either during or outside of recommended standard hours for construction work.

3.5.1 Construction Traffic Noise

The RNP provides guidance on the assessment of noise impacts from road traffic noise on sensitive receivers. Construction traffic would access the site via Smith and Dean St, therefore local road criteria would apply for additional traffic from construction works.

Table 3.9 presents a summary of the applicable criteria for residential receivers.

Table 3.9 Road traffic noise criteria for residential receivers on existing roads affected by additional traffic from land use developments

Road type	Road Traffic Noise Criteria	
	Day (7am to 10pm)	Night (10pm to 7am)
Local Roads	55 dBA L _{eq} 1hr	50 dBA L _{eq} 1hr

The RNP application 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 dBA above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dBA of, or exceeds, the relevant day or night noise assessment criterion.’

Therefore, if the road traffic noise levels increase by more than 2 dBA as a result of the proposed construction traffic, and the criteria in Table 3.9 are exceeded, an investigation of mitigation options would be required.

3.6 Construction Vibration

Vibration associated with construction activities can result in impacts on human comfort or the damage of physical structures such as dwellings. These two impacts have different criteria, with the effects of vibration on human comfort having a lower threshold.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building’s structural integrity. If there is no significant risk of cosmetic damage, then structural damage is not considered a risk.

3.6.1 Cosmetic Building damage and structural integrity

There are no vibration limits for buildings and structures in Assessing Vibration: A Technical Guideline. Therefore, the limits set out in British Standard BS 7358-2: Evaluation and measurement for vibration in buildings guide to damage levels from ground-borne vibration have been adopted.

A summary of the limits is provided in Table 3.10. These peak vibration limits are set so that the risk of cosmetic damage is minimal. They have been set at the lowest level above which damage has been credibly demonstrated. The limits also assume that the equipment causing the vibration is only used intermittently.

Table 3.10 BS 7385-2 Guideline vibration limits for cosmetic damage

Group	Type of structure	Peak component particle velocity, mm/s ¹		
		4–15 Hz	15–40 Hz	40 Hz and above
1	Reinforced or framed structures Industrial or heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial buildings	15 – 20 ²	20 – 50	50

1. Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible).
2. At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

3.6.2 Human Comfort (Amenity)

Table 3.11 presents the limits (vibration dose values) above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be affected by intermittent vibration from construction works. These limits are sourced from *Assessing Vibration: A Technical Guideline* (NSW DEC, 2006).

Table 3.11 Human comfort (amenity) guideline vibration limits (intermittent work and continuous vibrations)

Location	Assessment period	Vibration dose value, m/s ^{1.75}		Weighted RMS Values for Continuous Vibration Acceleration (m/s ²) 1-80 Hz			
		Preferred values	Maximum values	Preferred z-axis values	Preferred X&Y -axes values	Maximum z-axis values	Maximum X&Y -axes values
Residences	Daytime	0.20	0.40	0.010	0.0071	0.020	0.014
	Night-time	0.13	0.26	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.40	0.80	0.020	0.014	0.040	0.028

4 Noise and vibration assessment

The following sections outline the noise and vibration impacts from the operation and construction activities associated with the Project. Information available at this stage of the Project is high level and conservative, however impacts will be conservative and allow management and mitigation recommendations to be developed to manage impacts at the nearest receivers.

4.1 Operational noise assessment

4.1.1 Building Services

Mechanical plant noise mitigation measures associated with the Project are currently being detailed as part of the design development submission and will be designed to meet the relevant operational noise emission criteria. This assessment has not included any building services noise mitigation measures and should be considered as a screening assessment against the noise emission criteria outlined in Table 3.3.

The major mechanical plant items contributing to the noise emissions from the development are located on Level 3 rooftop plantroom. Most of the plant is enclosed in plantrooms with acoustic louvres installed around the perimeter, however the pumps and chillers are not fully enclosed and will be open-air for unit heat rejection. Therefore, the focus of this screening assessment will be on these open-air units.

The sound power levels associated with the open-air plant that have been provided for this operational building services noise emissions assessment are provided in Table 4.1.

Table 4.1 Equipment sound power levels

Item	Location	SWL dBA / unit
Heat Pump	Level 3 Rooftop	87
Air-Cooled Chiller	Level 3 Rooftop	84
4-Pipe Chiller	Level 3 Rooftop	92
Primary Chilled Water Pumps	Level 3 Rooftop	84
Primary Heating Hot Water Pumps	Level 3 Rooftop	84

Operational noise levels generated by the Project building services are presented for day, evening and night periods in Table 4.2. Results represent a worst-case scenario with all equipment running at full capacity at the same time with no noise mitigation measures included.

Table 4.2 - Operational noise levels

ID	Criteria			PREDICTED NOISE LEVEL, dBA $L_{eq,15\text{ min}}$		
	Day	Evening	Night	Day	Evening	Night
R1	45	43	38	38	38	38
R2	45	43	38	38	38	38
R3	51	43	38	38	38	38
R4	51	43	38	37	37	37
R5	45	43	38	39	39	39 ⁽¹⁾

E1	43	43	43	36	36	36
E2	43	43	43	35	35	35
E3	43	43	43	28	28	28
C1	63	63	63	41	41	41
C2	63	63	63	38	38	38

- (1) Predicted noise level exceeding criteria by 1 dB is considered negligible under the NPfI, as an exceedance of up to 2 dB would not be discernible to the average listener and therefore would not warrant any additional noise mitigation measures.

Predicted noise levels from mechanical plant are predicted to comply with relevant criteria at the nearest receivers. Due to the conservative approach to this assessment, it is likely that predicted noise levels will be lower than those presented in Table 4.2 once the finalised noise mitigation measures are included. Note that the Project's buildings services noise mitigation measures are primarily determined to protect the amenity of the nearest occupancies within the development as well as the surrounding buildings within the hospital i.e. Ronald McDonald House, Inala House and the Acute Service Building.

4.1.2 Traffic noise

Vehicles associated with the Project will access the site via Smith or Dean Street and park within dedicated parking bays in Carpark B directly to the west of the Project and/or at the carpark associated with Early Works.

Based on information detailed by the Traffic Consultant (GeoLINK), it is understood a total addition of park bays as part of both the Main Works and Early is as follows:

- 40 general parking bays
- 2 accessible parking bays

Given the low volume of traffic generated by the Project, the noise increase to external and internal roads to the site is expected to fall within the 2 dBA increase limit as outlined in the NSW Road Noise Policy, and no increased noise impact is expected.

4.1.3 Sleep disturbance noise emissions

Sleep disturbance events can potentially be caused by short high level noise events from operations, in this case due to the proximity of the proposed car park redevelopment to residential receivers this sleep disturbance assessment focuses on the impact of peak noise events from car door slams.

Noise levels of L_{Amax} 98 dBA have been assumed to represent typical maximum noise level events from peak noise events from car door slams. L_{Amax} noise levels were predicted based on instantaneous maximum noise levels, and an average 15-minute noise level was determined based on a 10 second events per period.

The predicted maximum noise level results at the most sensitive residential receivers are presented in Table 4.3. Exceedances are presented in bold font and predicted internal noise levels are bracketed, which have been based on a 10 dB reduction due to the building envelope.

Table 4.3 Prediction L_{Amax} noise levels at nearest residential receivers

ID	CRITERIA ⁽¹⁾		PREDICTED NOISE LEVEL ⁽²⁾ , dB	
	$L_{Aeq,15min}$	L_{Amax}	$L_{Aeq,15min}$	L_{AFmax}
R1	43	53	41	60 (50)
R2	43	53	27	44 (34)

R3	50	60	41	60 (50)
R4	50	60	38	58 (48)
R5	43	53	29	48 (38)

(1) Night: 10pm-7am, unless preceding a Sunday or Public Holiday.

(2) External noise levels at boundary of residence.

Maximum external noise levels are predicted to exceed sleep disturbance criteria by up to 7 dB L_{AFmax} at the receiver location R1 nearest Carpark A (zone 4), which is approximately 30 m away. Maximum external noise levels will remain below relevant criteria at all other residences.

The NSW Road Noise Policy concludes that:

- maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep.
- one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

All predicted internal maximum noise levels fall within the noise level range where residents are unlikely to awaken from sleep, therefore sleep disturbance from development is expected to be minimal.

4.2 Construction Noise Assessment

This section outlines the construction noise assumptions and methodology based on information available at this stage of the project.

4.2.1 Construction staging

Although the construction methodology has not been finalised at this stage, Table 4.5 presents the indicative construction activities based on approximate stage durations. At this stage it is understood that the Early works will be carried out over a 22 week period and the Main works will be carried out over an 80 week period.

Table 4.4 Construction staging – Early works

Construction stages	Duration
Scenario 1 - Demolition/Bulk earth works	2 months
Scenario 2 - Paving/asphalting	3 months

Table 4.5 Construction staging – Main works

Construction stages	Duration
Scenario 1 - Demolition/excavation	4 months
Scenario 2 - Excavation and foundation works	4 months
Scenario 3 - During erection of structure	5 months
Scenario 4 - Fitout and landscaping	5 months

4.2.2 Construction Hours

It is understood that work would be completed in standard hours, as defined in the *Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime 2016)* and summarised in Table 4.6.

Table 4.6

Construction hours

Construction hours	Monday to Friday	Saturday	Sunday or Public Holidays
Standard Hours	7 am to 6 pm	8 am to 1 pm	No work
Construction activities with impulsive or tonal noise emissions	8 am to 5 pm	9 am to 1 pm	7 am to 6 pm

Works may be carried out in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. 'Continuous' includes any period during which there is less than a one-hour respite between ceasing and recommencing any of the work the subject of this condition.

It is assumed that all adjacent roads will remain open during construction with some kerbside or median lane closures as required during construction activities and reduced speed limits. No alternative routes or detours are proposed.

4.2.3 *Construction Staging and equipment*

An overview of the indicative construction activities and proposed equipment is provided in

Table 4.8.

The noise levels and data are taken the Australian Standard AS2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* and the CNVG.

Table 4.7 Early Works - Indicative construction staging and equipment

Construction stage	Equipment	Equipment SWL	Scenario SWL
Scenario 1 - Demolition/Bulk earth works	Excavators	110	120
	Dozers	116	
	Trucks	103	
	Chainsaws	114	
	Bobcat	112	
	Crane	98	
Scenario 2 - Paving/asphalting	Pavement laying machine	114	118
	Dump truck	110	
	Asphalt truck & sprayer	103	
	Concrete truck	109	
	Smooth drum roller	107	
	Concrete saw	118	

Table 4.8 – Main Works - Indicative construction staging and equipment

Construction stage	Equipment	Equipment SWL	Scenario SWL
Scenario 1 - Demolition/excavation	Excavators	110	120
	Dozers	116	
	Trucks	103	
	Chainsaws	114	
	Bobcat	112	
	Crane	98	
Scenario 2 - Excavation and foundation works	Impact piling	116	122
	Excavators (rock breaker/saw)	118	
	Dozers	116	
	Trucks	103	
	Graders	113	
	Cranes	98	
Scenario 3 - During erection of structure	Hand tools (angle grinders etc for formwork)	116	121
	Concrete pumps	102	
	Excavators	110	
	Dozers	116	
	Trucks	103	
	Vibratory compactor	109	
	Concrete truck/agitator	109	
	Generator	103	
	Jackhammer	113	
Scenario 4 - Fitout and landscaping	Excavators	110	119
	Dozers (50%)	113	
	Trucks	103	
	Concrete truck/agitator	109	
	Paving machine (50%)	111	
	Cranes	98	
	Hand tools (50%)	113	

4.2.4 *Construction Noise Impact*

Precise construction methodology will be confirmed by the construction contractor, however potential noise impacts associated with an indicative construction staging have been conservatively assessed to facilitate community consultation and effective noise management and mitigation prioritisation.

The desktop study has incorporated distance propagation loss, however no other mitigation measures have been incorporated at this stage.

It is understood that construction work will generally be undertaken during standard daytime hours. Predicted worst case construction noise levels at nearest sensitive receiver are presented in Table 4.9 and Table 4.10 for Early and Main works respectively. This allows determination of the potential maximum noise impact at the nearest residence and will assist in identifying the most appropriate management and mitigation options throughout the construction process. Exceedances of noise management levels are in bold text, with highly affected noise receivers indicated in red text.

Table 4.9

Early Works - Predicted maximum construction noise levels (dBA) per scenario

Noise Receiver ID	Carpark Zone Distance from Receiver (m)				NML – Standard hours Leq, 15min dBA	Predicted construction noise level, Leq, 15min dBA							
						Carpark A (zone 3)		Carpark A (zone 4)		Carpark B (zone 2)		Carpark D (zone 1)	
						Construction Scenario		Construction Scenario		Construction Scenario		Construction Scenario	
	CP-A-Z3	CP-A-Z4	CP-B-Z2	CP-D-Z1		1	2	1	2	1	2	1	2
RC01	100	140	90	170	55	72	70	69	67	73	71	67	65
RC02	110	150	180	65	55	71	69	68	66	67	65	76	74
RC03	45	75	80	55	55	79	77	75	73	74	72	77	75
RC04	3	40	100	230	55	102	100	80	78	72	70	65	63
RC05	6	13	170	280	55	96	94	90	88	67	65	63	61
R1	160	30	330	300	50	68	66	82	80	62	60	62	60
R2	390	380	480	190	50	60	58	60	58	58	56	66	64
R3	150	30	320	390	56	68	66	82	80	62	60	60	58
R4	150	40	320	440	56	68	66	80	78	62	60	59	57
R5	390	380	470	130	50	60	58	60	58	59	57	70	68
E1	240	250	300	530	55	64	62	64	62	62	60	58	56
E2	350	380	310	600	55	61	59	60	58	62	60	56	54
E3	1100	1100	1200	850	55	51	49	51	49	50	48	53	51
C1	50	60	80	310	70	78	76	76	74	74	72	62	60
C2	320	260	470	300	70	62	60	64	62	59	57	62	60

Exceedances of highly noise affected criteria have been predicted at RC02 – RC05 for the nearest hospital buildings due to the close proximity to the proposed construction site.

Exceedances of highly noise affected criteria have been predicted at the nearest residential receivers to the south of Carpark A (zone 4) R1, R3 and R4.

It is therefore critical that a detailed noise and vibration management plan be implemented to manage the noise levels at these receivers.

Table 4.10 Main Works - Predicted maximum construction noise levels (dBA) per scenario

ID	Distance (m)	NML – Standard hours Leq, 15min dBA	Predicted construction noise level Leq, 15min dBA			
			<i>Construction Scenario</i>			
			<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
RC01	6	55	96	98	97	95
RC02	14	55	89	91	90	88
RC03	11	55	91	93	92	90
R1	330	50	62	64	63	61
R2	305	50	62	64	63	61
R3	335	56	62	64	63	61
R4	365	56	61	63	62	60
R5	300	50	62	64	63	61
E1	410	55	60	62	61	59
E2	450	55	59	61	60	58
E3	1000	55	52	54	53	51
C1	220	70	65	67	66	64
C2	335	70	62	64	63	61
C3	340	50	61	63	62	60

Exceedances of highly noise affected criteria have been predicted at RC01, RC02 and RC03 due to the close proximity to the proposed construction site. It is therefore critical that a detailed noise and vibration management plan be implemented to manage the noise levels at these receivers.

4.2.5 Construction Traffic noise

The ICNG requires an assessment of construction traffic against RNP criteria. As discussed in Section 3.5.1, the RNP states that any increase in road traffic noise as a result of a traffic generating development should be limited to no more than 2 dBA over the existing traffic noise levels.

In lieu of a detailed construction program and equipment usage it is recommended that the construction contractor review the construction traffic movements when the methodology is developed to ensure that the provisions of the RNP are satisfied.

4.2.6 Construction vibration Impact assessment

Certain construction activities would require the use of vibration intensive equipment that may affect the nearest sensitive receivers. The most vibration intensive plant nominated as part of the work is the use of vibratory rollers and piling rigs.

Table 4.11 presents the indicative minimum working distances for the nominated construction plant to minimise the risk of structural damage and human comfort for sensitive receivers. No vibration sensitive land uses have been identified among the potentially affected hospital receivers.

The minimum working distances are based on the typical distance from receivers' work permitted to be carried out to meet the limits set out in Section 3.6. The distances are indicative only and results may vary depending on the activity, equipment, local ground, and receiver conditions.

Table 4.11 Recommended minimum working distances for vibration intensive plant

Plant item	Rating / description	Minimum working distance	
		<i>cosmetic damage</i>	<i>human comfort</i>
Large hydraulic hammer	1600 kg - 18 to 34t excavator	22 m	73 m
Handheld pneumatic hammer	10 kg	1 m (nominal)	Avoid contact with structure
Vibratory roller, smooth drum	> 18t	25 m	100 m
Pile driver - vibratory	Sheet piles	2 to 20 m	20 m

All off-site sensitive receivers are located outside the minimum working distances for cosmetic damage and human comfort. Based on the construction footprint, it is anticipated that the nearest hospital structures (RC01,02,03) may be located inside the minimum working distance for cosmetic damage for some plant items.

To minimise the potential for vibration impact on these receivers, mitigation and management measures are discussed in Section 5.

5 Noise and Vibration Management

5.1 Operations

Building Services plant is proposed to be located on the Level 3 of the development. This noise assessment has been based on unattenuated units while noise mitigation measures are being finalised as part of the Design Development Submission. Noise control measures will be designed to meet the nominated operational project criteria as outlined in Table 3.3.

Given the low volume of traffic generated by the Project, the noise increase to external and internal roads to the site is expected to fall within the 2 dBA increase limit as outlined in the NSW Road Noise Policy, and no increased noise impact is expected.

Predicted maximum noise levels are predicted to fall within the range where people are unlikely to awaken from sleep and therefore no further management measures have been considered.

5.2 Construction noise and vibration

Prior to commencement of construction works and when details of construction methodology and equipment are available, a Construction Noise and Vibration Management Plan (CNVMP) is to be prepared and implemented in accordance with the requirements of the ICNG. The CNVMP would take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where practicable. The CNVMP should include a detailed noise assessment updated to consider potential noise impacts at all affected properties.

The CNVMP would outline measures to reduce the noise impact from construction activities. Reasonable and feasible noise mitigation measures which would be considered include:

- avoiding any unnecessary noise when carrying out manual operations and when operating plant
- ensuring spoil is placed and not dropped into awaiting trucks
- avoiding/limiting simultaneous operation of noisy plant in discernible range of a sensitive receiver where practicable
- switching off any equipment not in use for extended periods e.g. heavy vehicles engines would be switched off whilst being unloaded
- restriction of heavy vehicle movements to and from the site to standard (daytime) hours where feasible and avoiding deliveries at night/evenings wherever practicable
- no idling of delivery trucks
- keeping truck drivers informed of designated routes, parking locations and acceptable delivery hours for the site
- compounds, refuelling areas and work areas designed to promote one-way traffic so that vehicle reversing movements are minimised.
- minimising talking loudly; no swearing or unnecessary shouting, or loud stereos/radios onsite; no dropping of materials from height where practicable, no throwing of metal items and slamming of doors.
- maximising offset distances between noisy plant and adjacent sensitive receivers and determining safe working distances
- using the most suitable equipment necessary for the construction works at any one time
- directing noise-emitting plant away from sensitive receivers

- regularly inspecting and maintaining plant to avoid increased noise levels from rattling hatches, loose fittings etc
- using non-tonal reversing/movement alarms such as broadband (non-tonal) alarms or ambient noise-sensing alarms for all plant used regularly onsite (greater than one day), and for any out of hours works
- use of quieter and less vibration emitting construction methods where feasible and reasonable.

The most applicable standard management measures are outlined as follows:

- construction hours and scheduling:
 - works should generally be carried out during standard construction hours (i.e. 7 am to 6 pm Monday to Friday; 8 am to 1 pm Saturdays).
- vibration monitoring:
 - to avoid structural impacts as a result of vibration or direct contact with structures, the proposed works would be undertaken in accordance with the safe work distances and attended vibration monitoring or vibration trials would be undertaken where these distances are required to be challenged
 - vibration resulting from construction and received at any structure outside of the Project would be managed in accordance with:
 - for structural damage vibration - British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings.
 - for human exposure to vibration the acceptable vibration - values set out in the Environmental Noise Management Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006) which includes British Standard BS 6472:1992 Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz).
 - property conditions surveys would be completed prior to any vibration intensive work being carried out at or within the minimum distances set out in this report. Minimum working distances should be confirmed prior to carrying out any vibration intensive work on site.

Table 5.1 provides indicative benefits of typical engineering control mitigation measures for construction activities, based on guidance in AS 2436 and experience on similar construction proposals.

Table 5.1 - Indicative noise reduction from construction controls

Engineering Controls	Possible noise reduction, dBA
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers.	3-6
Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.	2-5
Orienting equipment away from sensitive receivers.	3-5
Carrying out loading and unloading away from sensitive receivers.	3-5
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as possible away from sensitive receivers	3-6

6 Conclusion

WSP has conducted a preliminary noise and vibration impact assessment for the proposed Banksia Mental Health Unit located in Tamworth, NSW.

The results of this assessment have found that operational noise impacts associated with the Project are expected achieve the NPfI and RNP criteria at the nearest residence to the Project area.

Note that the operational building services noise assessment has been based on unattenuated open-air units while noise mitigation measures are being finalised as part of the Design Development Submission. Noise control measures will be detailed to meet the nominated operational project criteria as outlined in Table 3.3.

During both Early works and Main works construction stages, maximum predicted noise levels will exceed construction noise levels at the most exposed receivers to the works areas and will require a detailed noise and vibration mitigation and management plan. Residential receivers (R1, R3 and R4) are predicted to be “highly noise affected” (i.e., exposed to levels of construction noise greater than 75dBA) during early works as part of Carpark A (Zone 4). Shielding of more distant receivers would attenuate noise at receivers further distant to the work sites.

Based on available information, it is anticipated that any operational traffic noise increase, will be minimal and comply with relevant noise goals.

An assessment of construction vibration impacts has been conducted, and the potential for vibration impact at off-site sensitive receivers or structures is considered minimal. However, hospital structures nearest the construction site may be located inside the minimum working distance for cosmetic damage for some plant items. A detailed noise and vibration management plan should be implemented to protect structures nearest to proposed construction site.

To manage noise impacts at the nearest affected receivers, a number of mitigation and management measures have been recommended for the construction and operation of the Project, refer to Section 5.2.

Based on the available information, the findings of this assessment considered that the construction and operation of the Project can achieve compliance to all off-site receivers with relevant environmental criteria if the findings and recommendations outlined in this report and design development submission are implemented. A detailed noise and vibration management plan should be carried out for hospital structures nearest the proposed construction site.

Appendix A

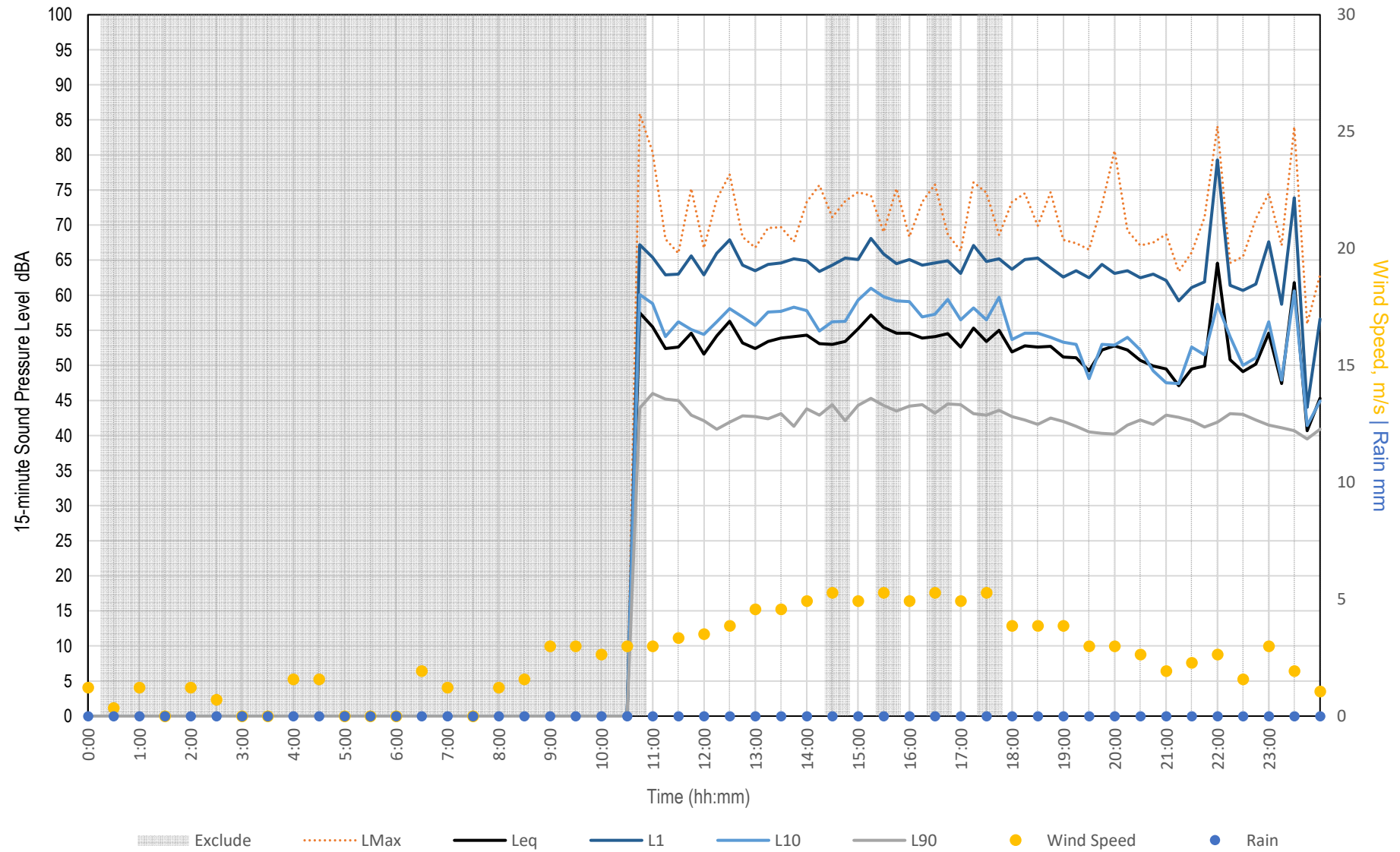
Noise Monitoring Results



A1 Noise Logger – NM02

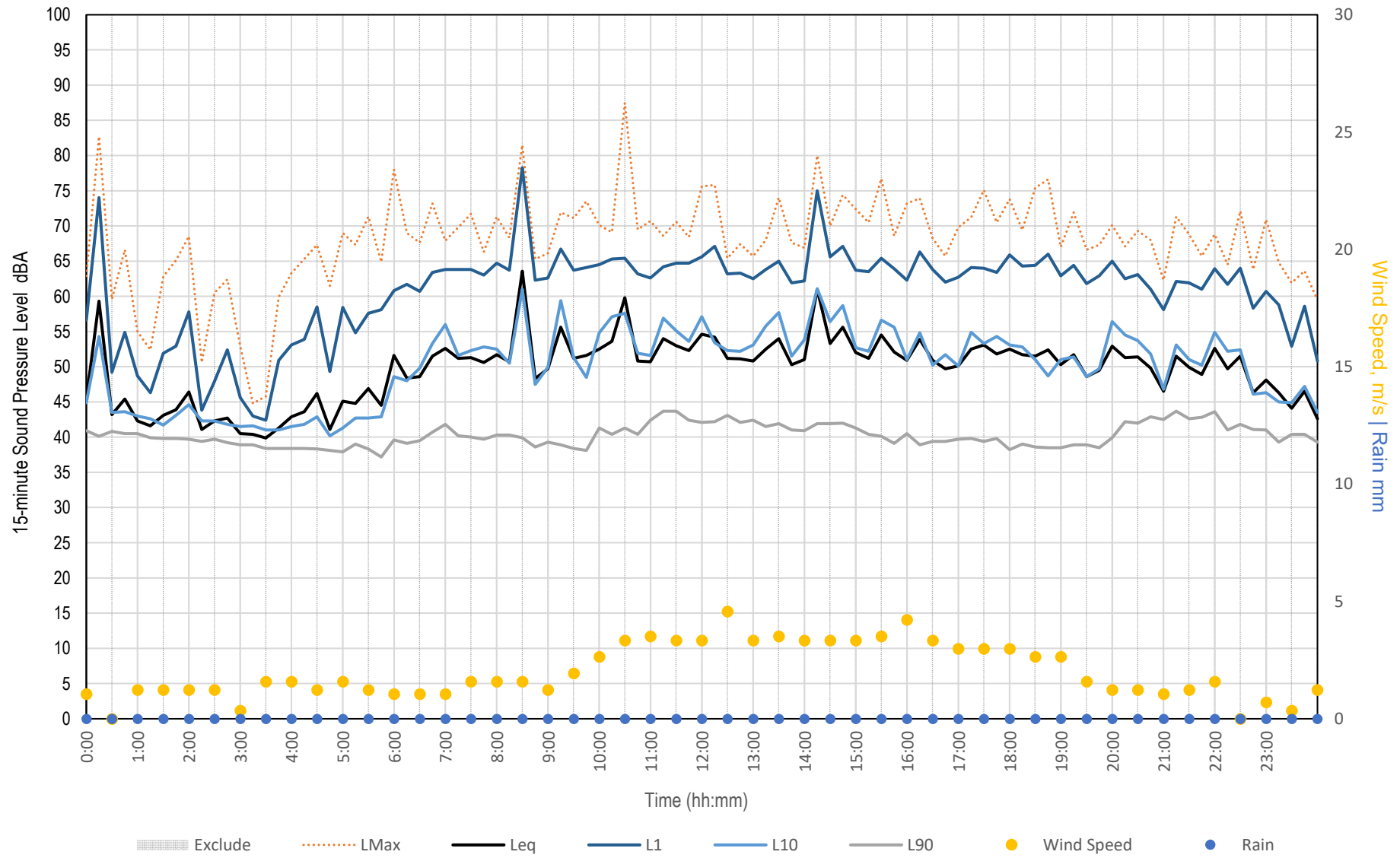
Measured Noise Levels - Tamworth Hospital, Johnston St East Parking Lot

Friday, 03 February 2023



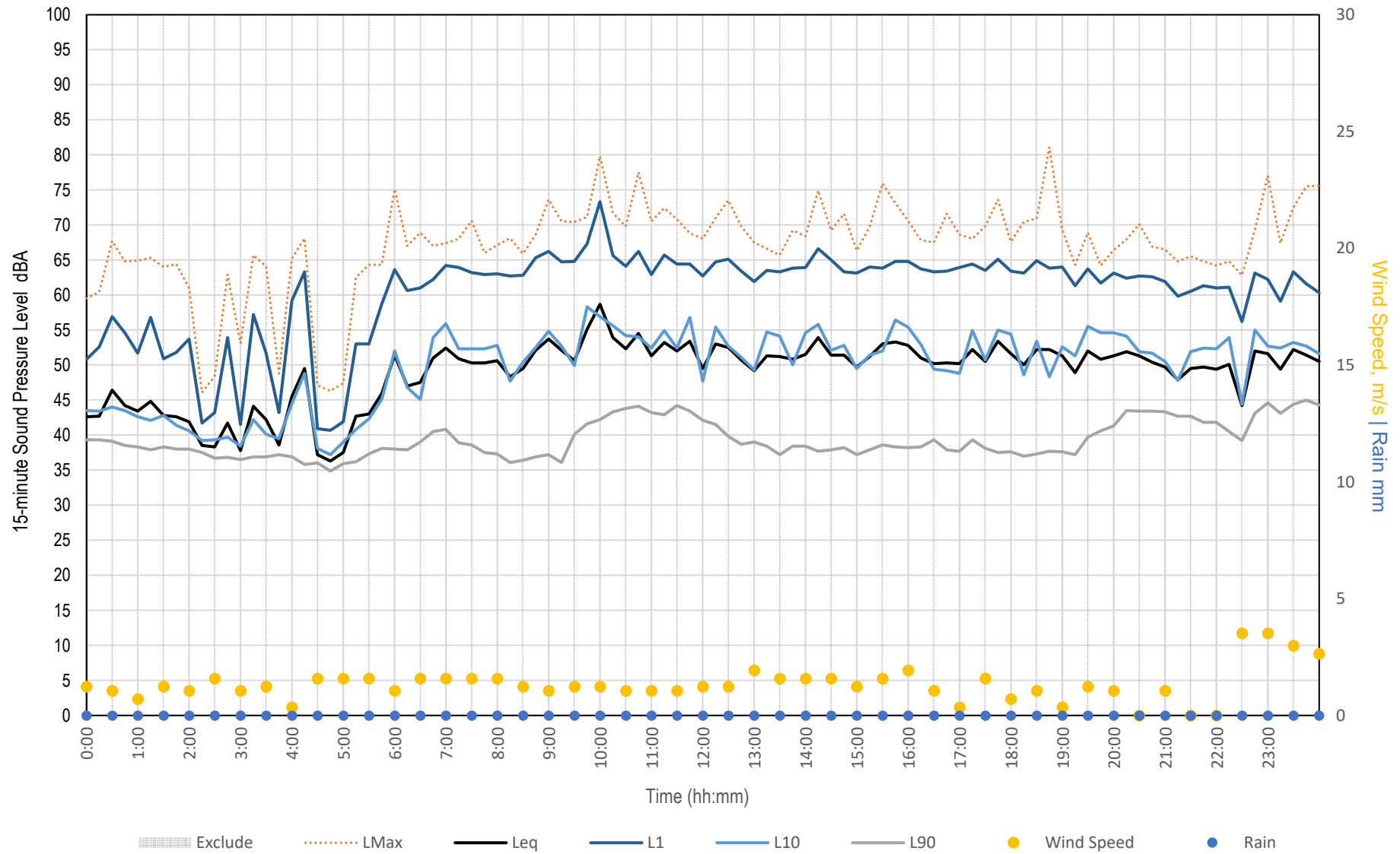
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Saturday, 04 February 2023



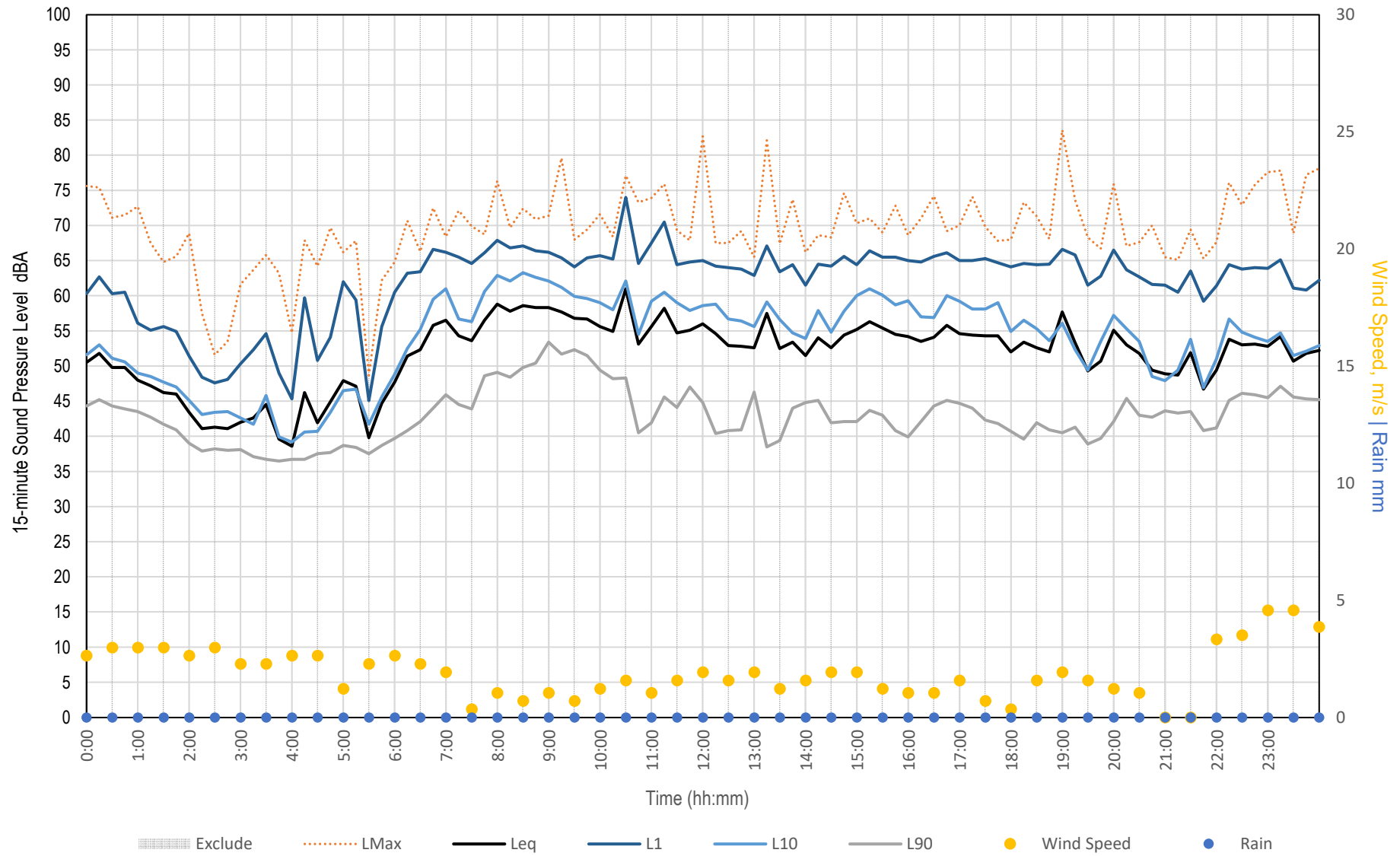
Measured Noise Levels - Tamworth Hospital, Johnston St East Parking Lot

Sunday, 05 February 2023



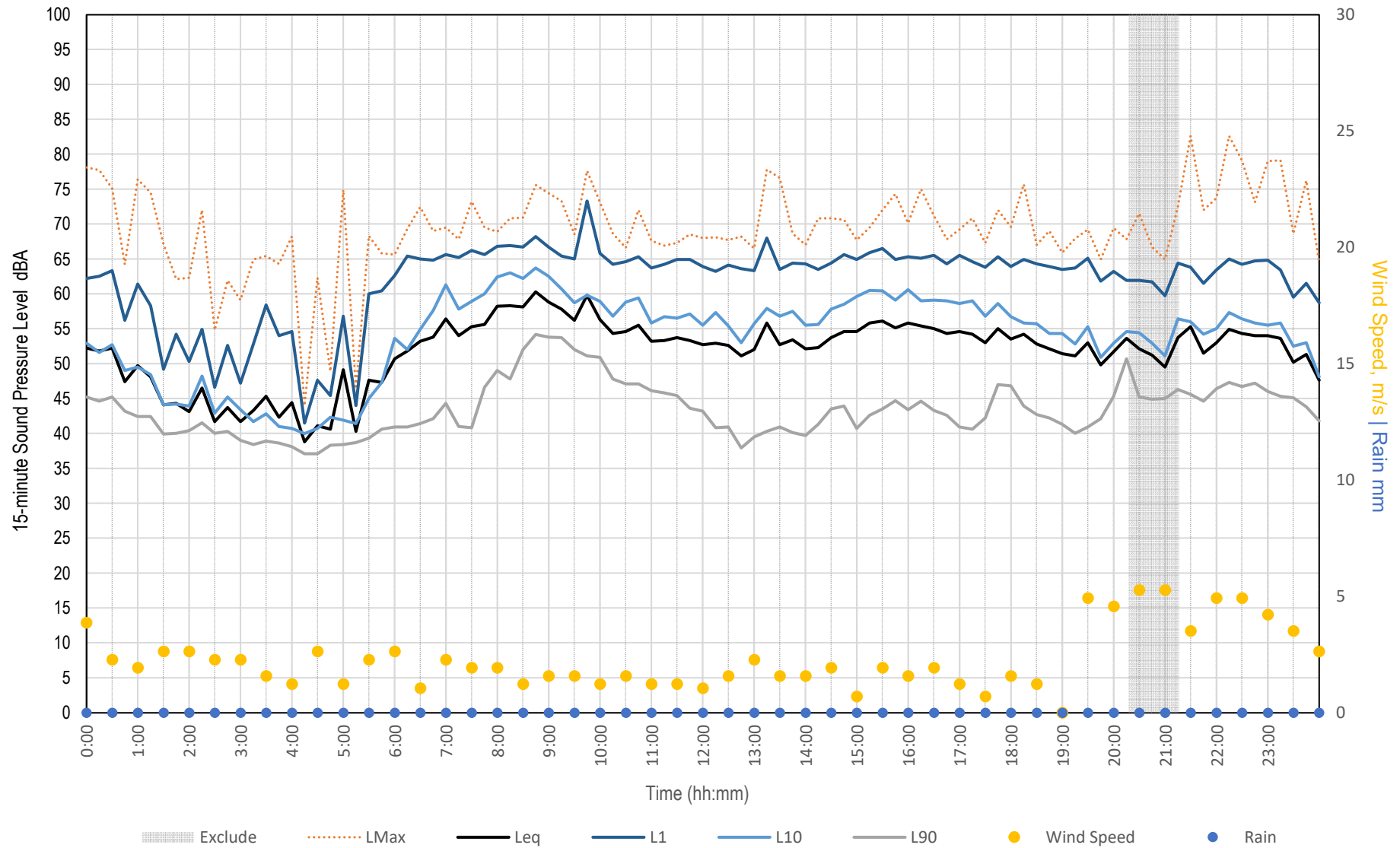
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Monday, 06 February 2023



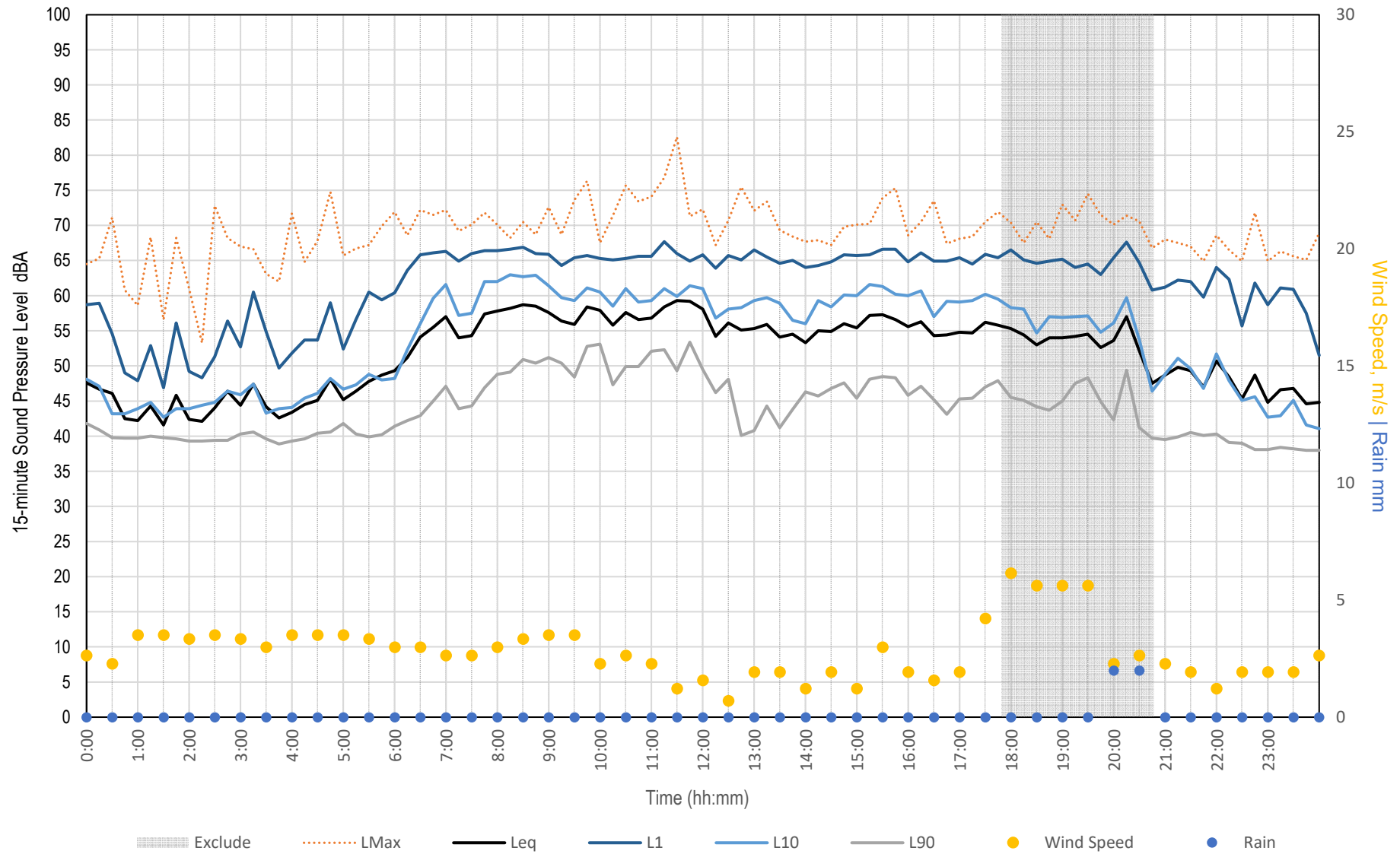
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Tuesday, 07 February 2023



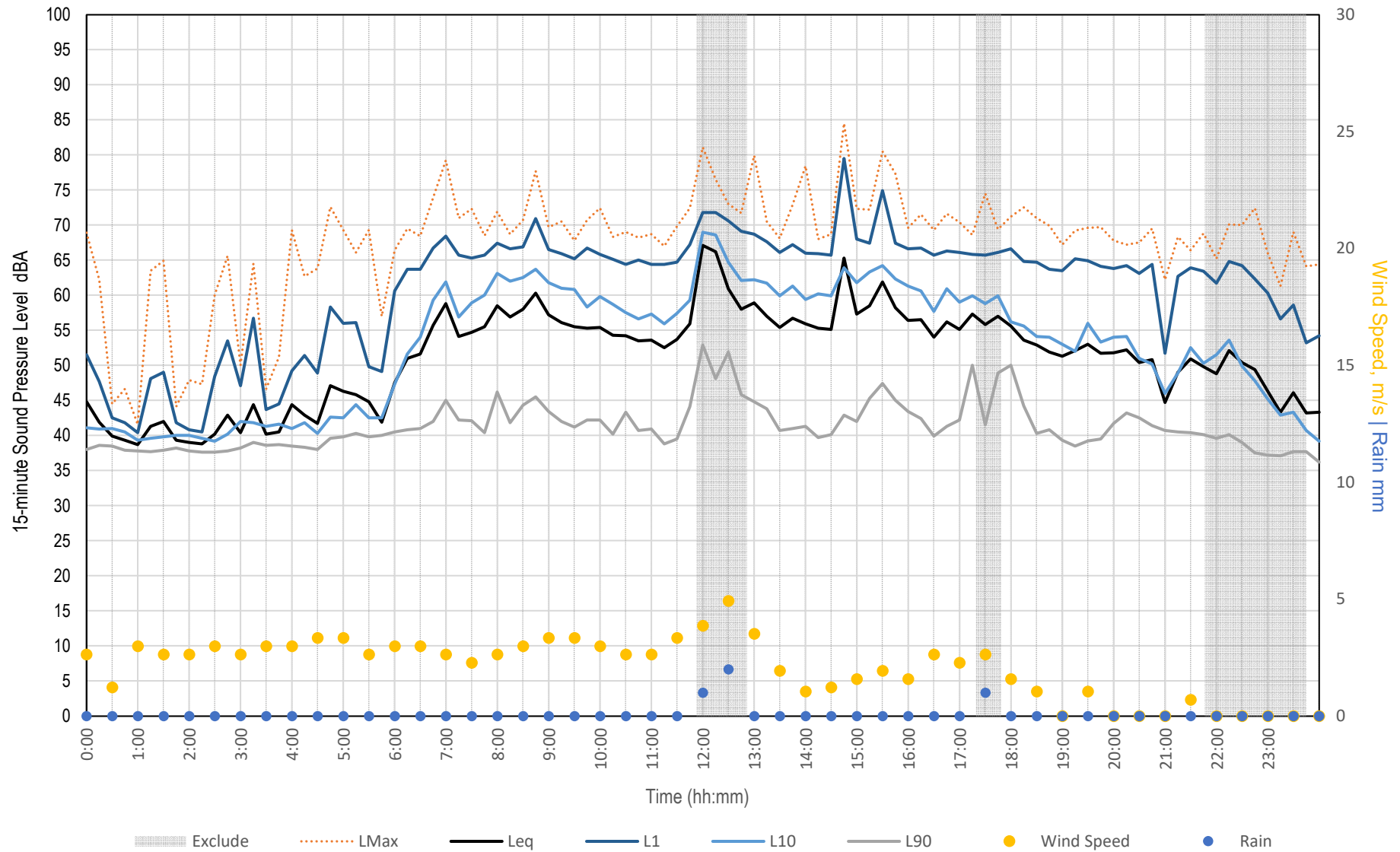
Measured Noise Levels - Tamworth Hospital, Johnston St East Parking Lot

Wednesday, 08 February 2023



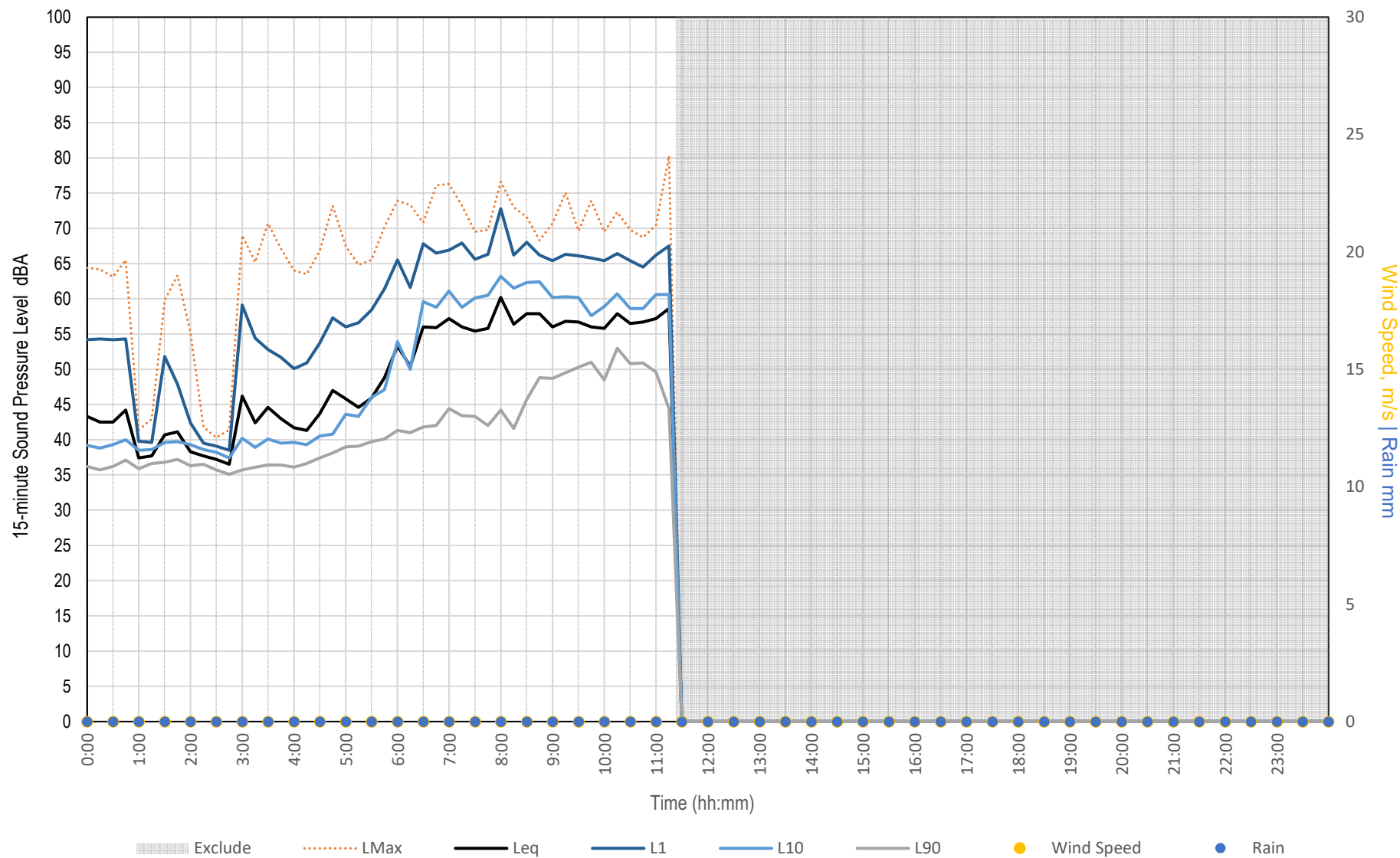
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Thursday, 09 February 2023



Measured Noise Levels - Tamworth Hospital, Johnston St East Parking Lot

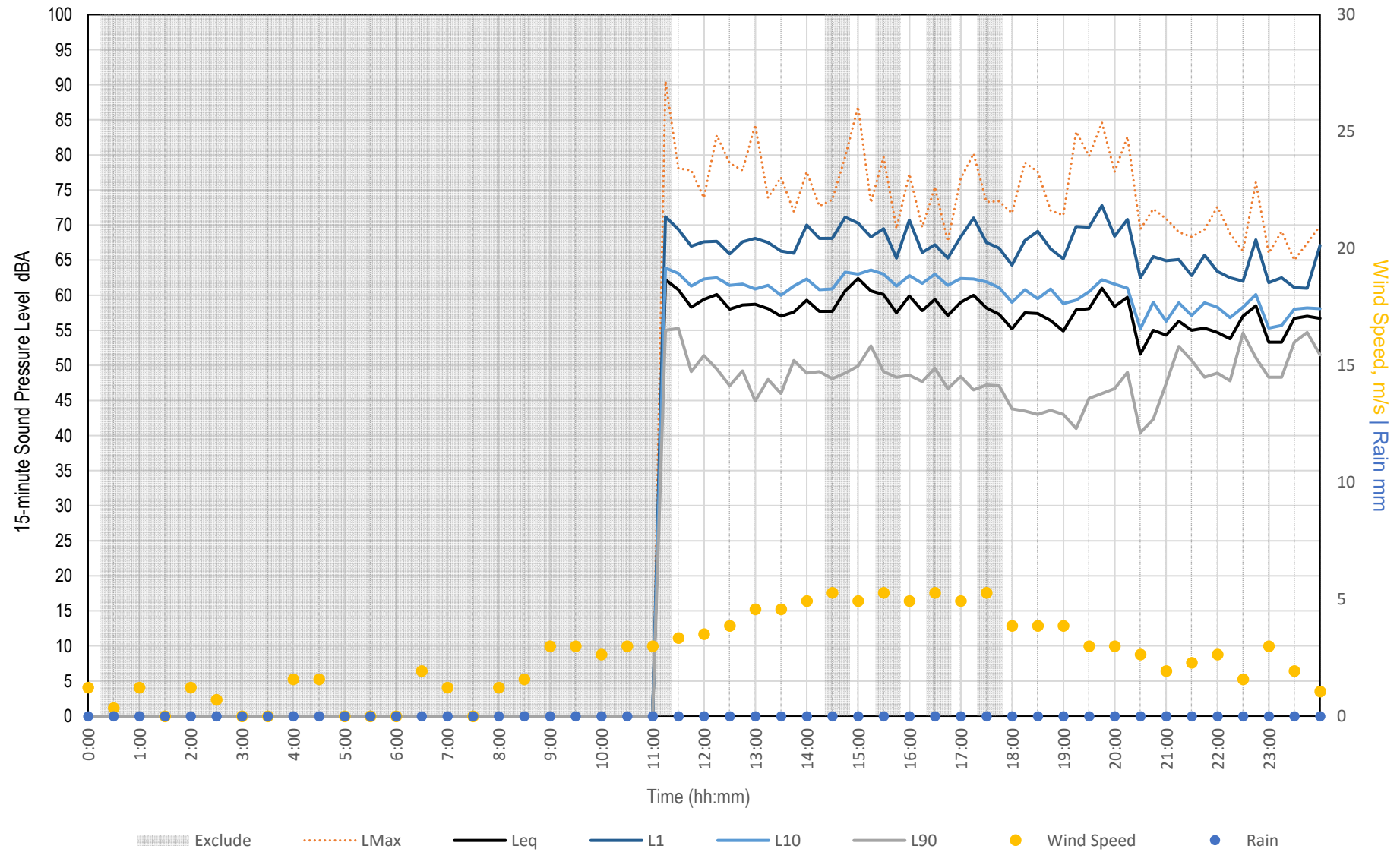
Friday, 10 February 2023



A2 Noise Logger – NM03

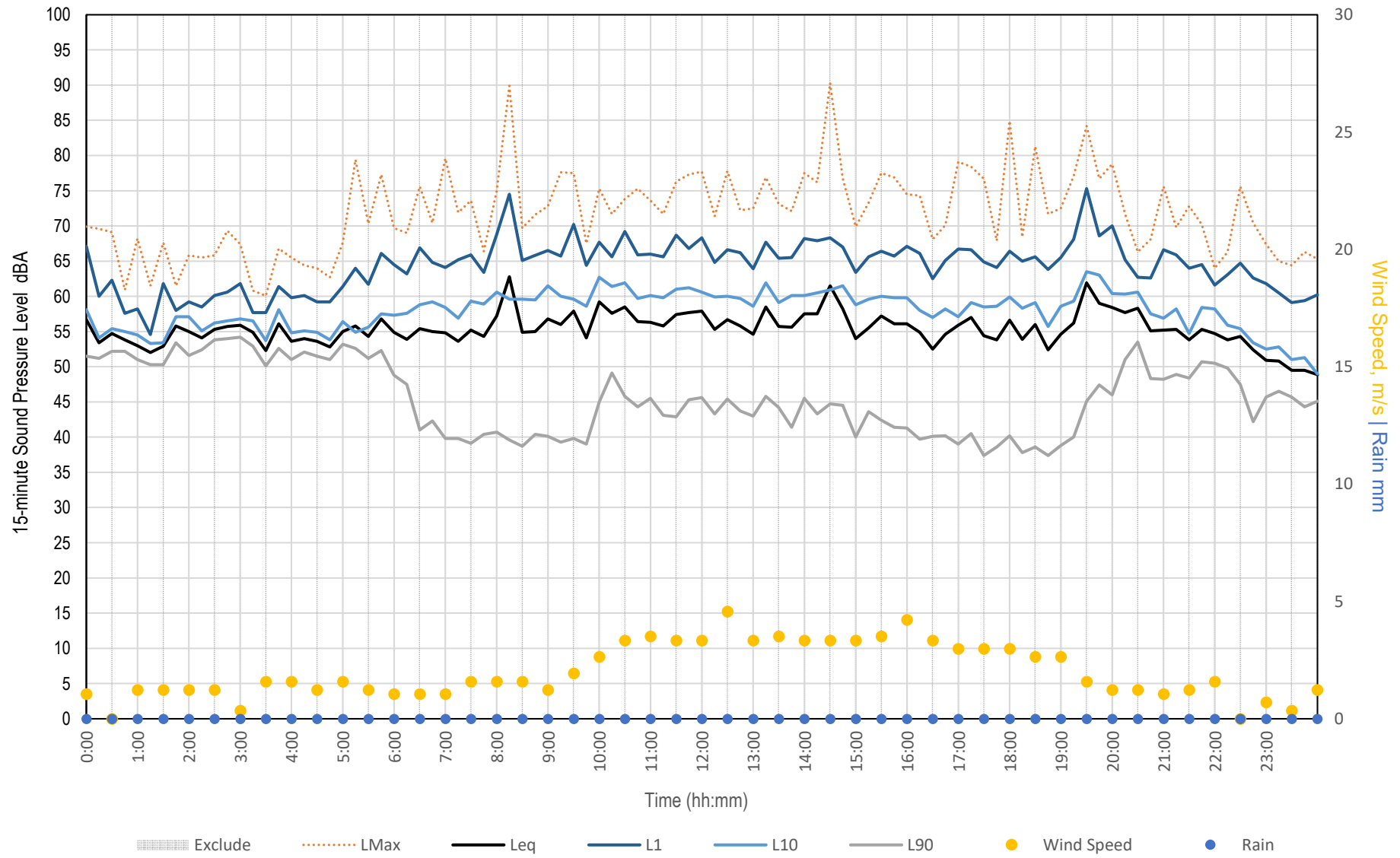
Measured Noise Levels - Cnr Johnston & Dean St

Friday, 03 February 2023



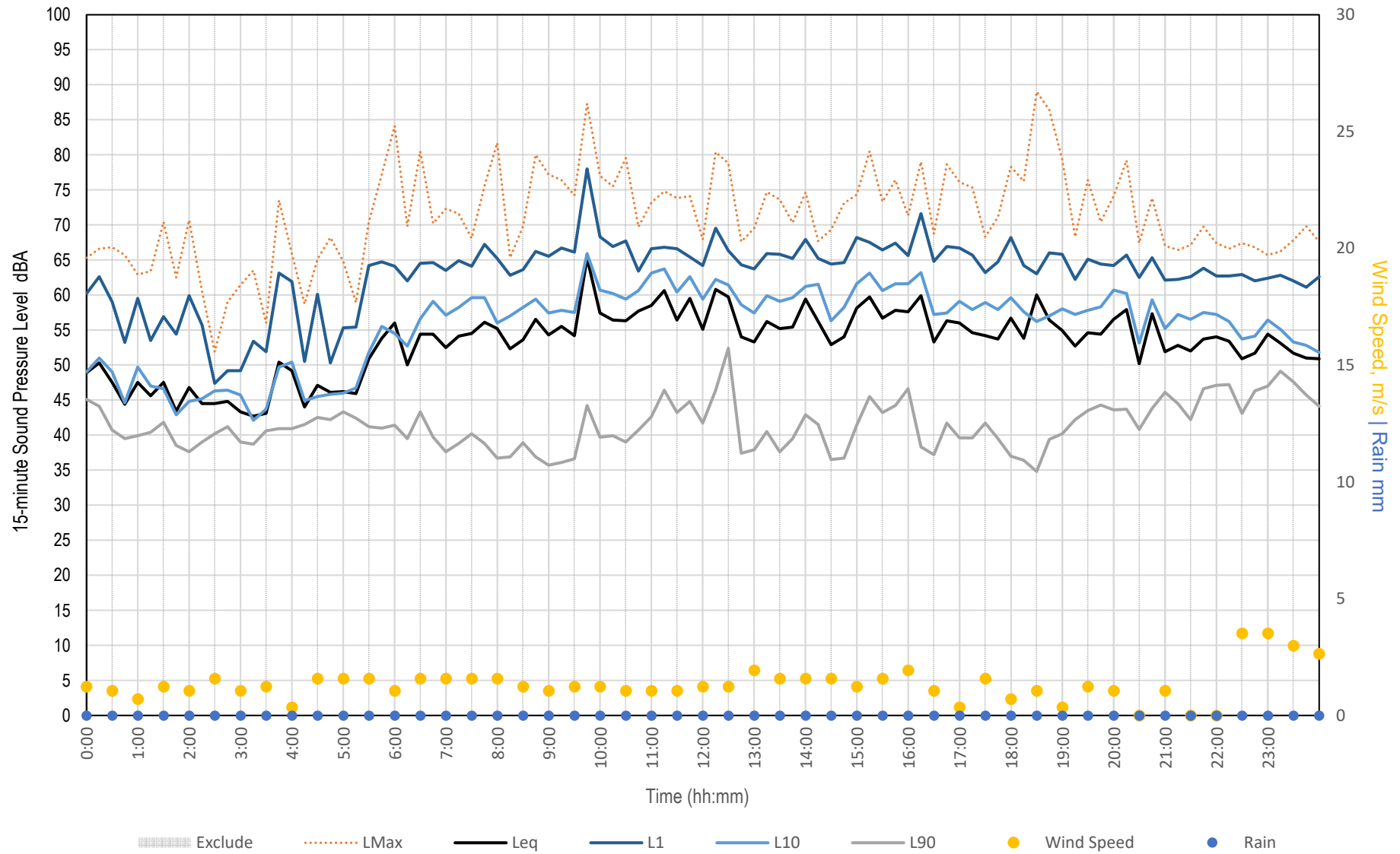
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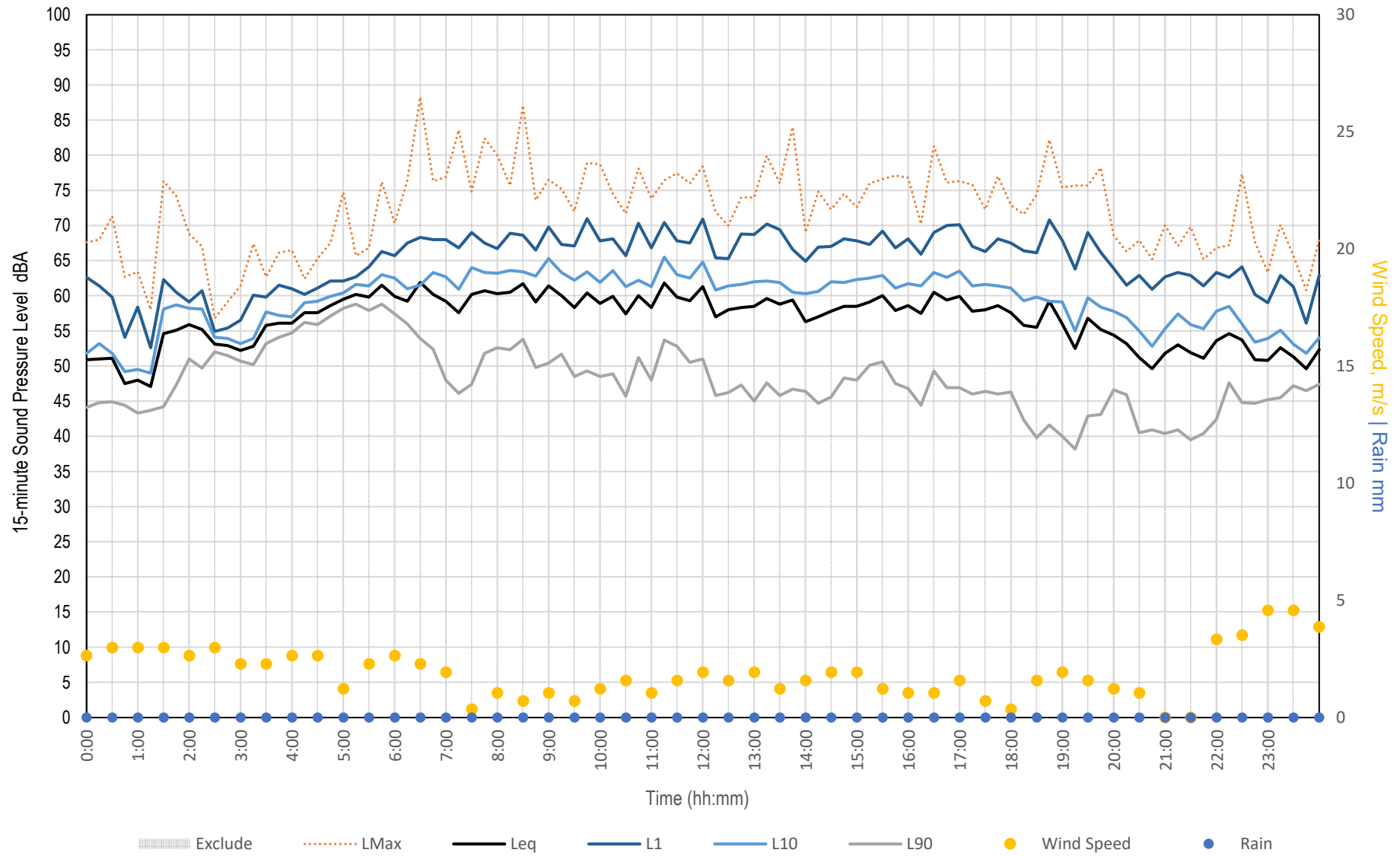
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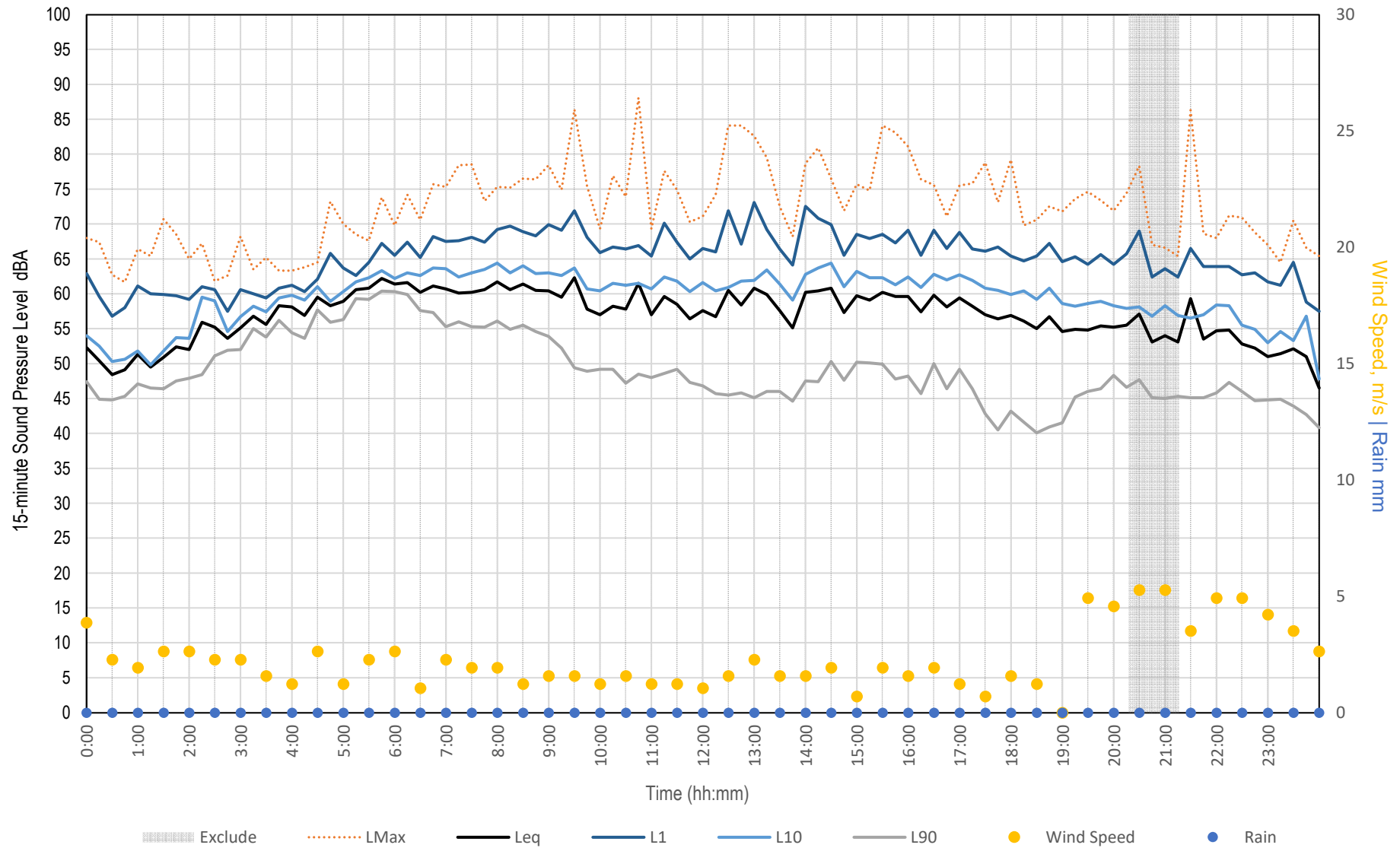
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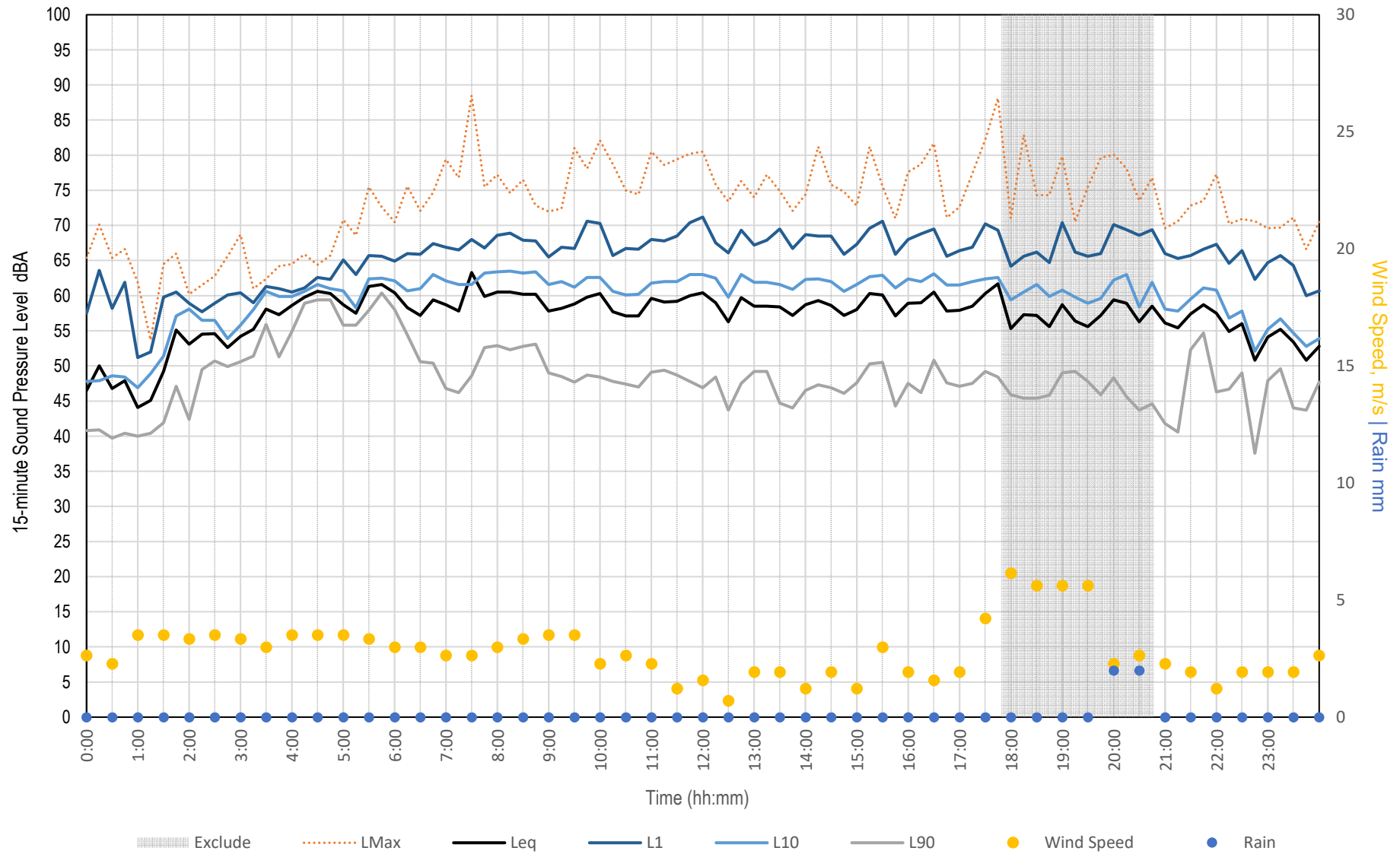
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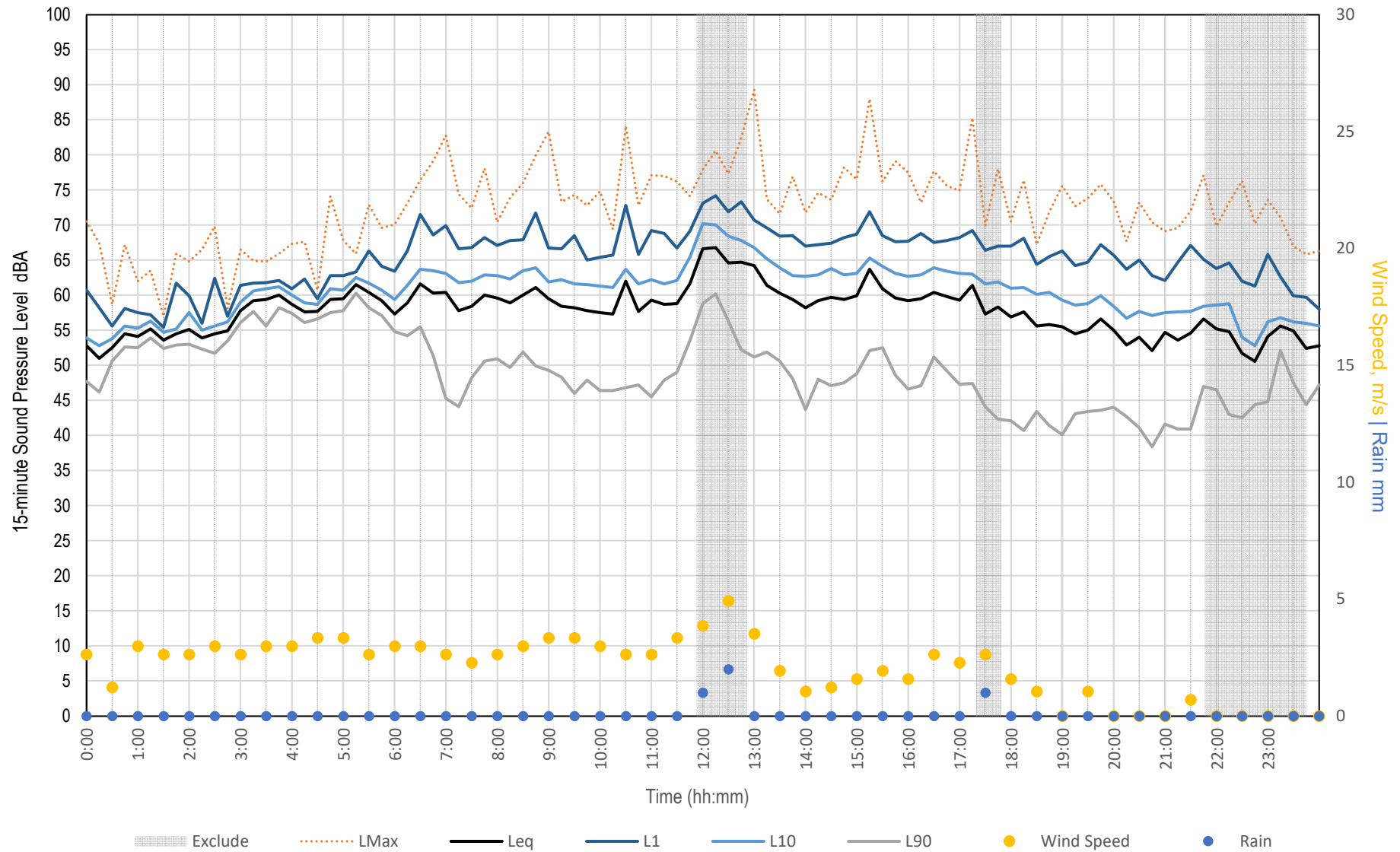
Measured Noise Levels - Cnr Johnston & Dean St

Wednesday, 08 February 2023



Measured Noise Levels - Cnr Johnston & Dean St

Thursday, 09 February 2023



Measured Noise Levels - Cnr Johnston & Dean St

Friday, 10 February 2023

