160-172 Lord Sheffield Circuit, Penrith

Noise Impact Assessment

Urban Property Group Pty Ltd

Report number: 220387 - 160-172 Lord Sheffield Circuit - Noise Impact Assessment-R4
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1 INTRODUCTION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by Urban Property Group Pty Ltd to undertake an acoustic assessment for the proposed multi-residential development with the potential for commercial properties located at 160-172 Lord Sheffield Circuit, Penrith.

This assessment will address the following:

- Potential surrounding environmental noise intrusion impacts on the development (i.e., traffic noise from the surrounding roadways and other external noise sources).
- Noise emissions to nearby receivers from the operation of the base building services, vehicle noise and other noise generating components.

This report will discuss the relevant acoustic criteria which have been adopted as well as the outcome of the assessment.

A list of acoustic terminology used in this report is included in Appendix A of this report.

1.1 Proposed Development

The proposed project involves the redevelopment of the existing land on Lot 3001, Lot 3002 and Lot 3011 DP1184498 and is within the Penrith City Council local government area.

The proposed development seeks to utilise the land for a multi-story residential development and includes the projects design as detailed in the SJB architectural drawings with Job number 6626 and dated November 2022.

1.2 Site Layout

The project site is zoned as Mixed Use (B2) as per the NSW Planning ePlanning Spatial Viewer Zoning Maps. The objectives of the aforementioned zone are as follows:

- To provide a range of retail, business, entertainment and community uses that serve the needs of people who live in, work in and visit the local area.
- To encourage employment opportunities in accessible locations.
- To maximise public transport patronage and encourage walking and cycling.
- To provide retail facilities for the local community commensurate with the centre's role in the local and regional retail hierarchy.
- To ensure that future housing does not detract from the economic and employment functions of a centre.
- To ensure that development reflects the desired future character and dwelling densities of the area.

The nearest noise sensitive receivers around the site are identified below.

Location 1: Existing residential dwellings located north of the site along Lord Sheffield Circuit and Aviators Way.

Location 2: Fifth Combat Engineering Regiment to the east of the site.

The site location is detailed in Figure 1 below.

Figure 1 Site Map, Logger Location and Nearest Sensitive Receivers – Sourced from SixMaps NSW

Site Location | Residential Receivers | Active Recreational Receivers | Unattended Noise Measurement Locations | Attended Vibration Measurement Location

2 EXISTING ACOUSTIC ENVIRONMENT

This section of the report details the acoustic survey which has been undertaken at the site for the purpose of obtaining existing background noise levels, as well as noise levels incident to the future building façades.

2.1 Unattended Noise Monitoring

As part of this assessment an acoustic survey of the existing acoustic environment at the site and surrounding receivers was undertaken. The survey included long-term unattended noise logging between Wednesday 27 July and Monday 8 August 2022 and additional noise logging to the north of the site between the 16th and 23rd February 2023.

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events have been excluded from the results, and also excluded from the data used to determine the noise emission criteria. Meteorological information has been obtained from the Penrith Lakes AWS weather station (ID 67113).

Noise logging was undertaken at two locations surrounding the site using Rion NL-42 type noise monitors with serial numbers 01000231 and 01000233. The additional noise monitoring completed at NM-3 included a Rion NL-42 type monitor with serial number 00998079. Calibration of the loggers were checked prior to and following the measurements. Drift in calibration did not exceed ±0.5 dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

The unattended noise monitors were located along the railway to the west of Penrith Station and within proximity to the station's platform. The location of the loggers enabled the noise levels from locomotive traffic through the station and noise emissions from the operation of the station (ie, intercom announcements) to be captured.

The additional noise monitoring completed at to the north of the site, including the location NM-3 in Figure 1 above, was undertaken to assess background noise levels for the residential receivers to the north of the site.

The monitor locations were used to determine the background noise to establish the maximum allowable noise for residential receivers.

The location of the noise loggers are shown in Figure 1 and were positioned such that they did not require façade corrections.

Graphs presenting summaries of the measured daily noise data are attached to this report in Appendix B. The graphs present each 24-hour period and show the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15-minute periods. This data has been filtered to remove periods affected by adverse weather conditions based on weather information.

2.2 Noise Descriptors & Terminology

Environmental noise constantly varies in level with time. Therefore, it is necessary to measure environmental noise in terms of quantifiable time periods and statistical descriptors. Typically, environmental noise is measured over 15 minute periods and relevant statistical descriptors of the fluctuating noise are determined to quantify the measured level.

Noise (or sound) consists of minute fluctuations in atmospheric pressure capable of detection by human hearing. Noise levels are expressed in terms of decibels, abbreviated as dB or dBA, the "A" indicating that the noise levels have been frequency weighted to approximate the characteristics of normal human hearing. Because noise is measured using a logarithmic scale, 'normal' arithmetic does not apply, e.g., adding two sound sources of equal values result in an increase of 3dB (i.e., 60 dBA plus 60 dBA results in 63 dBA). A change of 1 dB or 2 dB in the sound level is difficult for most people to detect, whilst a 3 dB – 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change roughly corresponds to a doubling or halving in loudness.

The most relevant environmental noise descriptors are the L_{Aeq}, L_{A1}, L_{A10} and L_{A90} noise levels. The L_{Aeq} noise level represents the "equivalent energy average noise level". This parameter is derived by integrating the noise level measured over the measurement period. It represents the level that the fluctuating noise with the same acoustic energy would be if it were constant over the measured time period.

The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample period. These levels can be considered as the maximum noise level, the average repeatable maximum and average repeatable minimum noise levels, respectively.

Specific acoustic terminology is used in this assessment report. An explanation of common acoustic terms is included as Appendix A.

2.3 Unattended Noise Monitoring Results

2.3.1 Results in accordance with the NSW *EPA Noise Policy for Industry (NPI) 2017* (RBL's)

In order to assess the potential noise impacts of the development on nearby sensitive receivers the measured background noise data was processed in accordance with the Environmental Protection Authority (EPA) *Noise Policy for Industry* (NPI).

The Rating Background Noise Level (RBL) is the background noise level used for assessment purposes at the nearest potentially affected receiver. It is the 90th percentile of the daily background noise levels during each assessment period, being day, evening and night. RBL levels $L_{A90\ (15minute)}$ and L_{Aeq} noise levels are presented in Table 1.

Table 1 Measured Ambient Noise Levels corresponding to the NPI's Assessment Time Periods

Measurement Location See Figure 1	Daytime[1] 7:00 am to 6:00 pm		Evening[1] 6:00 pm to 10:00 pm		Night-time[1] 10:00 pm to 7:00 am	
	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)
Eastbound Penrith Station (NM-1)	56	63	54	62	51	59
Penrith Station Platform (NM-2)	53	62	48	62	40	63
North of the site (NM-3)	47	58	45	55	41	53

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am

Note 2: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 3: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

2.3.2 Results in accordance with the NSW SEPP (INFRASTRUCTURE) 2021 (Noise Intrusion)

In determining the required façade construction for the proposed building in accordance with the internal noise level requirements of NSW *State Environmental Planning Policy Infrastructure 2021* (SEPP), measured noise levels are shown based on the time periods defined by the SEPP below.

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events have been excluded from the results, and also excluded from the data used to determine the noise emission criteria.

Table 2 Measured Ambient Noise Levels corresponding to the SEPP Assessment Time Periods

Measurement Location	Daytime [1] 7:00 am to 10:00 pm	Night-time [1] 10:00 pm to 7:00 am
	$L_{Aeq\ (whole\ period)}$ [2] (dBA)	$L_{Aeq\ (whole\ period)}$ [2] (dBA)
Eastbound Penrith Station (NM-1)	63	59
Penrith Station Platform (NM-2)	62	63
North of the site (NM-3)	58	53

Note 1: For Monday to Saturday, Daytime 7:00 am – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 10:00 pm; Night-time 10:00 pm – 8:00 am.

Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

3 ACOUSTIC CRITERIA

The acoustic criteria which have been adopted for this assessment are outlined below. All criteria have been separated into; *Noise Intrusion* (Assessment of building envelope), *Noise Emissions* (Assessment of noise to surrounding receivers) or *Acoustic Separation* (Assessment of noise within the building).

3.1 Noise Intrusion Criteria

External noise intrusion into the building will generally be via the building envelope (External wall, glazing or external roof). The design of the building envelope should be such that the requirements listed below are achieved.

3.1.1 Penrith City Council DCP 2014

Penrith Council DCP Volume 1 Chapter C12 outlines the requirements for a noise and vibration assessment for sites within proximity to railway corridors and is outlined below.

12.2 Rail Traffic Noise and Vibration

C. Controls

1) Rail noise and vibration

a) The siting and design of developments on land sited on, or within, 80m of an operating rail corridor or land reserved for the construction of a railway line is to address the matters raised in the Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning, 2008) and, where appropriate, incorporate any recommendations into the design of the development.

b) Council will not grant consent to residential development, residential subdivision or other sensitive land uses on land in the vicinity of a rail corridor unless it complies with the relevant standards and criteria set by the EPA and Department of Planning, as well as any relevant Australian Standards.

c) Council will not grant consent to any development which potentially has sensitive occupancies (such as residential, office or laboratory premises) and is proposed to be constructed within 20m of the rail line unless an assessment of the vibration impacts from the rail line has been carried out. This is to be undertaken by a recognized acoustic consultant to demonstrate that the impact of vibration from the rail corridor will not significantly impact upon the future occupants of the development.

d) Sensitive land uses subject to rail noise and vibration criteria referred to in (b) above include educational establishments (including schools), places of public worship, hospitals, nursing homes, mixed use development, offices/workplaces, and passive and active recreation areas.

Noise Impact Statements – specific requirements

b) The Noise Impact Statement should demonstrate acoustic protection measures necessary to achieve an indoor environment meeting residential standards, in accordance with EPA and Department of Planning criteria, as well as relevant Australian Standards and Clause 87 – Impact of Rail Noise or Vibration on Non-Rail Development of SEPP (Infrastructure) 2007.

As the document refers to the State Environmental Planning Policy (Infrastructure) 2007 and the Department of Planning's 'Development near Rail Corridors - Interim Guidelines') to establish an acoustic criterion, these documents are adopted and included in the following sections.

3.1.2 The State Environmental Planning Policy (Infrastructure) 2021

The State Environmental Planning Policy (Infrastructure) 2021 (Infrastructure SEPP) was introduced to assist the delivery of necessary infrastructure by improving regulatory certainty and efficiency. The Infrastructure SEPP has specific planning provisions and development controls for various types of infrastructure, and also for developments located adjacent to infrastructure. In order to provide guidelines for this type of assessment (noise intrusion from road and rail traffic noise), the Department of Planning of the NSW Government has prepared a document titled *"Developments Near Rail Corridors and Busy Roads – Interim Guideline"* (DNRC & BR-IG).

The DNRC & BR-IG applies to development adjacent to rail corridors and busy roads. It can also provide a useful guide for all development that may be impacted by, or may impact on, rail corridors or busy roads. According to this document, busy roads are defined as follows:

- Roads specified in Clause 102 of the Infrastructure SEPP: Freeway, tollway or a transitway or any other road with an average annual daily traffic (AADT) volume of more than 40,000 vehicles.
- Any other road is defined as roads with an average annual daily traffic (AADT) volume of more than 20,000 vehicles.
- Any other road with a high level of truck movements or bus traffic.

According to Clause 2.99 (rail) and 2.119 (road) of the Infrastructure SEPP, if the development is for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded (with windows and doors closed):

- In any bedroom in the building – 35 dBA $L_{Aeq(9hour)}$ between 10:00 pm and 7:00 am
- Anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 40 dBA L_{Aeq} at any time (i.e., $L_{Aeq(15hour)}$ and $L_{Aeq(9hour)}$).

If internal noise levels with windows or doors open exceed the criteria by more than 10 dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also meet the ventilation requirements of the National Construction Code (NCC).

Where windows must be kept closed, the adopted ventilation systems must meet the requirements of the national Construction Code and Australian Standard 1668 – *The use of ventilation and air conditioning in buildings*.

3.1.3 Australian and New Zealand Standard AS/NZS 2107:2016 Acoustics– Recommended design sound levels and reverberation times for building interiors

Since the *State Environmental Planning Policy (Infrastructure) 2021* does not provide a criteria for all occupancies possible within a residential apartment, the *Australian and New Zealand Standard AS/NZS 2107:2016 Acoustics– Recommended design sound levels and reverberation times for building interiors* is adopted as a supplement.

Recommended ambient noise levels and reverberation times for internal spaces are given in a number of publications including Table 1 of Australian / New Zealand Standard 2107:2016 "*Acoustics - Recommended design sound levels and reverberation times for building interiors*". Unlike the previous version of this Standard, this latest edition recommends a range with lower and upper levels (rather than "satisfactory" and "maximum" internal noise levels) for building interiors based on room designation and location of the development relative to external noise sources. This change has occurred due to the fact that sound levels below 'satisfactory' could be interpreted as desirable, but the opposite may in fact be the case. Levels below those which were listed as 'satisfactory' can lead to inadequate acoustic masking resulting in loss of acoustic isolation and speech privacy.

Internal noise levels due to the combined contributions of external noise intrusion and mechanical ventilation plant should not exceed the maximum levels recommended in this Standard. The levels for areas relevant to this development are given in table below. The mid to maximum points of the internal noise level ranges are generally adopted as the internal design noise criteria for the combined effect of mechanical services and external noise intrusion.

Table 3 AS2107 Design Sound Levels for Occupancies excluded from SEPP (Infrastructure) 2021

Type of occupancy/activity	Design Sound Level Range $L_{Aeq\ (Period)}$ [1] (dBA)	Time Period	Project Criteria $L_{Aeq\ (Period)}$ [1] (dBA)
Houses and apartments near major roads			
Apartment common areas (eg. foyer, lift lobby)	45 to 50	Anytime	**<50**

Note 1: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound

3.1.4 Development Near Rail Corridors and Busy Roads – Interim Guideline

As the proposed development is in proximity to the railway line south of the site, the *Development Near Rail Corridors and Busy Roads – Interim Guideline* was adopted to determine if an acoustic assessment of rail induced noise and vibration is required.

Section 3.5.1 of the *Development Near Rail Corridors and Busy Roads – Interim Guideline* includes a guidance for the requirement of an acoustic assessment for noise and vibration based on the distance of the site from the railway line as shown in Figure 2 and Figure 3 respectively.

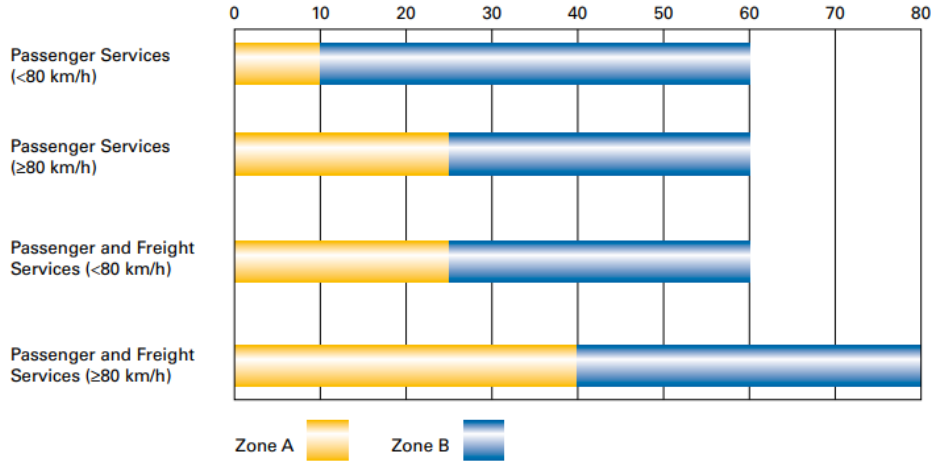


Figure 2 Noise Assessment Zones based on Distance (m) of Noise – Sensitive Development from Operational Track (Not Corridor)

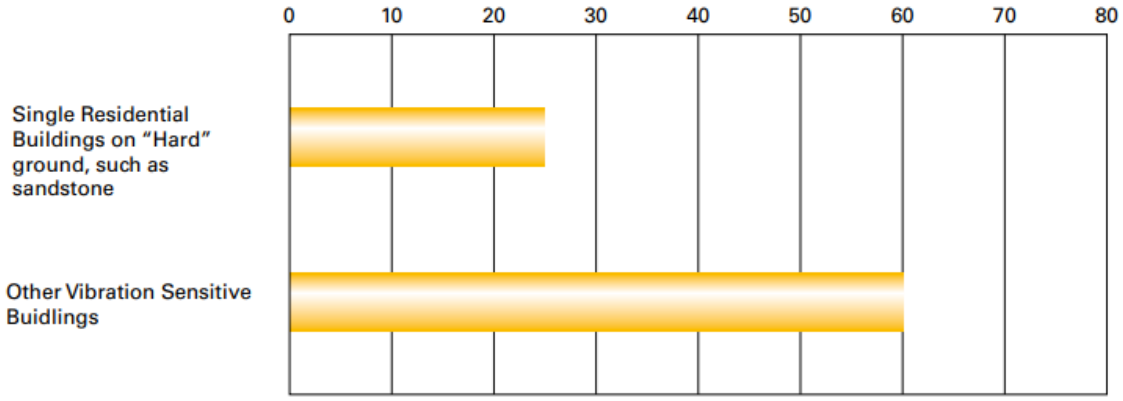


Figure 3 Vibration Assessment Zones based on Distance (m) of Sensitive Development from Operational Track (Not Corridor)

An approximate distance from the proposed site to the railway line is depicted in Figure 4, and indicates that the site is within the distances required for noise and vibration assessments based on Section 3.5.1 of the *Development Near Rail Corridors and Busy Roads – Interim Guideline*. Therefore, a detailed assessment of noise and vibration resulting from trains is undertaken.

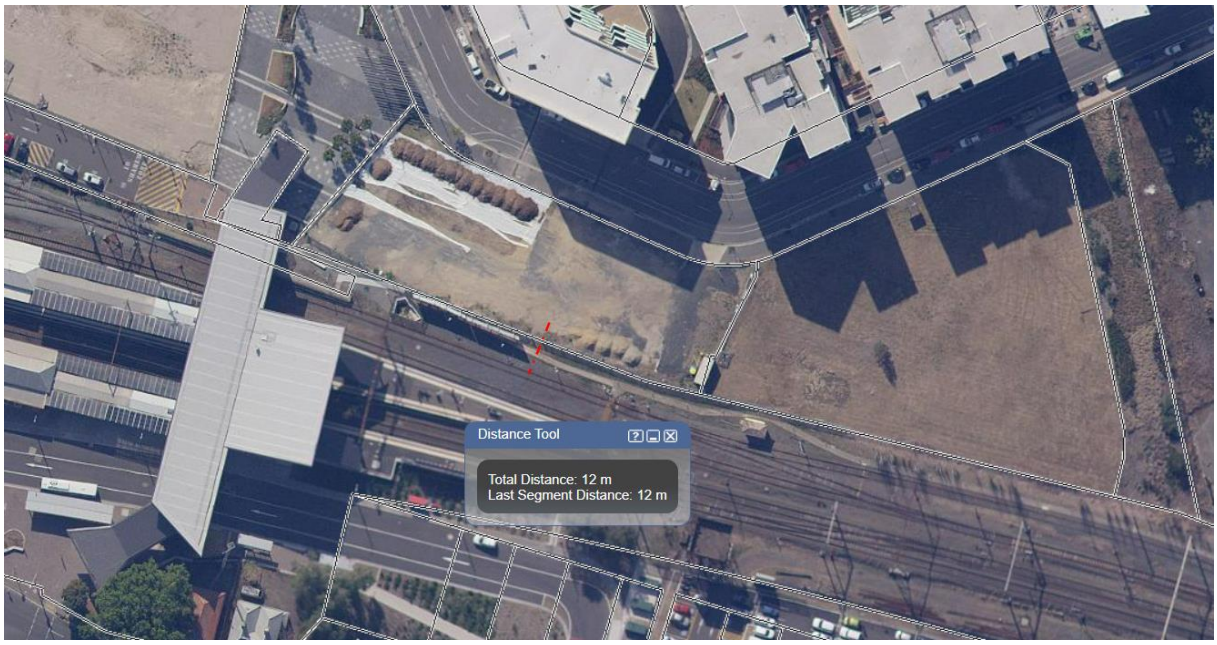


Figure 4 Distance of Railway Line to Proposed Site - Sourced from SIXmaps

3.1.5 Regenerated Noise Criteria

Regarding the potential for a gymnasium to be established on ground level or level 1, the following section establishes the relevant noise criteria. Regenerated (structure-borne) noise from various impacts within the gymnasium (such as weight drops) is likely to result in the largest potential noise impacts on the receivers located below.

Noise arising from the vibration of building structures is typically characterized by low-frequency noise in the spectral region below about 100 Hz. Structure-borne noise should be measured at the location in the room where its effect is considered to be most disturbing. It might often be masked by ambient noise from other sources, making its unambiguous determination difficult or impossible.

A specific set of criteria relating to regenerated noise from gymnasiums are not currently available (with exception of the CoS typically imposed gymnasium criteria). The sensitivity of humans with respect to potential annoyance from regenerated noise, however, has been well researched. This is particularly true with regard to regenerated noise from underground railways and construction works. Whilst these sources may differ from those associated with this project, the mechanisms are similar. The suggested noise targets for regenerated noise typically take the form of a maximum A-weighted noise level that should not be exceeded during the relevant period of assessment.

Experience with gymnasium developments in commercial and residential buildings suggest that assessing the maximum regenerated noise level from impacts caused by dropping weights against the background noise level most accurately quantifies potential impacts. The following criterion has been found to result in acceptable outcomes and minimises the risk of adversely affecting retail / commercial / residential amenity:

$$L_{Amax(fast)} \leq \text{Minimum } L_{A90(fast)} + 5\ dB$$

Note: In some assessments of regenerated noise, such as railway activity in tunnels below residences, where there is build-up and prolongation of the noise level, the "slow" time weighting is used to assess the regenerated noise level. For the relatively infrequent and sudden impacts associated with the dropping of weights, the "fast" time weighting is thought to be a more conservative and appropriate time weighting for the assessment of this potential noise source

Given that the tenancies above the potential gymnasium are residential, it is appropriate to review the emissions from the gymnasium against noise and vibration criteria relevant to these tenancies during the night-time period when noise from other sources, such as road traffic, is minimized and the background noise level is lowest.

3.2 Noise Emission Criteria

Noise emissions from the operation of the site impacting on the adjacent land users are outlined below. Noise emissions expected from the use of the site include mechanical services and communal areas.

3.2.1 Penrith City Council DCP 2014

Based on the development control plan for residential purposes, there are no set criteria for noise emissions to surrounding receivers. However, section 12.4.C outlines control measures for industrial and commercial premises and refers to the *Industrial Noise Policy* (superseded by the *NSW EPA Noise Policy for Industry (NPI))* for noise emissions from the site. This is included below for reference.

12.4 Industrial and Commercial Development

C. Controls

1) General

a) Council will not grant consent to any noise generating industrial development, commercial development or licensed premises unless it can be demonstrated that:

i. The development complies with the relevant State Government authority or agency standards and guidelines for noise, as well as any relevant Australian Standards;

ii. The development is not intrusive (as defined in the EPA's Industrial Noise Policy);

iii. Road traffic noise generated by the development complies with the provisions of Section 12.1 Road Traffic Noise of this Section;

iv. The development complies with rail noise and vibration criteria (refer Section 12.2 Rail Traffic Noise and Vibration of this Section); and

v. The development does not adversely impact on the amenity of the area or cause sleep disturbance.

As such, the *NSW EPA Noise Policy for Industry (NPI) 2017* is adopted for the purposes of noise emissions to receivers in proximity and the criteria established in this document is outlined in section 3.2.2.

3.2.2 NSW EPA Noise Policy for Industry (NPI) 2017

In NSW, the control of noise emissions is the responsibility of Local Governments and the NSW Environment Protection Authority (NSW EPA).

The NSW EPA has recently released a document titled *Noise Policy for Industry* (NSW NPI) which provides a framework and process for determining external noise criteria for the assessment of noise emission from industrial developments. The NSW NPI criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and

- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

3.2.2.1 Intrusive Noise Impacts (Residential Receivers)

The NSW NPI states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noises are generally considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq}), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). This is often termed the Intrusiveness Criterion.

The 'Rating Background Level' (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in the NSW NPI. Using the rating background noise level approach results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

3.2.2.2 Protecting Noise Amenity (All Receivers)

To limit continuing increase in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW NPI. That is, the ambient L_{Aeq} noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the 'Background Creep' or Amenity Criterion.

The amenity assessment is based on noise criteria specified for a particular land use and corresponding sensitivity to noise. The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. These criteria relate only to other continuous industrial-type noise and do not include road, rail or community noise. If the existing (measured) industrial-type noise level approaches the criterion value, then the NSW NPI sets maximum noise emission levels from new sources with the objective of ensuring that the cumulative levels do not significantly exceed the criterion.

Project amenity noise level for industrial developments is specified as the recommended amenity noise level (Table 2.2 of the NPI) minus 5 dB(A). To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the $L_{Aeq,15min}$ will be taken to be equal to the $L_{Aeq,period}$ + 3 decibels (dB).

Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level, the project amenity noise levels can be set at 10 dB below existing industrial noise levels.

3.2.2.3 Area Classification

The NSW NPI characterises the following relevant noise environment areas with an acoustical environment that:

Urban Residential

- *Is dominated by 'urban hum' or industrial source noise where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources.*
- *Has through-traffic with characteristically heavy and continuous traffic flows during peak periods.*
- *Is near commercial districts or industrial districts.*
- *Has any combination of the above.*

The site's nearest surrounding receivers are located in an area defined as B2 (local centre). The most appropriate zoning for the site's surrounding receivers is *Urban residential.*

For residential in an urban residential area and non-residential receivers, the recommended amenity criteria are shown in Table 4 below.

When the existing noise level from industrial noise sources is close to the recommended "Amenity Noise Level" (ANL) given above, noise from the new source must be controlled to preserve the amenity of the area in line with the requirements of the NSW NPI.

Table 4 NSW NPI – Recommended L_{Aeq} Noise Levels from Noise Sources

Type of Receiver – See Figure 1	Indicative Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level ($L_{Aeq, period}$)[2] (dBA)
Residential Receiver at Location 1	Urban	Day	60
		Evening	50
		Night	45
Non-residential Receiver at Location 2	Active recreation area	When in use	55

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am

Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound

Note 3: As per section 2.6 of the Noise Policy for Industry, external noise levels 10 dB(A) above the internal noise levels apply

3.2.2.4 Project Trigger Noise Levels

The intrusive and amenity criteria for industrial noise emissions, derived from the measured data, are presented in Table 5. These criteria are nominated for the purpose of determining the operational noise limits for mechanical plant associated with the development which can potentially affect noise sensitive receivers.

For each assessment period, the lower (i.e., the more stringent) of the amenity or intrusive criteria are adopted, which are shown in bold text in Table 5.

Table 5 External noise level criteria in accordance with the NSW NPI

Location – See Figure 1	Time of Day [1]	Project Amenity Noise Level, $L_{Aeq, period}$ (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)[3]
Residential Receiver at Location 1	Day	55	47	63	**52**	58
	Evening	50	45	62	**50**	53
	Night	45	41	59	**46**	48
Active Recreation Area	When in use	50	-	-	-	**53**

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am

Note 2: L_{A90} Background Noise or Rating Background Level.

Note 3: Project Noise Trigger Levels are shown in bold. These are the Intrusive Criteria only, as per section 2.4 of the Policy.

3.2.3 Liquor & Gaming NSW

Due to the site's proposal for potential licensed premises to occupy the ground level and level 1 of the building, the relevant criteria for noise emissions from the site due to patron noise has been considered and the relevant criteria is included in this section. During this stage of the project, the utilisation of these levels have not been confirmed, yet once this is known, octave band noise measurements should be undertaken to establish the relevant criteria detailed below.

Section 79 of the Liquor Act 2007 provides mechanisms for complaints to be made when the amenity of local areas is disturbed by the use of licensed premises and registered clubs (including disturbances caused by patrons). These complaints are addressed by the Director of Liquor and Gaming, and in this process they may impose temporary or permanent noise conditions on the licensed venue. Typical noise conditions that are imposed upon licensed premises are as follows:

> *The L_{A10}* noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) by more than 5 dB between 07:00 am and 12:00 midnight at the boundary of any affected residence.*
>
> *The L_{A10}* noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) between 12:00 midnight and 07:00 am at the boundary of any affected residence.*
>
> *Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 am.*
>
> ** For the purposes of this condition, the L_{A10} can be taken as the average maximum deflection of the noise emission from the licensed premises.*
>
> *This is a minimum standard. In some instances the Director may specify a time earlier than midnight in respect of the above condition.*
>
> *Interior noise levels which still exceed safe hearing levels are in no way supported or condoned by the Director.*

3.2.4 Maximum Noise Level

In accordance with the NSW NPI, sleep disturbance is to be assessed in two stages addressing the likelihood of sleep disturbance and sleep awakening.

For the criterion addressing the likelihood of sleep disturbance, the NSW NPI recommends that the maximum noise level event should not exceed the following:

- 40 dB $L_{Aeq,\ 15\ minutes}$ or the prevailing RBL plus 5 dB, whichever is the greater; and / or
- 52 dB L_{AFmax} or the prevailing RBL plus 15 dB, whichever is the greater

As a result, the criterion of 66 dB L_{AFmax} is adopted as the criterion for the likelihood of sleep disturbance at all residences.

4 TRAIN VIBRATION ASSESSMENT

This section of the report details the suitable vibration criteria for possible impacts from the SP2 railway line located south of the site.

4.1 Vibration Impact Criteria

The potential for vibration impact from a train pass-by on the lines to the north of the site has been assessed for both tactile vibration impact as well as ground borne vibration resulting in structure borne noise.

The suitable criteria for the assessment of tactile vibration and structure borne noise are detailed in the following sections.

4.1.1 Tactile Vibration Impacts

The Department of Planning *Development Near Rail Corridor and Busy Roads – Interim Guideline (DNRCBR)* references to *"Assessing Vibration – A Technical Guideline".*

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG). The AVTG identifies railway induced vibration as intermittent in its' nature and is described as the following:

> *Sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by).*

The AVTG recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*".

The British Standard details suitable criteria for the assessment of intermittent vibrations to prevent adverse impacts on future residence.

Table 6 Intermittent vibration impacts criteria (m/s$^{1.75}$) 1 Hz-80 Hz, Vibration Dose Values (VDV)

Measurement Location	Daytime		Night-Time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	**0.20**	0.40	**0.13**	0.26

For the purpose of this assessment the *Preferred Values* detailed in the standard have been used as the criteria used in this assessment.

4.1.2 Structure Borne Noise

The borne vibration is the potential for audible noise to be generated as the result of vibration transferred through the building structure and emanating from the building surfaces (such as walls, ceilings and the like) as audible noise within the future residential dwellings within the development.

Potential structure borne noise impacts as a result of the existing railway has been assessed in accordance with the criteria detailed within the DNRCBR which includes the following:

> *Generally, ground borne noise is associated more closely with rail operations than roads. Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present without the normal masking effect of airborne noise.*
>
> *In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-borne LAmax noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter.*

As the railway line located to the south of the site is an above ground line and not within a tunnel, the requirements for ground borne vibration is not necessary to be assessed based on the DNRCBR as detailed above.

As the Main Southern railway line is above ground, the impact of airborne noise on the future residence will be greater than the potential for structure borne noise levels. Providing suitable treatments for airborne noise impacts are included in the design of the project and tactile vibration levels comply with the relevant criteria then all relevant acoustic requirements will be achieved.

4.1.3 Vibration Measurements

This section of the report details the measured vibration levels associated with rail pass by at the location detailed in Figure 1 of this report.

The assessment included attended vibration measurements conducted on 8 August 2022. Vibration levels were measured using an OmniDot Version 2.2C and included a minimum of 12 train pass by.

Obtained vibration levels included a number of train pass by which have been used to determine the period vibration exposure for the daytime and night-time periods Vibration Dose Values (VDV).

The results of the vibration level measurements including the calculations for VDV are detailed in Table 7 below.

Table 7 Calculated VDV

Location	Period	Criteria VDV $m/s^{1.75}$	Calculated VDV $m/s^{1.75}$
Future Residential Dwellings	Daytime	0.20	Less than 0.03
	Night-Time	0.13	Less than 0.03

Based on the results of the assessment of tactile vibration no additional acoustic treatment (or building vibration isolation) is required to comply with the relevant standards and ensure a suitable acoustic amenity for future occupants of the development.

5 OPERATIONAL ACOUSTIC ASSESSMENT

In addressing all the criteria shown above, each component of the development is assessed and presented below.

5.1 Building Envelope Assessment

5.1.1 Glazing Recommendations

The recommended sound transmission loss requirements required to satisfy the specified internal noise level criteria outlined above are summarised in Table 8 below.

Please note that these recommendations are also based on the floor details shown in the architectural drawings of the proposed development in Appendix C.

Table 8 In-principle Glazing Recommendations

Façade Orientation	Levels	Room Type	Recommended Glass Construction	Minimum Façade Acoustic Perforamnce[1]
Western and southern façade orientations (facing Penrith station and train line)	All Levels	Bedrooms	10.38mm laminated glass	Rw (C;Ctr): 35 (0;-3)
		Living Areas	10.38mm laminated glass	Rw (C;Ctr): 35 (0;-3)
		Common areas and lobbies	6.38mm Laminated	Rw (C;Ctr): 30 (0;-3)
		Retail or Commercial	6.38mm Laminated	Rw (C;Ctr): 30 (0;-3)
All other façade orientations	All Levels	Bedrooms	6.38mm Laminated	Rw (C;Ctr): 30 (0;-3)
		Living Areas	6.38mm Laminated	Rw (C;Ctr): 30 (0;-3)
		Common areas and lobbies	6.38mm Laminated	Rw (C;Ctr): 30 (0;-3)
		Wet areas	6mm Float or toughened	Rw (C;Ctr): 28 (0;-3)
		Retail or Commercial	6.38mm Laminated	Rw (C;Ctr): 30 (0;-3)

Note 1: The acoustic performance of the external façade includes the installed glazing and frame including (but not limited to) the façade systems seals and frame. All external glazing systems are required to be installed using acoustic bulb seals.

Please note for windows, this performance is not only subject to the glazing selection but also to the construction of the window frame and the frame seal selection. Therefore, it is recommended that the window manufacturer should confirm that the required sound insulation can be achieved. It is anticipated that the window system should comprise Q-Lon (or equivalent) or fin seals with deep C channels as part of the window track (i.e., Performance levels outlined above need to be achieved with glazed panels + frame + seals).

5.1.2 External Wall Construction

If external wall constructions are constructed either from an concrete or masonry construction, no further acoustic upgrading is required. If penetrations through any external skin are required, all gaps remaining in the penetration are to be filled with an acoustic grade sealant which provides an equal or better performance to the system being penetrated.

Any light-weight external plasterboard walls should be constructed from a construction with a minimum acoustic performance of Rw 50.

5.1.3 External Roof Construction

The required external roof and ceiling constructions for the project are required to include the following:

1. Concrete external roof construction – no additional treatments required.
2. Light Weight Construction – Install acoustic insulation within the external roof/ceiling cavity similar to a 75 mm thick 14 kg/m^3 insulation.

If penetrations through any external skin are required, all gaps remaining in the penetration are to be filled with an acoustic grade sealant which provides an equal or better performance to the system being penetrated.

5.1.4 Ventilation Requirements

The internal design sound levels detailed in the section above are achieved with the external building openings closed.

The requirement for an alternative source of outside air is triggered when internal noise levels +10 dB(A) with windows open to 5% of the floor area for ventilation. The location of the external passive air paths are to be installed to all units along the southern façade (ie. facing railway line), eastern façade and western façade.

The method of providing an alternative method of outside air ventilation is required to be provided in accordance with relevant regulations including the Building Code of Australia and AS1668.

Based on the noise levels obtained at the site and detailed in Section 2 above, an alterative source of outside air is required to be provided to units with aa façade orientation facing to the south towards the train line. For all other façade orientations internal design noise levels + 10 dB(A) will be achieved with the windows open to the equivalent area of 5% for ventilation.

Where an alternative source of ventilation is required, this should be undertaken in accordance with the requirements of AS1668.2 and can include either a mechanically aided source of outside air or acoustic plenums. Details of the required acoustic plenums are detailed in this section of the report. The installation of an alternative outside air source should not compromise the acoustic performance of the external building shell and is required to comply with the noise emission criteria detailed in the following section.

As part of the proposed development, the provision for an alternative passive air path could be provided to units with openings facing the railway line. This will include the treatment of noise via a transfer air path constructed from the following:

1. Minimum 25mm internally lined metal duct (or similar).
2. Sections of metal duct to include a maximum dimension of 800mm x 600mm as a cross sectional area.
3. The minimum length of the passive air path is to be 2m.
4. Overall open air to be equivalent to 5% of the floor area of the unit as required to comply with the relevant mechanical codes.
5. Opening at external side to be at 90o to the metal duct.
6. Internal opening to be within the residential dwelling. Internal opening to include an operable (open and closable) mechanism to prevent air flow in the event to occupant choses.
7. The proposed passive air treatment is to be approved by a relevant mechanical engineer prior to installation for compliance with project and AS1668.2 requirements.

8. The proposed design of the passive air path is detailed in Figure 5 and Figure 6 below.

Figure 5 Passive Air Path Design, Vertical Air Path

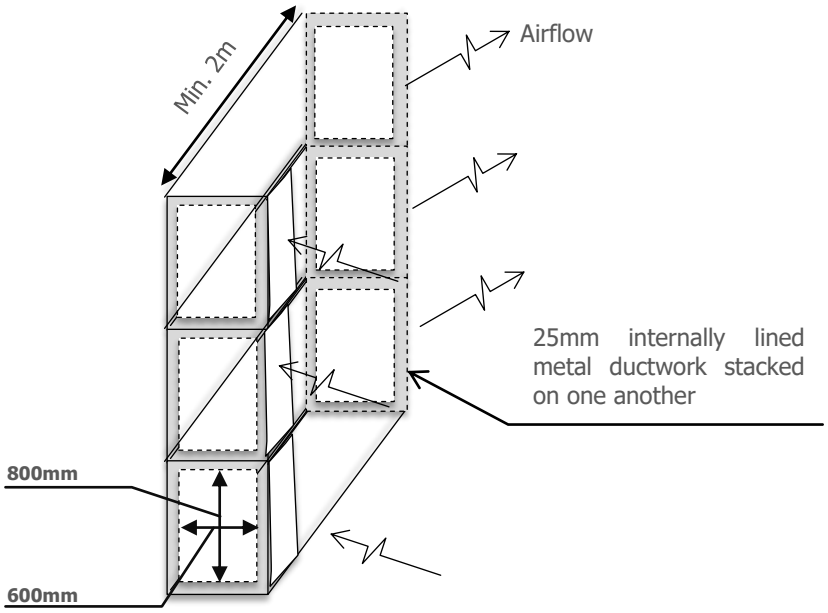
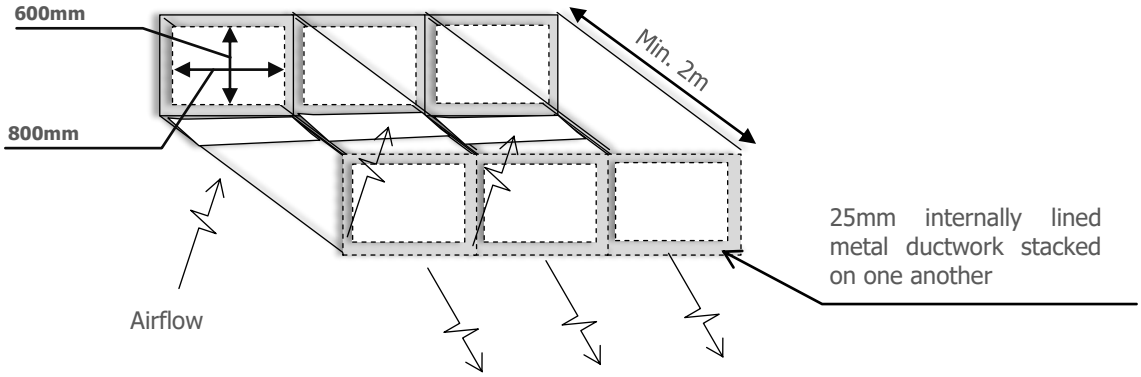


Figure 6 Passive Air Path Design, Horizontal Air Path



5.2 External Noise Emissions from Engineering Services

At this stage of the project, the exact locations of key plant items, and the selection of items to be installed, have not been selected. As such, a detailed assessment of noise associated with engineering services cannot be undertaken.

All future plant and equipment are to be acoustically treated to ensure the noise levels at all surrounding receivers comply with noise emission criteria detailed within this report. Experience with similar projects indicates that it is both possible and practical to treat all mechanical equipment such that the relevant noise levels are achieved. Examples of the possible acoustic treatments to mechanical equipment includes the following:

- Supply and Exhaust Fans – location of fans within the building and treated using internally lined ductwork or acoustic silencers.
- General supply and exhaust fans – general exhaust and supply fans such as toilet, kitchen, lobby and other small mechanical fans can be acoustically treated using acoustic flex ducting or internally lined ducting.

- Commercial Condensers – The project will likely involve external condenser units which will be located on the future roof. Providing condenser equipment is selected using suitable noise level data, then acoustic treatments can be implemented such as screening, enclosures, and treatment to exhaust to ensure that the relevant noise emission criteria will be achieved.

Details of the required mechanical services equipment and acoustic treatments to ensure the relevant noise level criteria is achieved will be provided as part of the CC submission of the project.

Experience with similar projects indicates that the acoustic treatment of whatever mechanical equipment is to be installed on the project is both possible and practical.

5.3 Noise from Additional Traffic

Noise impacts from the increase in vehicle movements along the surrounding roadways is to be assessed in accordance with the NSW EPA Road Noise Policy (RNP) 2011.

A peak hour increase proposed for the number vehicles associated with the development will not exceed a 2dBA increase at the nearest residential receivers. As summarised in the NSW EPA RNP, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person and is therefore considered acoustically acceptable.

5.4 Patron Noise Emissions

As per section 3.2.3, the potential establishment of licensed premises along the ground level and level 1 of the building has been considered. Although a detailed assessment should be carried out once tenancies has been confirmed, general noise mitigating recommendations are included in section 5.4.1 and has proven to be effective based on PWNA's experience with similar projects.

5.4.1 General Noise Mitigating Controls

Based on the site's proximity to sensitive receivers along Lord Sheffield Circuit, the following noise mitigating treatments are likely to be required:

- No music is played in the outdoor seating area at any given time.
- No patrons should be seated outdoors after midnight.
- Music internally should be kept to a sound pressure level of 75 dB(A).
- Windows and doors are required to be closed after midnight and potentially during all periods of the day pending further acoustic investigations.
- Minimum glazing performances equivalent to 6.38mm laminated to all glass partitions including glass doors.

5.5 Gymnasium Treatments

In order to treat the expected regenerated noise from the utilisation of the gymnasium, pre-construction and post-construction treatments are both possible and should be considered. Due to nature of regenerated noise, the most effective method of mitigation would require structurally isolating the gym from the rest of the builder via rubber mounts between slabs.

Alternatively, post-construction treatments would include undertaking a gymnasium compliance assessment to ensure the internal noise levels at the most sensitive residential receivers above complies with the criteria outlined in section 3.1.5. If compliance is not achieved, further treatments would be required including upgrading the density and/or thickness of the gym mats, installing springs mounts underneath machines and establishing weight drop height limits and/or establishing a dedicated weight drop area.

From PWNA's experience with similar projects, structurally isolating the entire slab is an expensive solution that should be avoided if possible. Post treatment solutions are more cost-effective and versatile and can be assessed prior to Occupational Certificate. However, based on the development's proposal for residential above, gymnasiums should be restricted to ground level if required, but is highly unadvised for this development.

5.6 Roof Top Communal Area

5.6.1 Noise Emissions from Roof Top Communal Areas

Noise associated with communal areas is not well addressed in NSW. The Penrith Council DCP 2014 provides general precautions regarding communal areas and their impact on surrounding receivers yet does not establish a quantitative criterion. This is outlined in section 6.1.4 of the DCP and is included below.

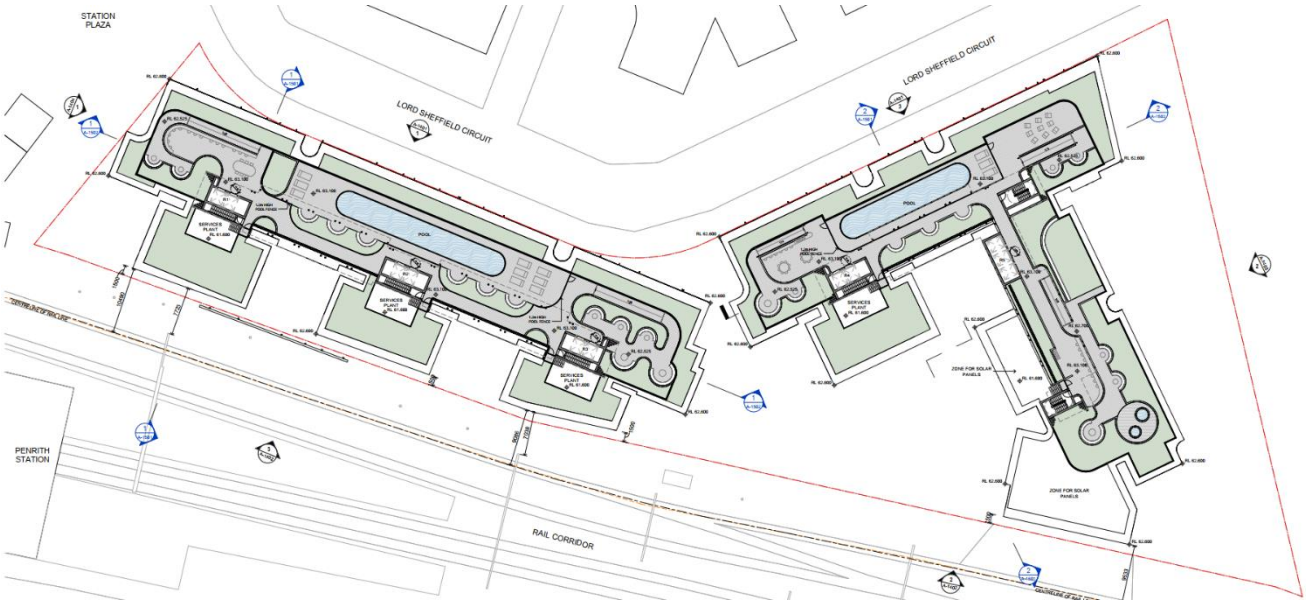
6.1.4 Site Amenity

2) Open Space Requirements

b) Communal space/recreational facilities must be located and designed to avoid nuisance or danger to neighbours, residents and visitors. Consideration should be given to the type of activities to be undertaken, hours of use, noise generation and on-going maintenance and safety of the space/recreational facility.

Additionally, the NSW EPA *Noise Policy for Industry* does not address noise emissions from communal areas. As such to ensure the acoustic amenity is reasonably maintained for the existing surrounding developments Pulse White Noise Acoustics believe a RBL + 5dBA as a L_{Aeq} approach is considered acceptable. Adoption of a background + 5dB approach, is similar to the criteria typically adopted in the assessments of external areas of a licensed venue during the daytime period (noted: NSW Liquor and Gaming use a L_{10} rather a L_{Aeq}).

The proposed development includes roof top communal areas, which includes pools, seating and general areas for communal use. Details of the proposed common areas are included in the figure below,



The proposed communal area includes an outdoor area for the use of residents. The communal open space includes an open area which will include exposure of noise from surrounding environmental noise sources including surrounding roadways and the railway corridor to the south of the site.

For the purpose of this assessment, we have assumed the following noise levels:

- Single person talking – 69dBA and an assumption of up to 50 people using the roof top terrace of the building to west and up to 50 people using the roof top terrace of the building to east 1 in 3 talking at any one time.

- Background music (for internal areas only) – 65dBA

To mitigate noise levels from the proposed common area to within the required noise emission criteria detailed in this report the following acoustic mitigations are recommended:

1) External common areas are only to be used during the daytime and evening time which are as follows:

   a) (For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm.

   b) On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm)

2) Use of the common area is permitted for communal activities. The area is not to be used for high noise generating activities such as large gatherings, playing of loud music or parties.

3) Amplified music is not permitted in the communal area or in the common room at any-time.

4) Signs must be installed within the area outlining the recommendations above.

Providing the recommended acoustic mitigations detailed in the points above are included in the design and operation of the proposed development the resulting noise emissions from the use of the communal area will comply with the noise emission criteria detailed in this report and will be acoustically acceptable.

5.6.2 External Noise Levels Impacting the Roof Top Communal Areas

The main contribution of potential noise intrusion into the communal area is due to railway pass-by along the site's southern boundary. The expected noise level at the communal area due to railway pass-by is expected to be 59 dB(A) as a worst-case scenario. Based on the potential for noise impact from train pass bys on the proposed common areas the following acoustic impact and possible and practical mitigations are discussed:

1. The noise impact from train pass byes on the railway line to the south of the site will include periods when trains are moving on the train lines. The greatest noise impact would be experiences on the roof top communal areas which are located within close proximity to the southern portion of the communal area.

2. To future mitigate noise impact from train pass byes to the communal external areas the following building constructions may be possible:

   a. Solid screening or balustrades to the southern edge of the communal roof top areas would be recommended.
   It is noted that the projects design includes solid building elements such as lift cores, stairwells and the like which will result in acoustic screening to the communal areas.

   Screens should include a solid construction to be acoustically effective such as glass, masonry, FC sheet, Perspex or the like including elements currently included in the architectural drawings.

   In the event screening to the southern edge of the communal external areas can be provided then external noise levels would be approximately 53 dB(A) or less for the future users of the space.

3. From past experience in similar projects, due to the nature of railway pass-by being an intermittent event, this is not expected to affect speech eligibility or the acoustic amenity of the area for the use of passive recreational use.

Based on the discussions included above the resulting noise levels on the communal area will be acoustically acceptable for the use of residence and their guests for recreational use, including passive recreational use.

6 CONSTRUCITON NOISE AND VIBRATION MANAGEMENT PLAN

This section of the report details the assessment of noise associated with the proposed construction activities associated with the development. The assessment has been undertaken to assess the potential noise impacts from construction and demolition on surrounding receivers to the project.

The proposed construction and demolition activities to be undertaken on the Site include the strip out of the existing areas of the existing building and limited external demolition of the existing building on the Site. The development will then be constructed using normal construction processes.

6.1 Construction Noise

The assessment of construction noise impacts generated from the Site has been undertaken in accordance with the requirements of the EPA's *Interim Construction Noise Guideline*.

The EPA's Interim Construction Noise Guideline defines normal day time hours as the following:

2.2 Recommended standard hours

The recommended standard hours for construction work are shown in Table 1; however, they are not mandatory. There are some situations, as described below, where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Table 1: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

6.2 Proposed Appliances

The proposed appliances which will be used as part of the construction of the project are detailed in the table below.

Table 9 Noise Level from Expected Construction Appliances

Tasks	Equipment	Sound Power Levels per task dB(A) L_{10}	Aggregate Sound Power Level per Task dB(A) L_{10}
Site Excavations	Jack hammer mounted on excavator	118	122
	Saw cutting	119	
	Excavators and bulldozers	115	
	Materials Movements	105	
	Bulldozers	115	
	Trucks	109	
Construction Works	Piling	115	120
	Welder	101	
	Saw cutter	109	
	Dump truck	109	
	Concrete saw	119	
	Power hand tools	109	
	Cranes	110	

Notes: Noise levels of proposed equipment to be used on the Site based on the Australian Standard AS2436-2010 and noise level measurements previously undertaken of similar equipment on construction Sites.

6.3 Construction Noise Criteria

This section of the report details the relevant construction noise criteria which is applicable to the Site including the EPA's *Interim Construction Noise Guideline* (ICNG).

6.3.1 Interim Construction Noise Guideline

Noise criteria for construction and demolition activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all "feasible" and "reasonable" work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting Site-specific feasible and reasonable work practices in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for receivers have been reproduced from the guideline and are listed in the table below.

Table 10 Noise Management Levels from Construction – Quantitative Assessment

Receiver Type	Time of Day	Noise Management Level LAeq(15minute)1,2	How to Apply
Residential	Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm 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 LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
		Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
	Outside recommended standard hours	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 above the noise affected level, the proponent should negotiate with the community.

Table 10 Continued

Receiver Type	Time of Day	Noise Management Level LAeq(15minute)1,2	How to Apply
offices, retail outlets: external	When is use	LAeq (15 min) 70 dB(A)	During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.

Note 1 *Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

Note 2 *The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).*

Based on the table above the suitable construction noise management levels for works undertaken on the Site is detailed in Table 11 below.

Table 11 Site Construction Noise Management Levels

Noise Source	Time Period	Receiver Type	Construction Noise Management Level	'High Noise Affected' Level
Construction Noise	Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays Or approved construction hours within the projects Conditions of Consent based on approvals	Residential Receivers	57 dB(A) LAeq (15min)	75 dB(A) LAeq (15min)
		Commercial Receivers	70 dB(A) LAeq (15min)	75 dB(A) LAeq (15min)

Note 1: Construction noise management levels based on the Interim Construction Noise Guideline

6.4 Construction Vibration Assessment

This section of the report details the assessment of construction vibration impacts on surrounding receivers.

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 6.4.1.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 6.4.2.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 6.4.2.

6.4.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG) This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (refer to Table 12).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 13).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 14).

Table 12 Continuous vibration acceleration criteria (m/s2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 13 Impulsive vibration acceleration criteria (m/s2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 14 Intermittent vibration impacts criteria (m/s1.75) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

6.4.2 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed against international standards as follows:

- For transient vibration: British Standard BS 7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration" (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 "Effects of Vibration on Structure" (DIN 1999).

6.4.2.1 Standard BS 7385 Part 2 - 1993

For transient vibration, as discussed in standard BS 7385 Part 2-1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 15 and illustrated in the Figure below.

Table 15 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure below	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385 Part 2 – 1993 states that the values in Table 15 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 15 may need to be reduced by up to 50% (refer to Line 3 in the Figure below).

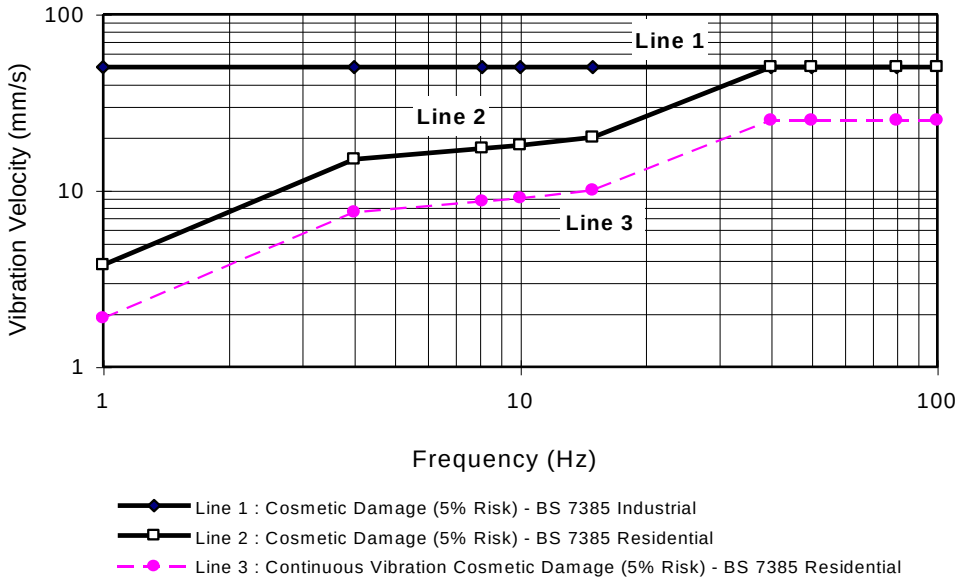


Figure 7 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 15, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 15 should not be reduced for fatigue considerations.

6.4.2.2 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 16. The criteria are frequency dependent and specific to particular categories of structures.

Table 16 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.

6.4.3 Project Vibration Criteria

Based on the details included in the sections above the project specific vibration criteria to protect the surrounding residential receivers from structural or architectural damage includes the following:

1. Project construction vibration criteria, all surrounding structures – 10 mm/s

6.5 Construction Noise Management

Based on the assessment conducted of the expected construction noise levels generated from the Site, levels are generally expected to require the building contractor to engage in management of activities on the Site and engagement with the local community.

Notwithstanding, the following management controls are recommended to mitigate construction noise levels on the Site:

1. Construction to be undertaken within the approved hours detailed within the projects *Conditions of Consent.*

2. All plant and equipment are to be maintained such that they are in good working order.

3. A register of complaints is to be recorded in the event of complaints being received, including location, time of complaint, nature of the complaint and actions resulting from the complaint.

4. If required a noise level measurement of the offending plant item generating complaints is to be conducted and noise mitigations undertaken to reduce noise levels to within Noise Management levels in the event magnitude of noise levels is found to be above suitable levels.

5. The use of percussive and concrete sawing should be undertaken behind a closed façade when possible.

6. The use of percussive equipment including hydraulic hammering should be limited such that they are not undertaken prior to 7.30am on weekdays and prior to 8.30am on Saturdays.

7. Where possible any excavation to be undertaken on the Site is to include ripping of material where possible.

In addition to the recommended mitigations above details of the proposed construction (including demolition) works to be conducted on the Site, including type of activities to be conducted as well as the expected duration of activities should be provided to the neighbouring receivers.

In the event noise levels are found to required additional noise reduction then all possible and practical mitigations are required to be included in the construction of the project. Possible acoustic treatments and controls may include the following:

1. Use of alternative appliances to complete the required works which result in reduced noise impacts on surrounding neighbours.

2. Period when noisy appliances are undertaken, such as undertaking noisy works on locations with the greatest distance to residential receivers during morning periods if possible.

3. Construction of acoustic screening to permanently located high noise generating equipment such as pumps and generators.

4. Scheduling of high noise generating works outside of noise sensitive periods if possible.

5. Other Site specific treatments and controls which may become possible once works commence.

6.6 Construction Vibration Impacts

An assessment of the potential for vibration generated as part of the required construction activities on the project (including ground works and construction) has been undertaken.

As the proposed building to be demolished on the Site are not attached to neighbouring structures and the proximity of neighbouring structures to the development Site (which include residential receives) vibration levels generated from the proposed demolition and construction on the Site are expected to comply with all vibration criteria detailed in this report.

In the event excavation is required on the Site including removal of stone, the following management technique should be included in the excavation methodology:

- Based on the location of the site compliance with the relevant construction vibration criteria is expected to be achieved without additional mitigations required.

Based on the location of the Site and the required works to be completed as part of the construction of the project magnitudes of vibration with the potential to exceed suitable limits for structural and architectural damage are not expected to be generated to all surrounding receivers.

6.7 Noise and Vibration Monitoring

As part of the management of noise from the proposed demolition, excavation and construction activities to be undertaken on the Site the following noise and vibration measurements are recommended to be undertaken:

1. Noise – Attended noise level measurements of typical demolition, excavation and construction activities should be undertaken at Site. A

   Attended construction noise surveys of the Site and surrounding impacts on neighbours should be undertaken during the following as a minimum:

   i. Commencement of any rock breaking on the Site.

   ii. Periodically during the construction period if required.

   iii. In response to any ongoing complaints received from neighbours.

2. Vibration – Based on the proximity of the surrounding receivers to the works required to be conducted on the Site vibration magnitudes with the potential to exceed the vibration criteria detailed in this report are not expected, therefore vibration monitoring is not recommended for the construction phases of the project.

6.8 Community Engagement

During the proposed construction of the project (including demolition, excavation and construction) the building contractor is required to engage in community interaction. The community interaction and notification is required to include the following:

1. Notification of the proposed works to be undertaken on the Site and the periods when works will be conducted, including information regarding the programme of works such as demolition and excavation.

2. Details of the relevant Site representative where complaints can be registered.

3. Details of the methodology to respond to complaints raised from the surrounding receivers.

4. A register of complaints, to be kept on Site including record of time and nature of the complaint as well as the outcomes and comments regarding investigations resulting from the complaint.

7 CONCLUSIONS

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by Urban Property Group Pty Ltd to undertake an acoustic assessment for the proposed residential development at 160-172 Lord Sheffield Circuit, Penrith.

As part of this assessment, we have undertaken a review of the building envelope and noise emissions from the use of the site. From this assessment we note the following:

- Minimum acoustic performances and associated indicative constructions for the building envelope have been provided in section 5.1 of this report. The recommended treatments have been provided to ensure compliance with the objectives presented in section 3.1.
- To control noise impacts at external receivers, recommended indicative treatments for major engineering services are included in section 5.2
- An assessment of patron noise from potential licensed premises along ground level and level 1 have been provided in section 5.4
- An assessment of regenerated noise from a potential gymnasium development along ground level and level 1 have been provided in section 5.5
- Noise intrusion and emissions related to the open communal space located on the roof-top have been included in section 5.6
- A project construction noise and vibration management plan has been undertaken and included in Section 6.

For any additional information please do not hesitate to contact the person below.

Regards

Ben White
Director
Pulse White Noise Acoustics

APPENDIX A: ACOUSTIC TERMINOLOGY

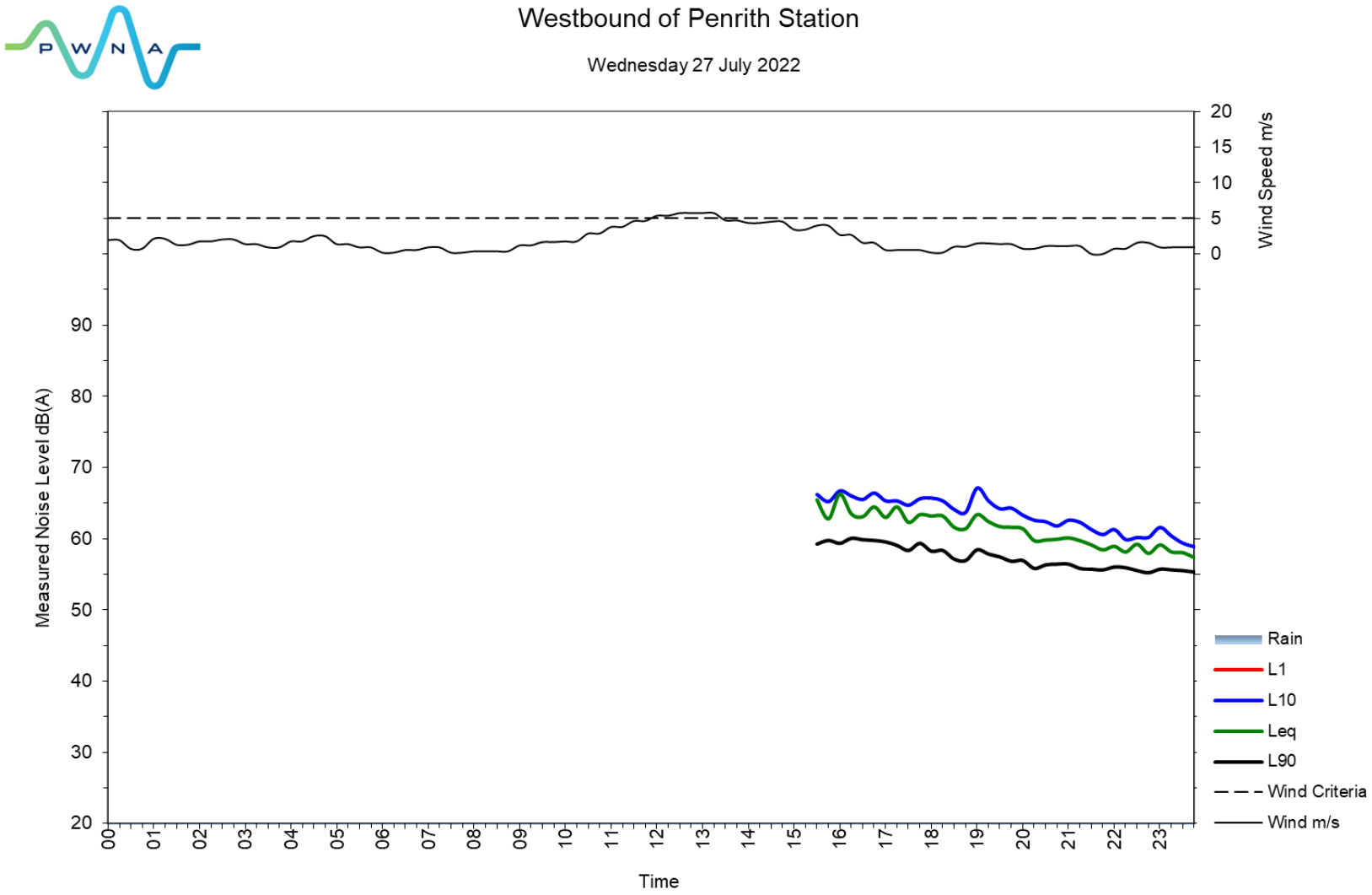
The following is a brief description of the acoustic terminology used in this report.

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing 30dB(A) A quiet country park 40dB(A) Whisper in a library 50dB(A) Open office space 70dB(A) Inside a car on a freeway 80dB(A) Outboard motor 90dB(A) Heavy truck pass-by 100dB(A) Jackhammer/Subway train 110 dB(A) Rock Concert 115dB(A) Limit of sound permitted in industry 120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Ambient sound	The all-encompassing sound at a point composed of sound from all sources near and far.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
Reverberation	The persistence of sound in a space after the source of that sound has been stopped (the reverberation time is the time taken for a reverberant sound field to decrease by 60 dB)
Air-borne sound	The sound emitted directly from a source into the surrounding air, such as speech, television or music
Impact sound	The sound emitted from force of one object hitting another such as footfalls and slamming cupboards.
Air-borne sound isolation	The reduction of airborne sound between two rooms.
Sound Reduction Index [R] (Sound Transmission Loss)	The ratio the sound incident on a partition to the sound transmitted by the partition.
Weighted sound reduction index [R_w]	A single figure representation of the air-borne sound insulation of a partition based upon the R values for each frequency measured in a laboratory environment.
Level difference [D]	The difference in sound pressure level between two rooms.

Normalised level difference [D_n]	The difference in sound pressure level between two rooms normalised for the absorption area of the receiving room.
Standardised level difference [D_{nT}]	The difference in sound pressure level between two rooms normalised for the reverberation time of the receiving room.
Weighted standardised level difference [$D_{nT,w}$]	A single figure representation of the air-borne sound insulation of a partition based upon the level difference. Generally used to present the performance of a partition when measured in situ on site.
C_{tr}	A value added to an R_w or $D_{nT,w}$ value to account for variations in the spectrum.
Impact sound isolation	The resistance of a floor or wall to transmit impact sound.
Impact sound pressure level [L_i]	The sound pressure level in the receiving room produced by impacts subjected to the adjacent floor or wall by a tapping machine.
Normalised impact sound pressure level [L_n]	The impact sound pressure level normalised for the absorption area of the receiving room.
Weighted normalised impact sound pressure level [$L_{n,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in a laboratory.
Weighted standardised impact sound pressure level [$L'_{nT,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in situ on site.
C_I	A value added to an L_{nW} or $L'_{nT,w}$ value to account for variations in the spectrum.
Energy Equivalent Sound Pressure Level [$L_{A,eq,T}$]	'A' weighted, energy averaged sound pressure level over the measurement period T.
Percentile Sound Pressure Level [$L_{Ax,T}$]	'A' weighted, sound pressure that is exceeded for percentile x of the measurement period T.

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*

APPENDIX B: UNATTENDED NOISE MONITORING RESULTS – NM-1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Time
Rain
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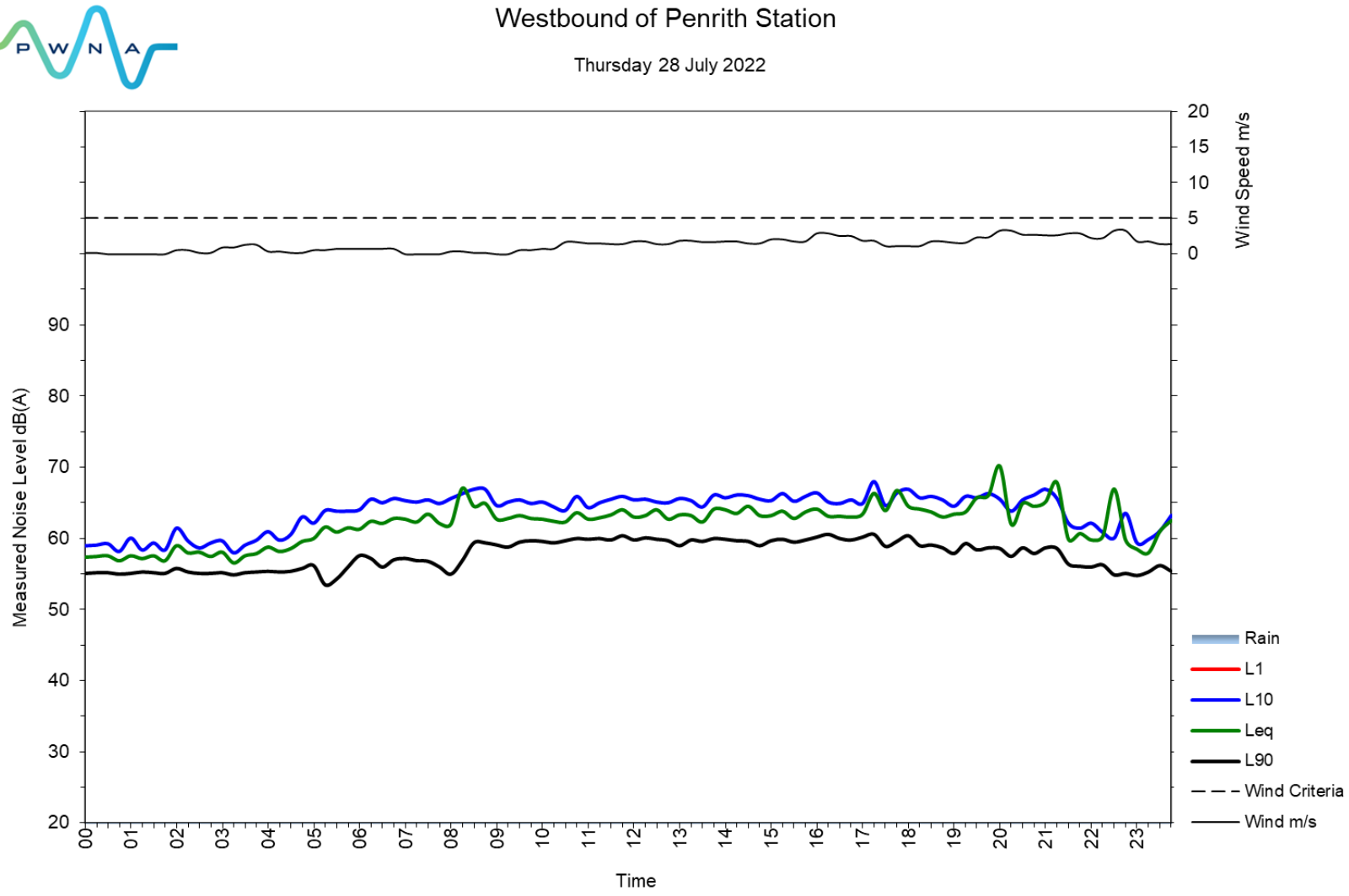
Wind m/s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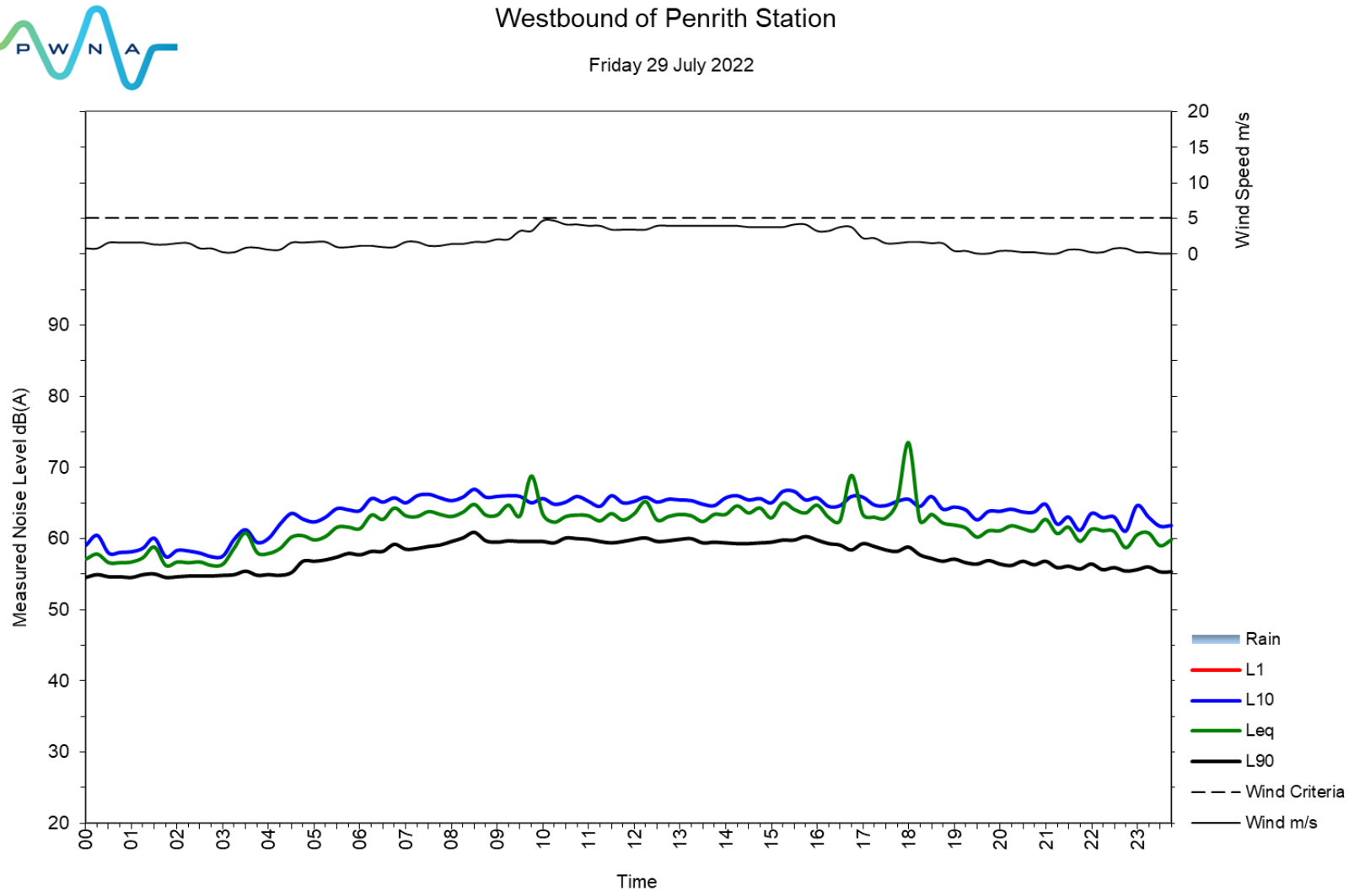
Wind m/s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Time
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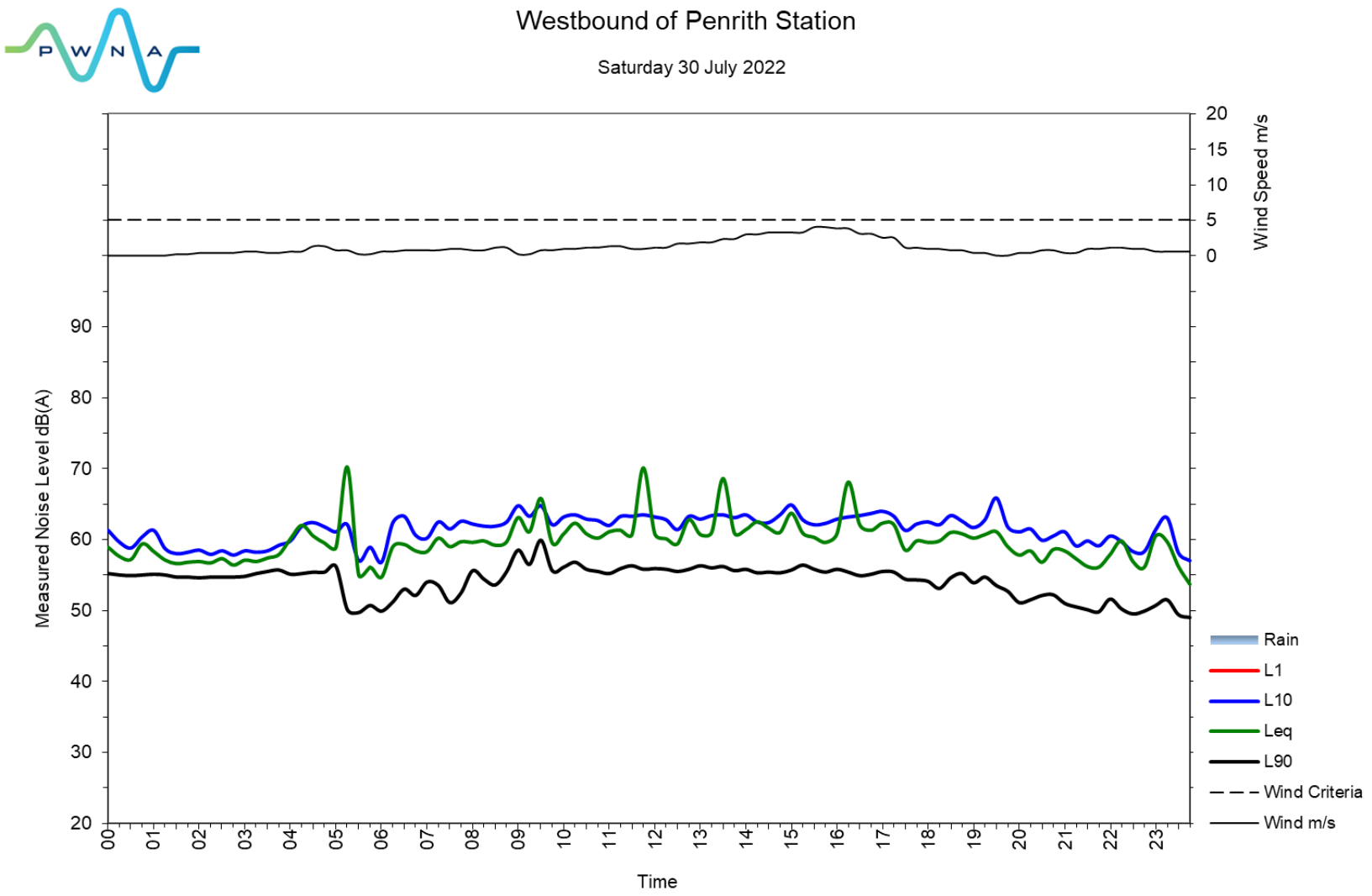
Wind m/s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Time
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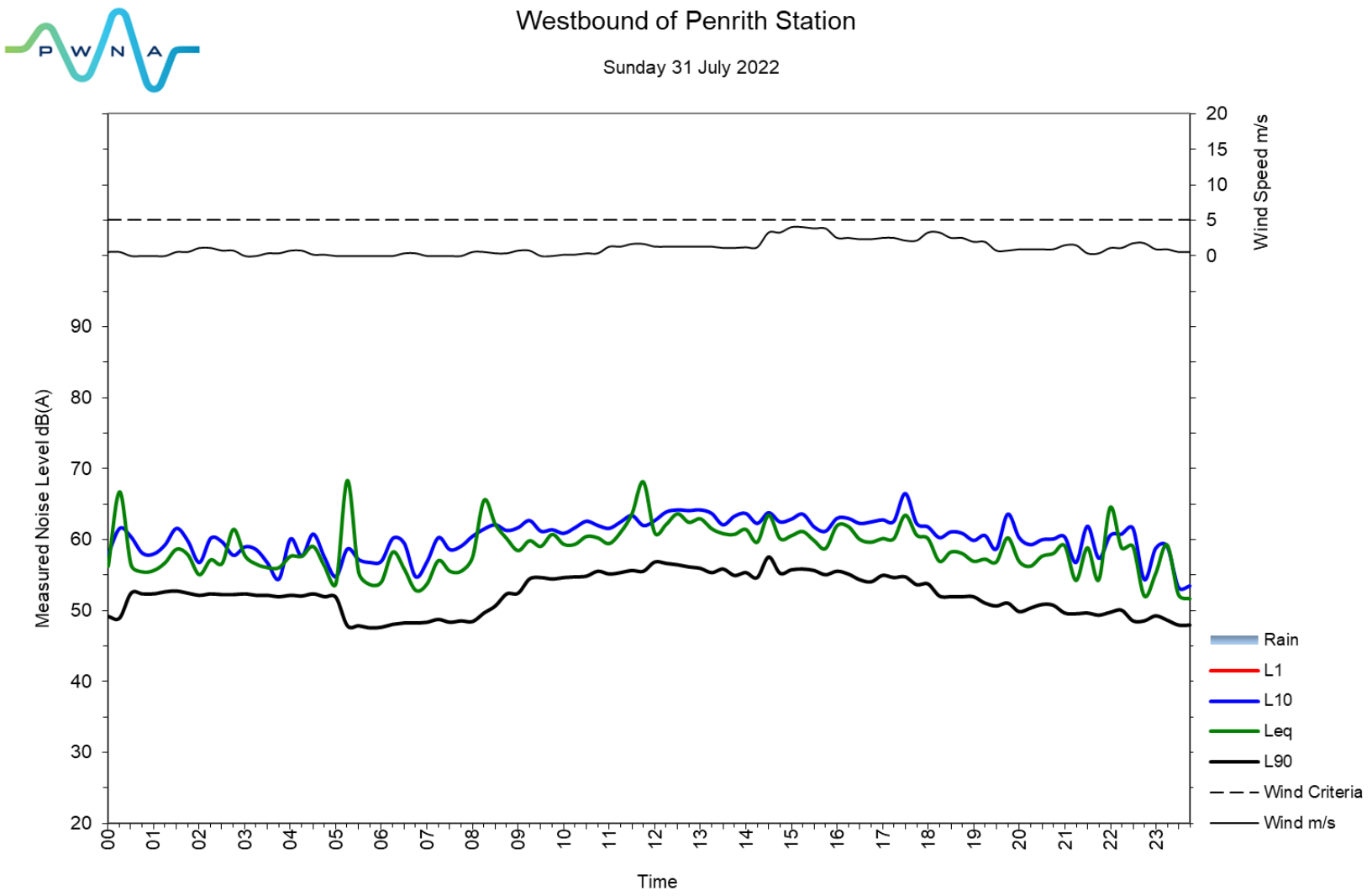
Wind m/s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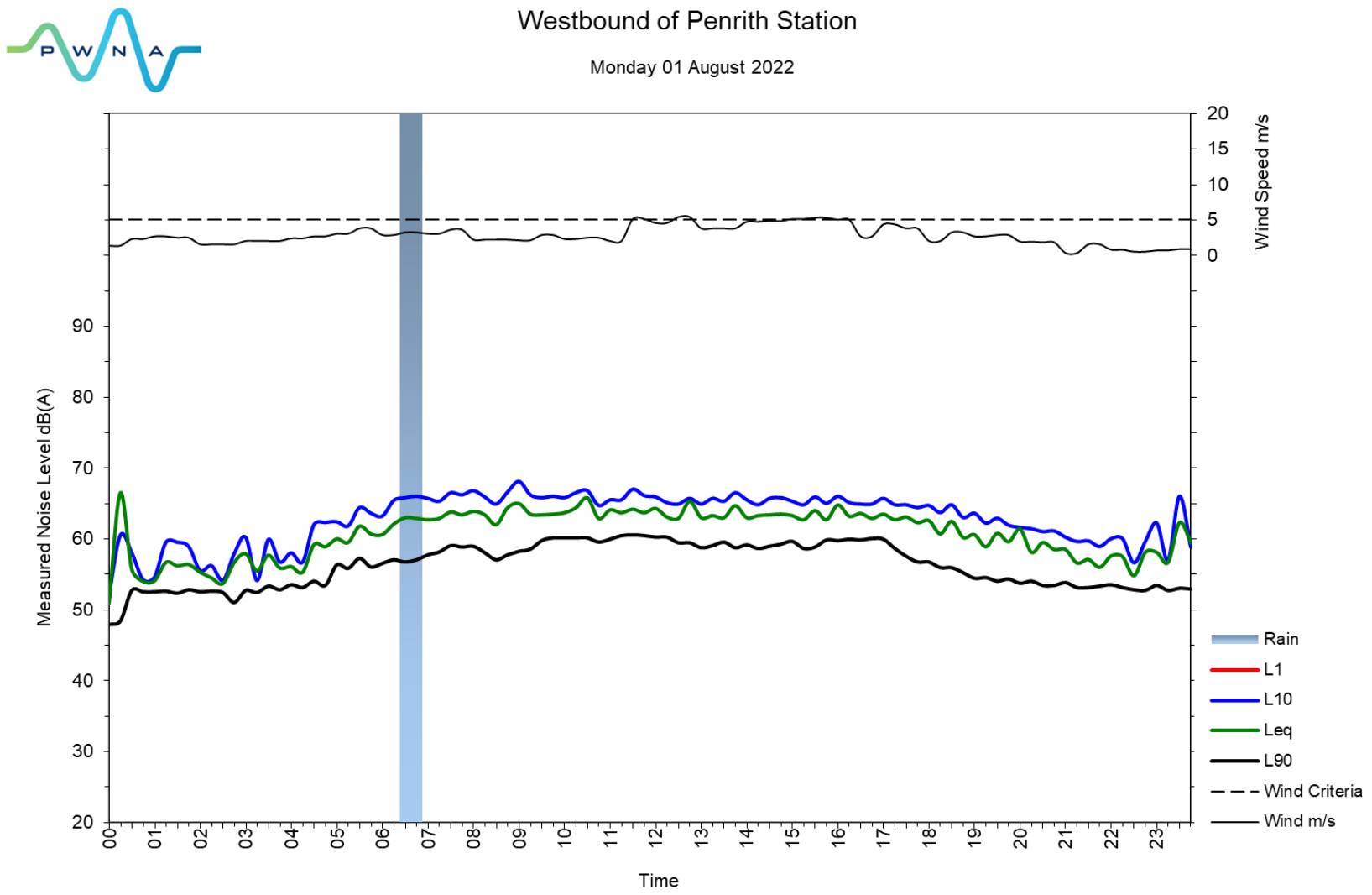
Wind m/s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Time
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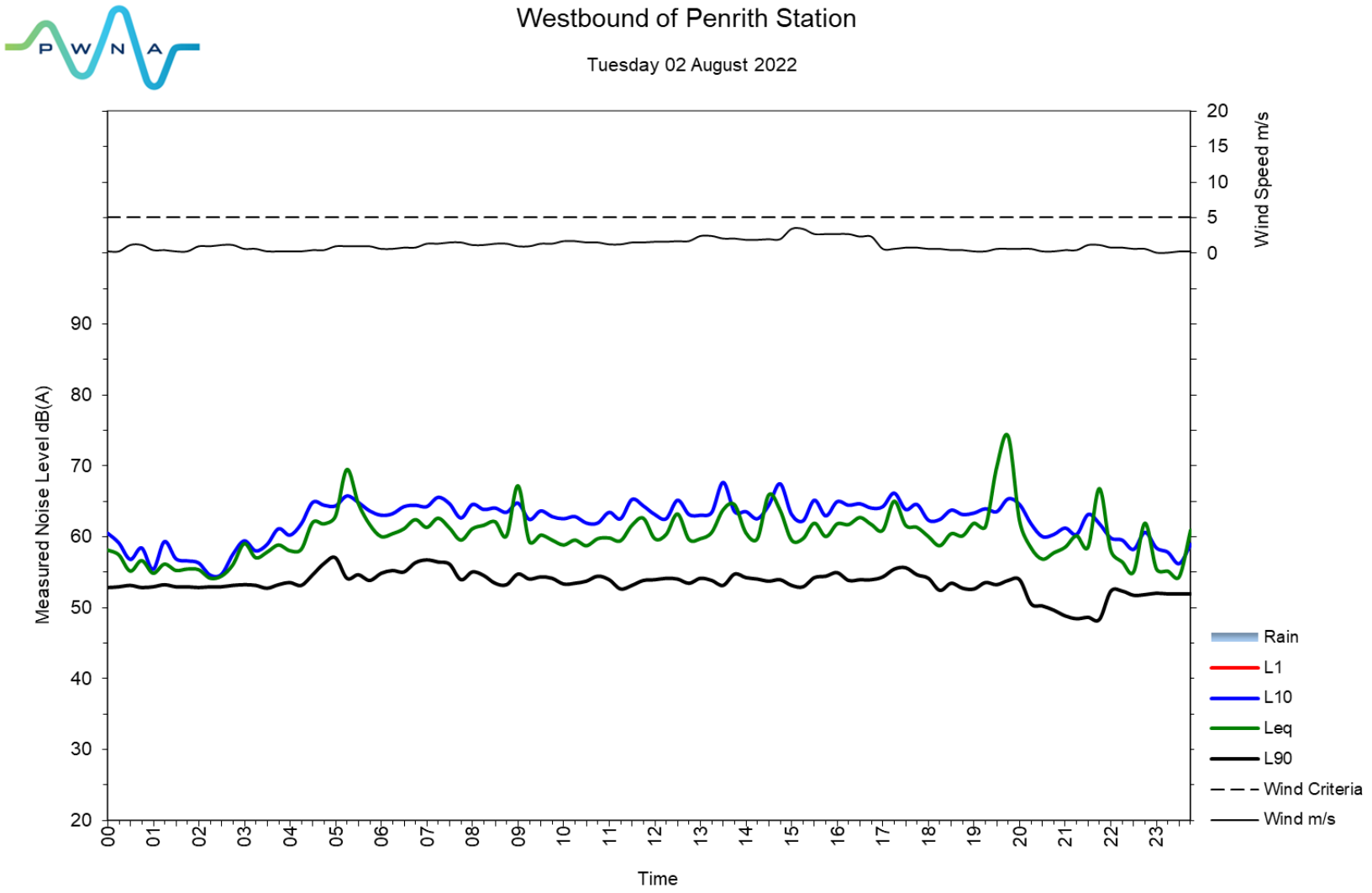
Wind m/s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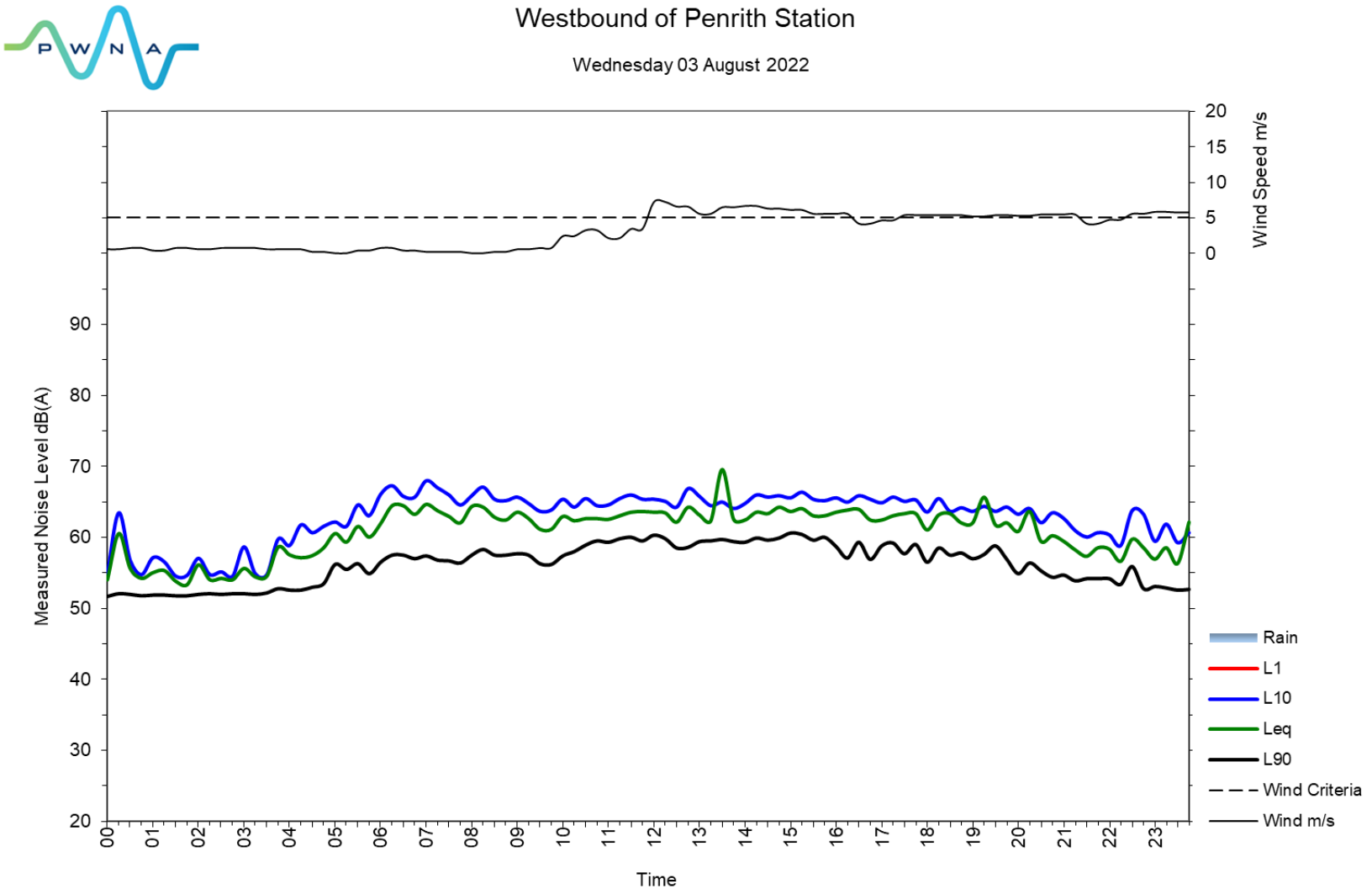
Wind m/s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L90
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Wind m/s

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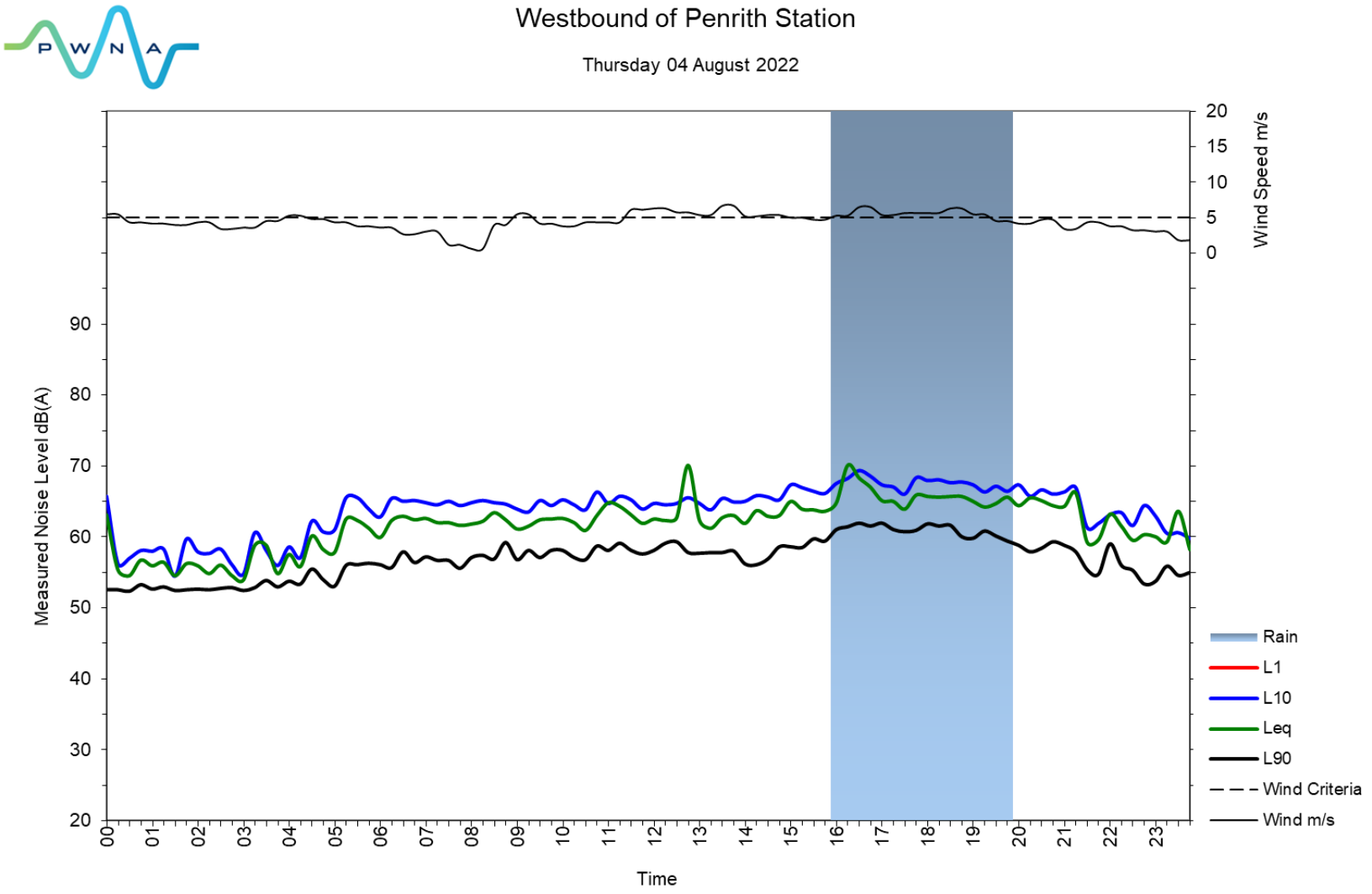
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Wind m/s

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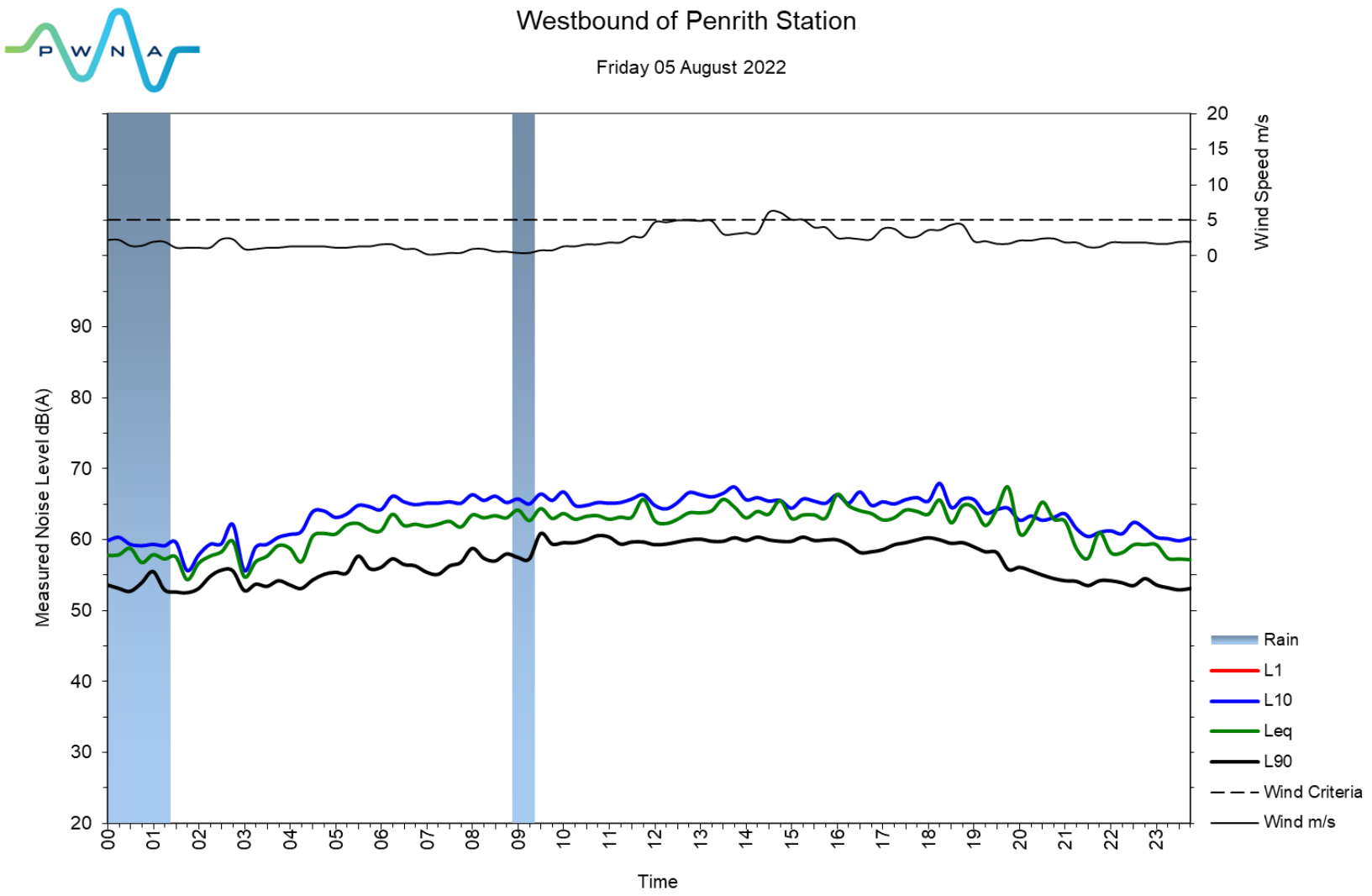
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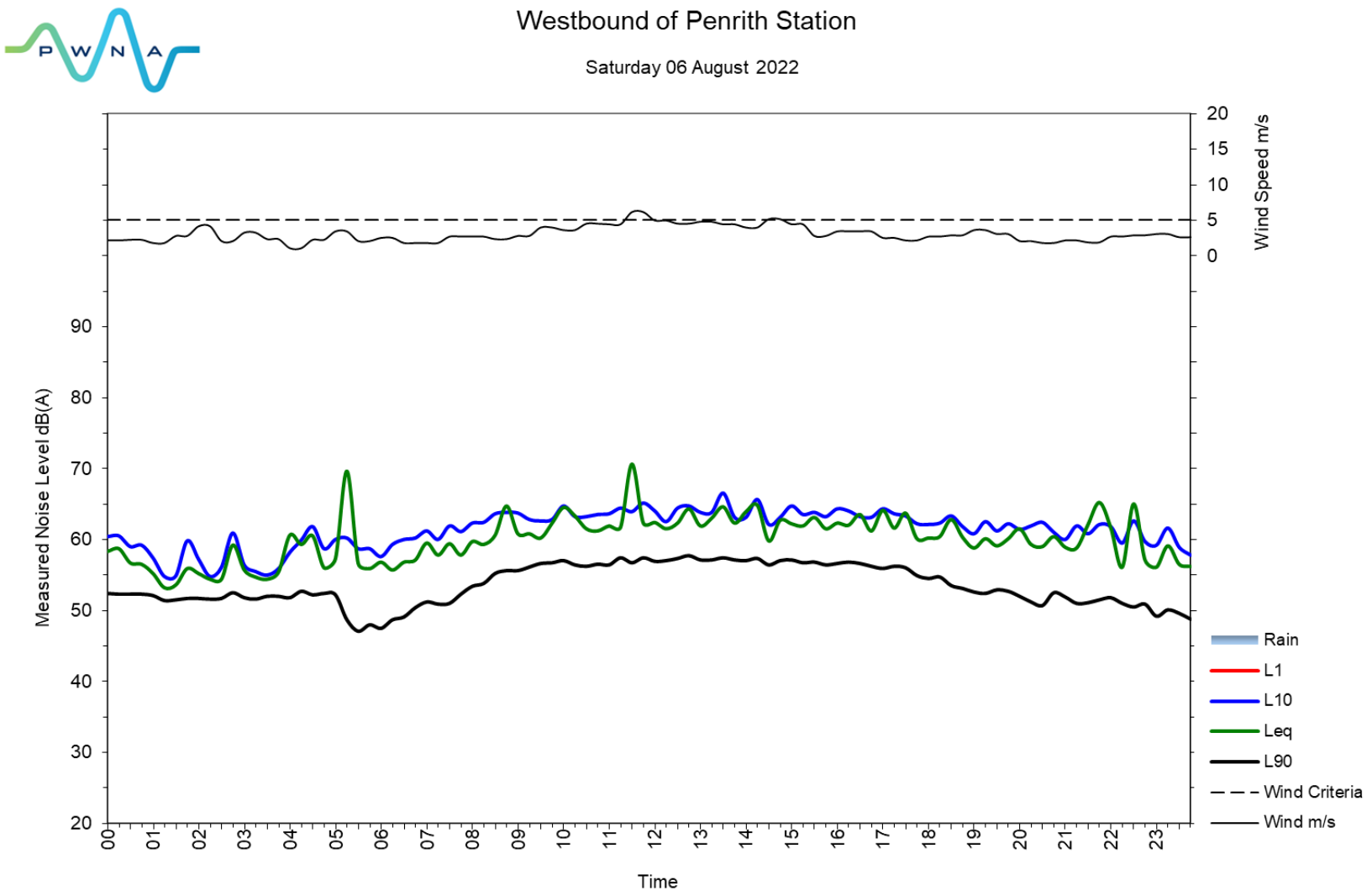
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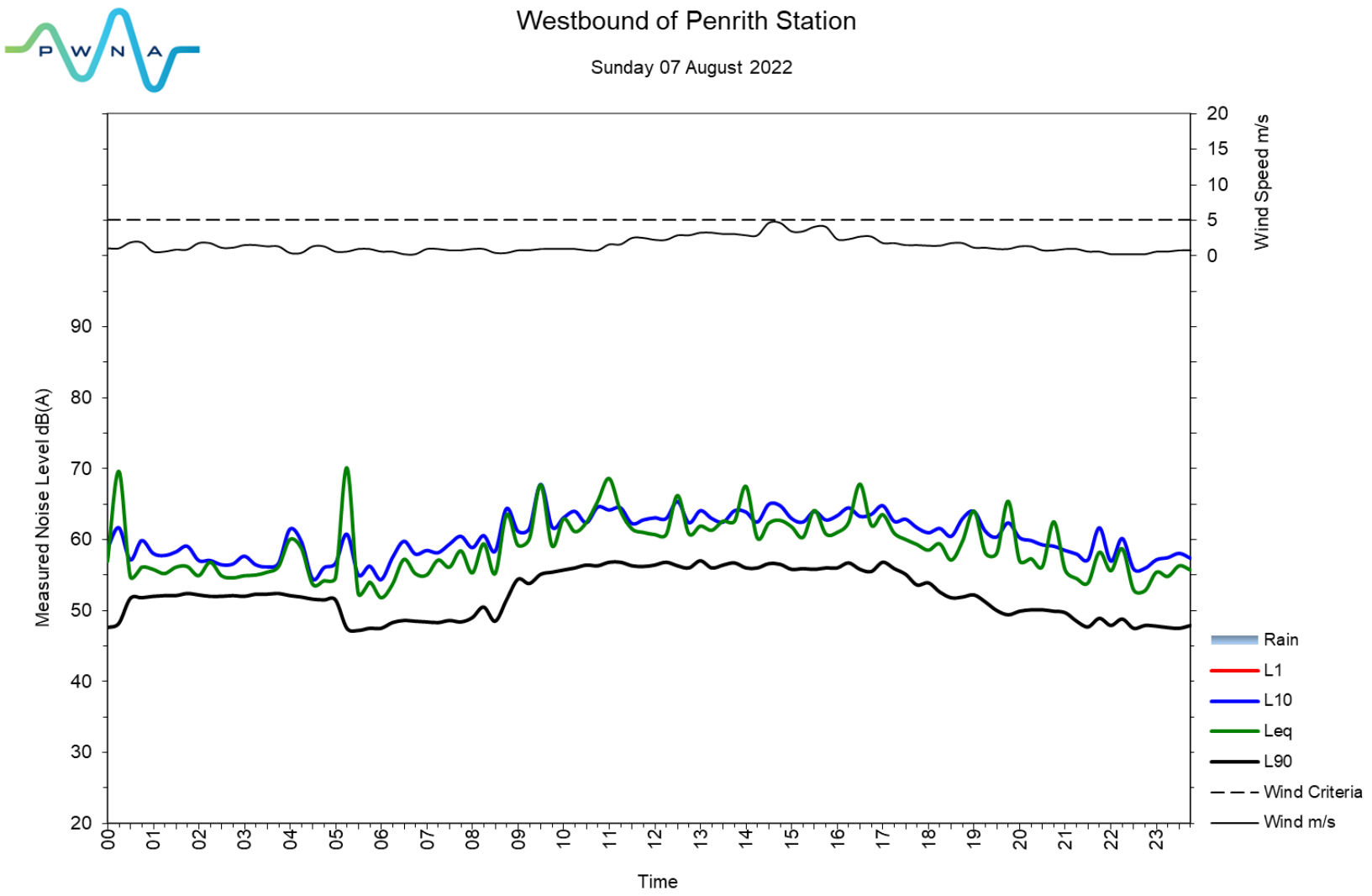
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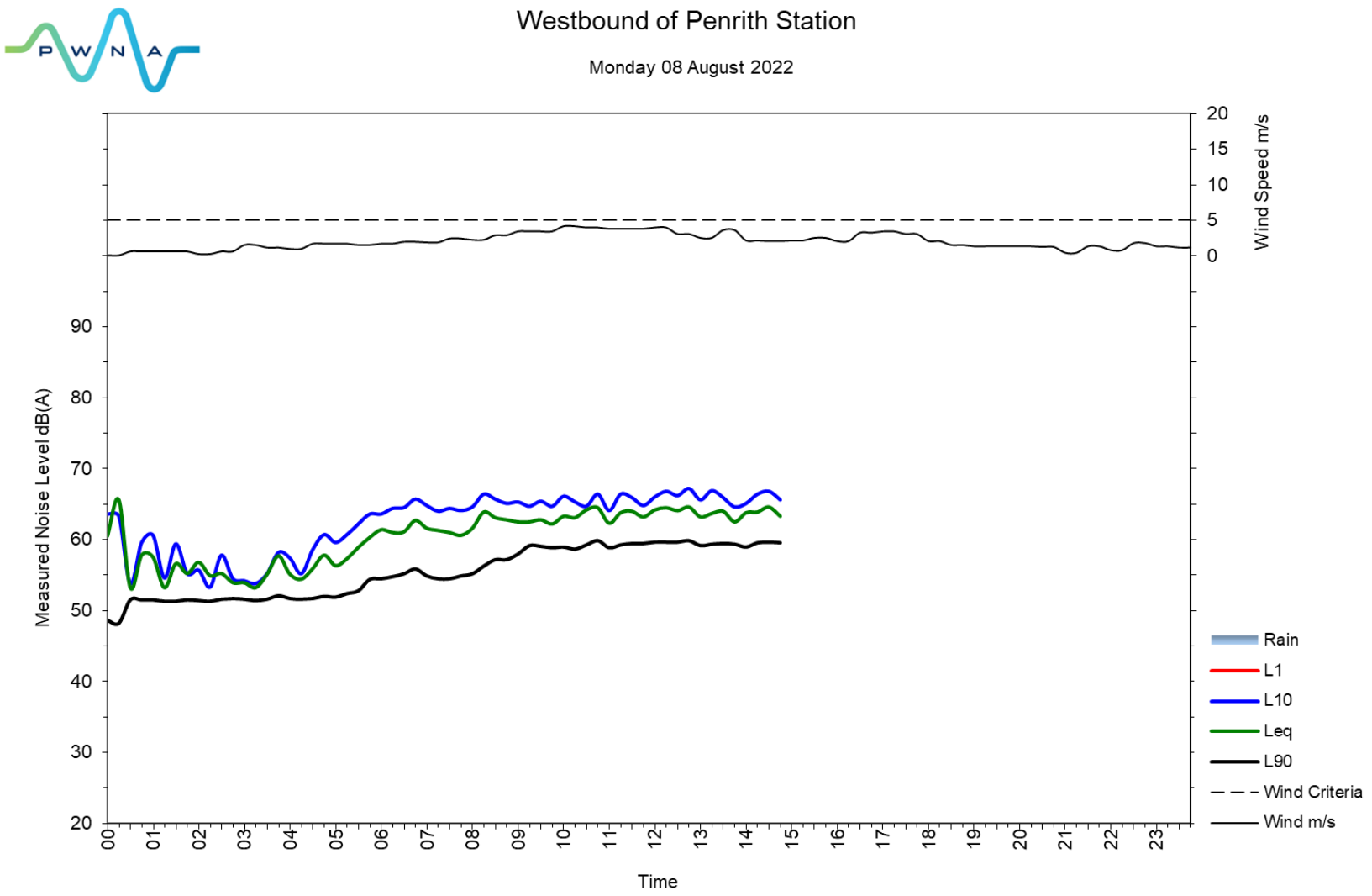
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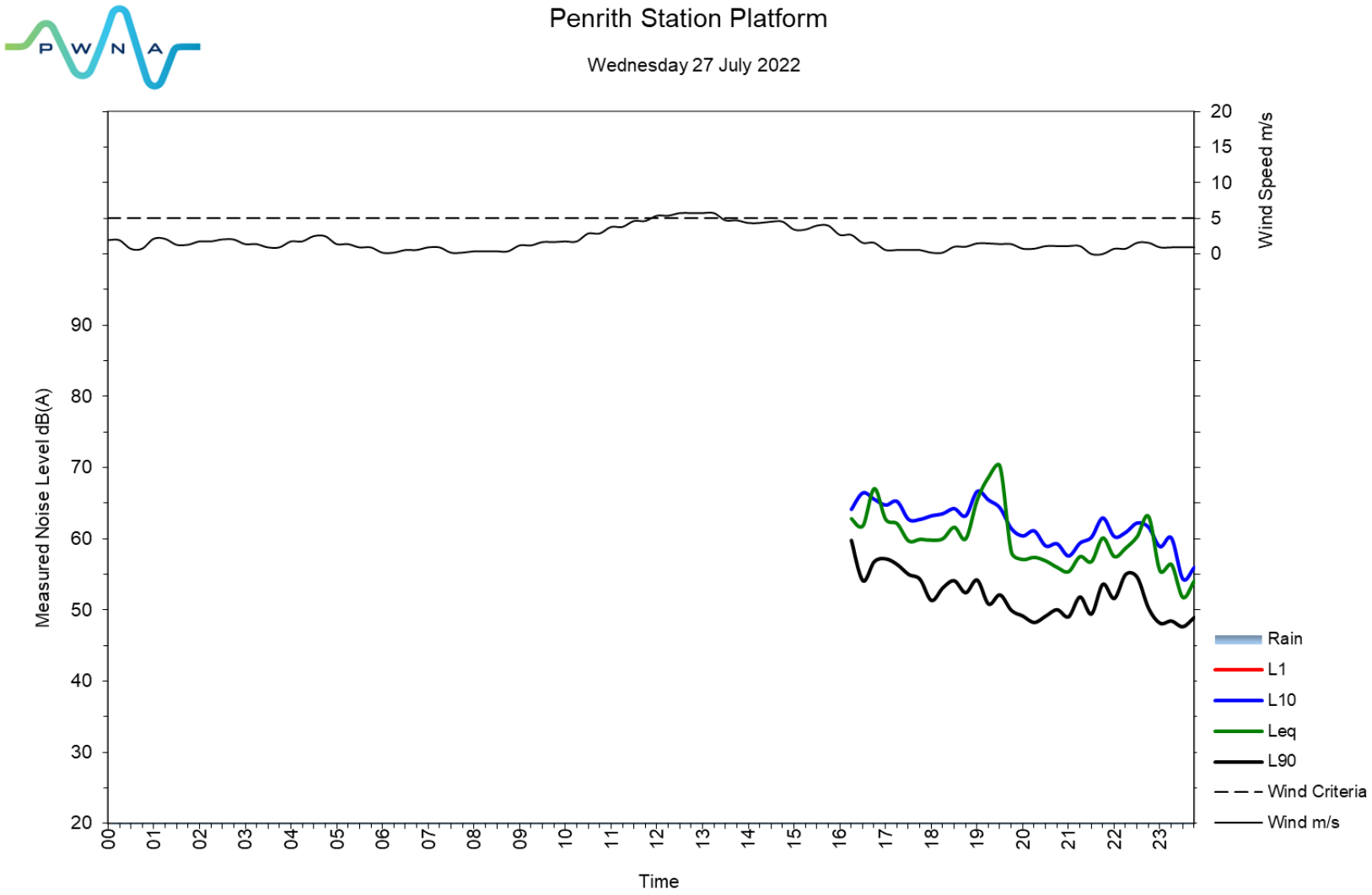
APPENDIX C: UNATTENDED NOISE MONITORING RESULTS – NM-2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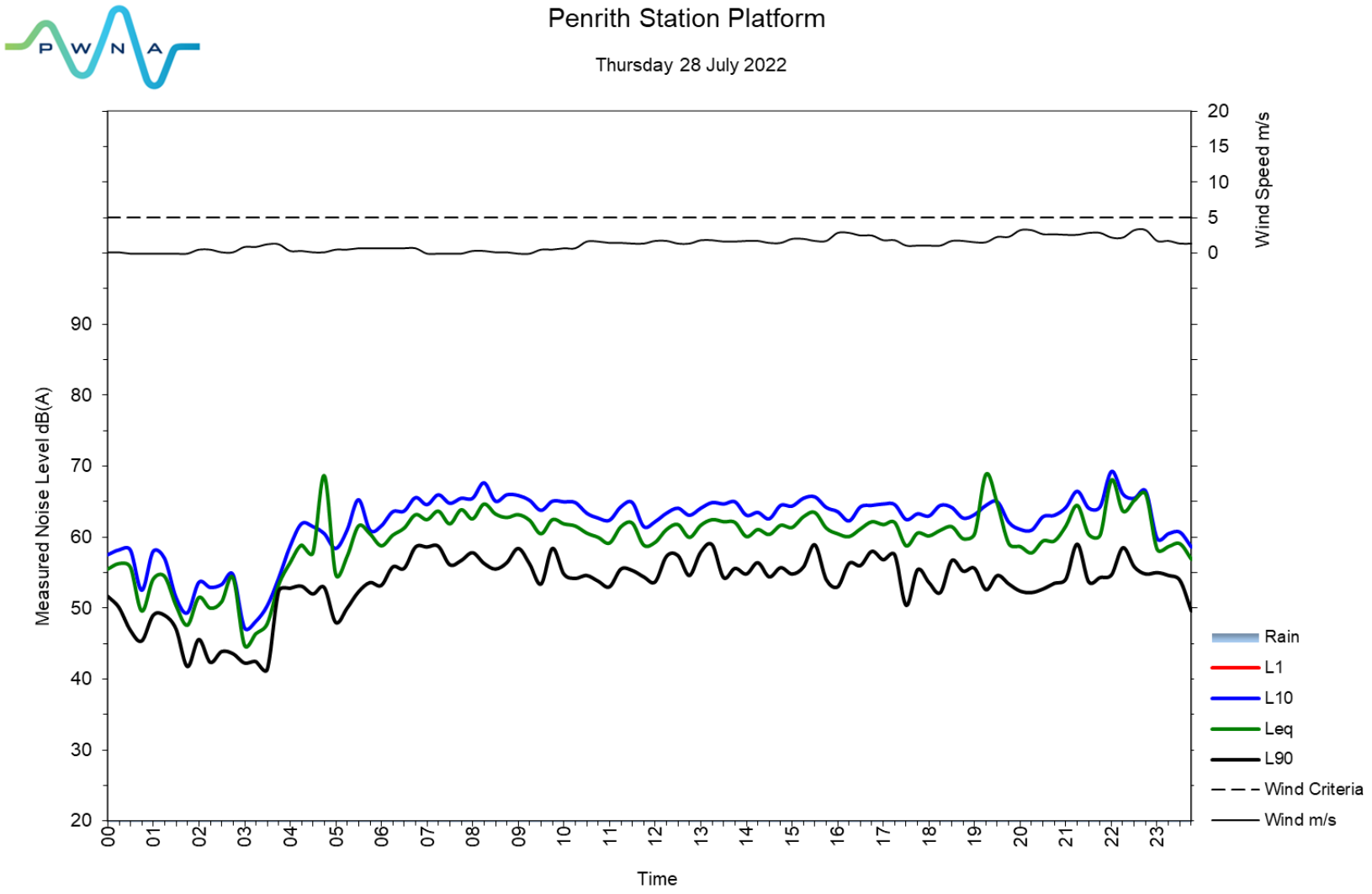
Wind m/s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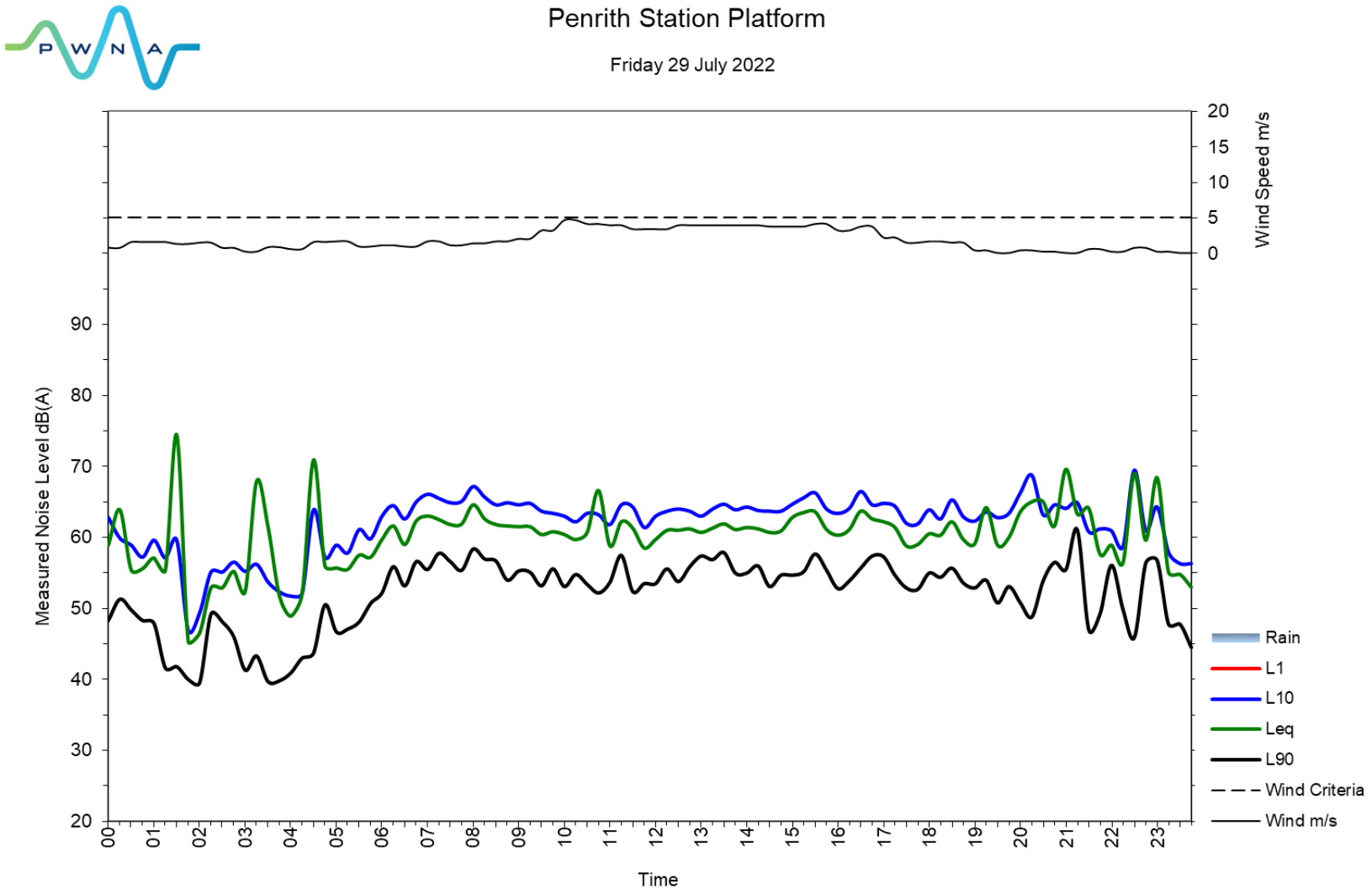
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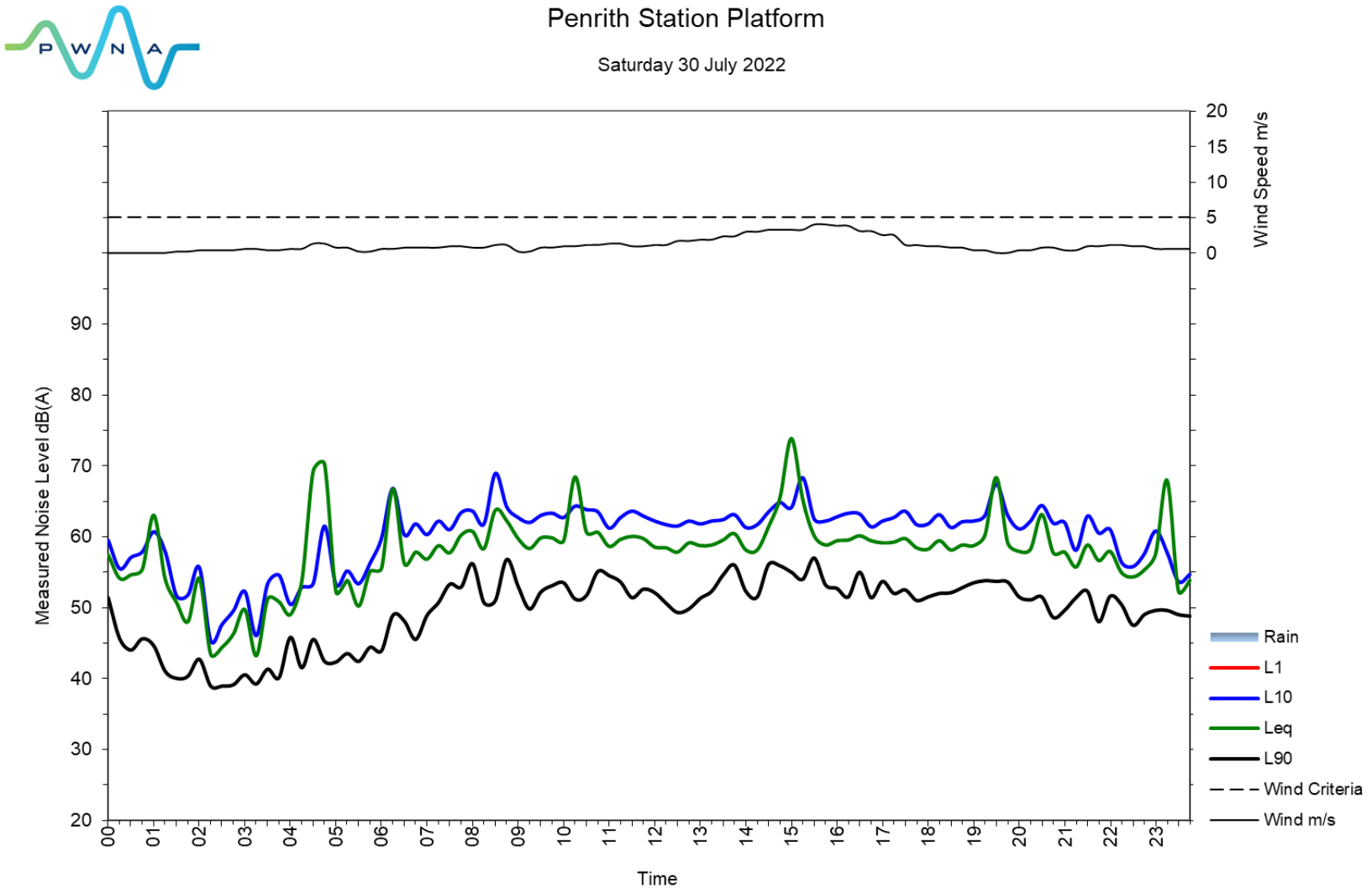
Wind m/s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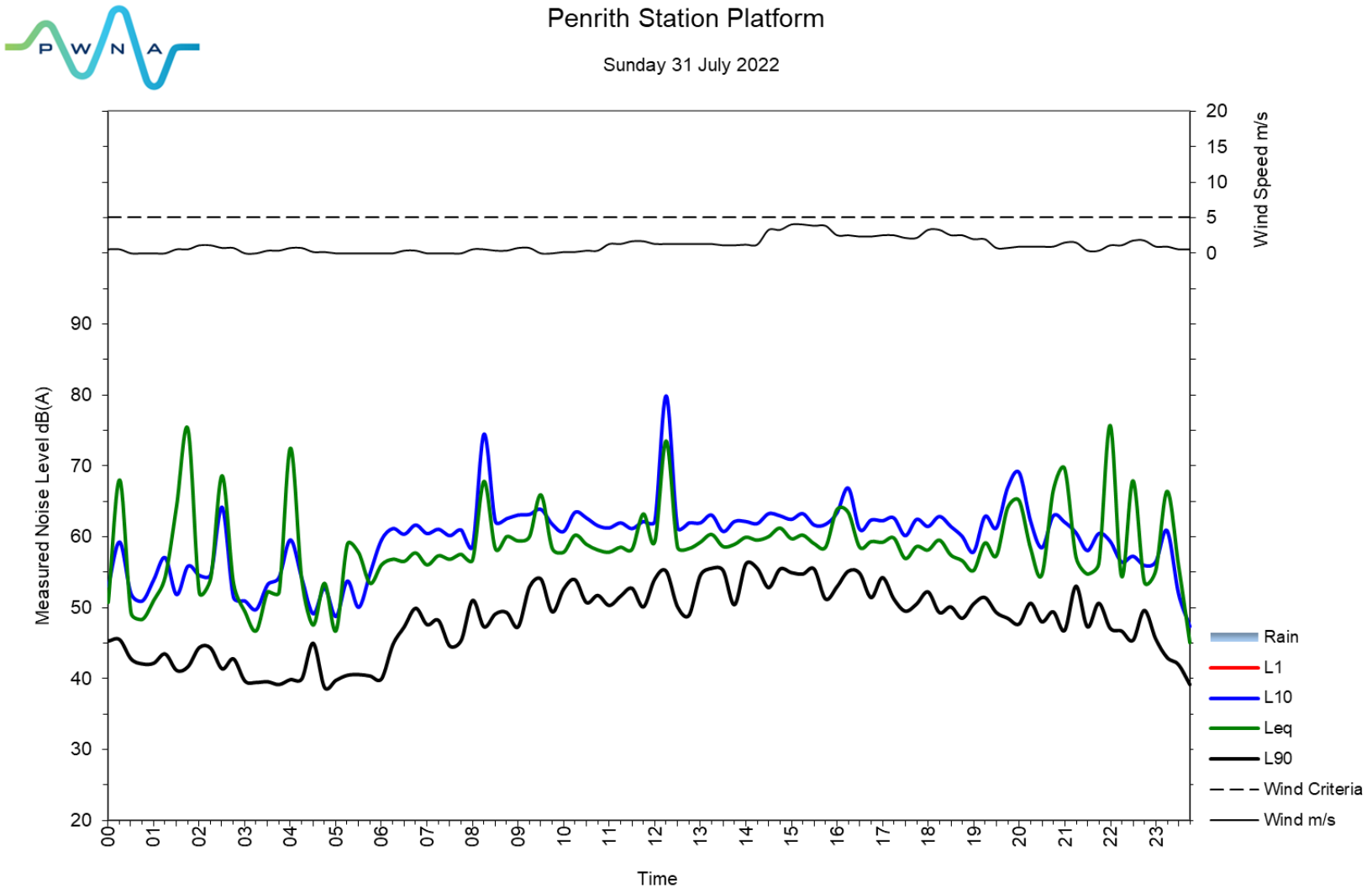
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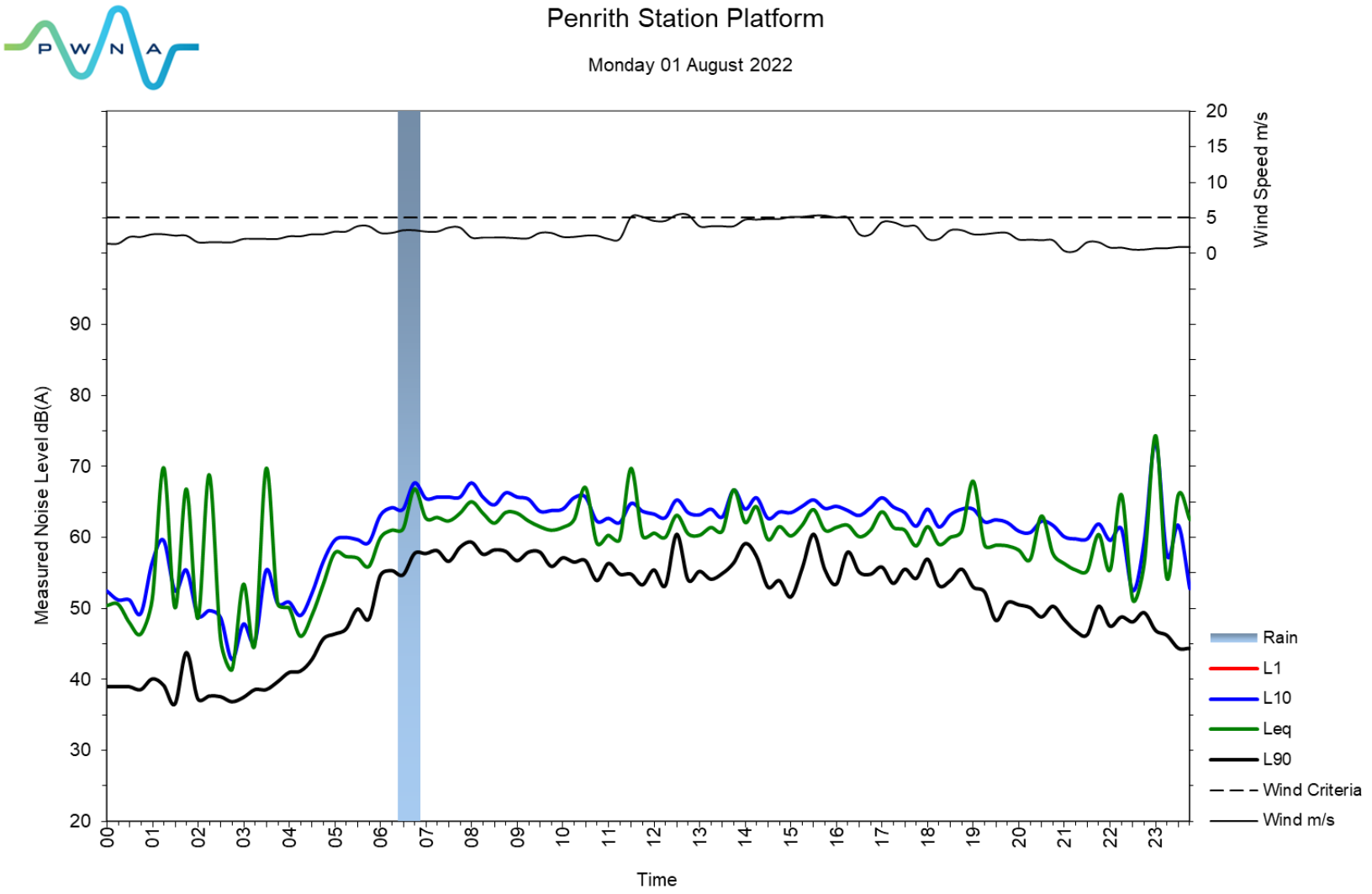
Wind m/s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Wind m/s

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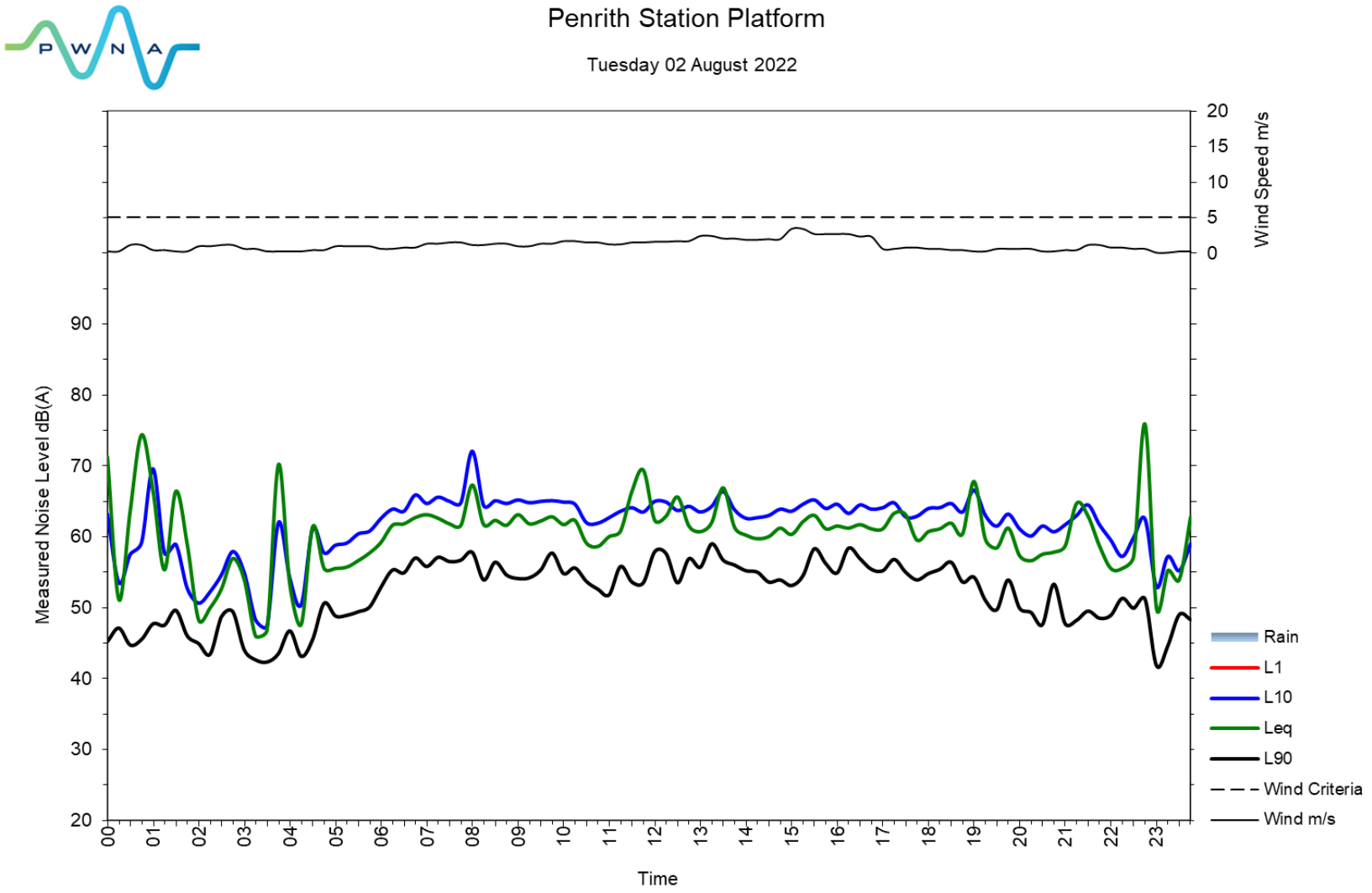
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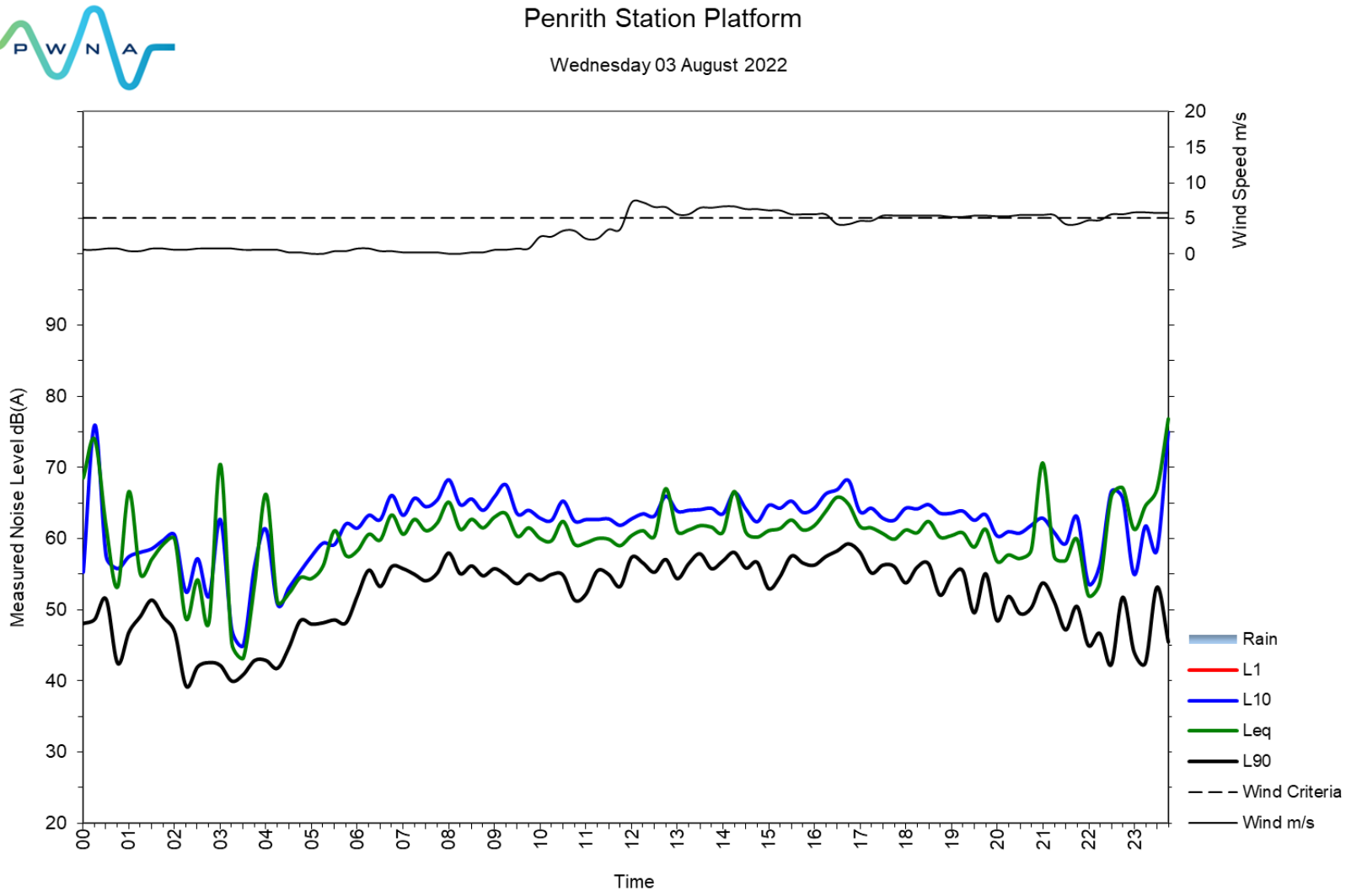
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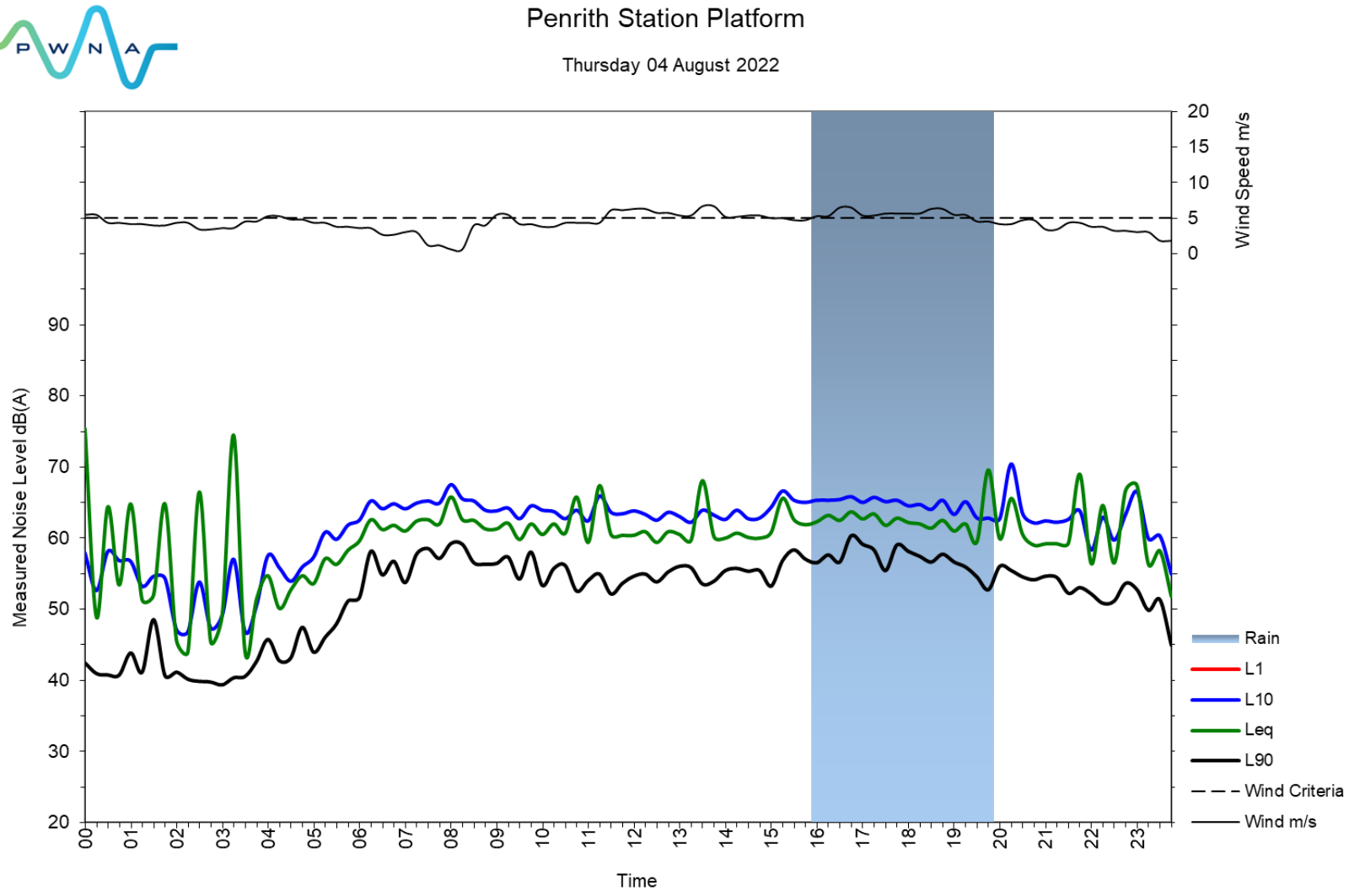
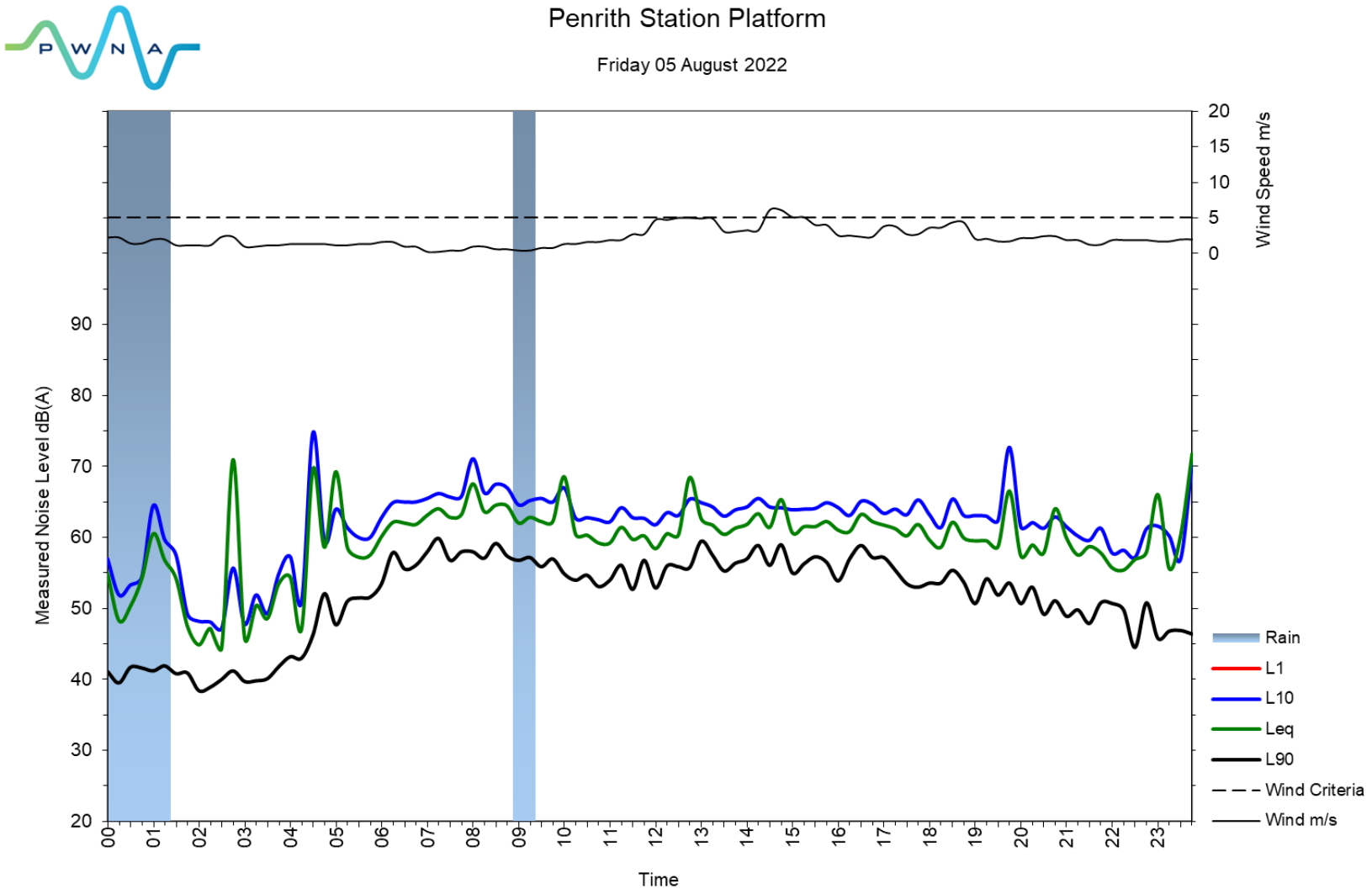
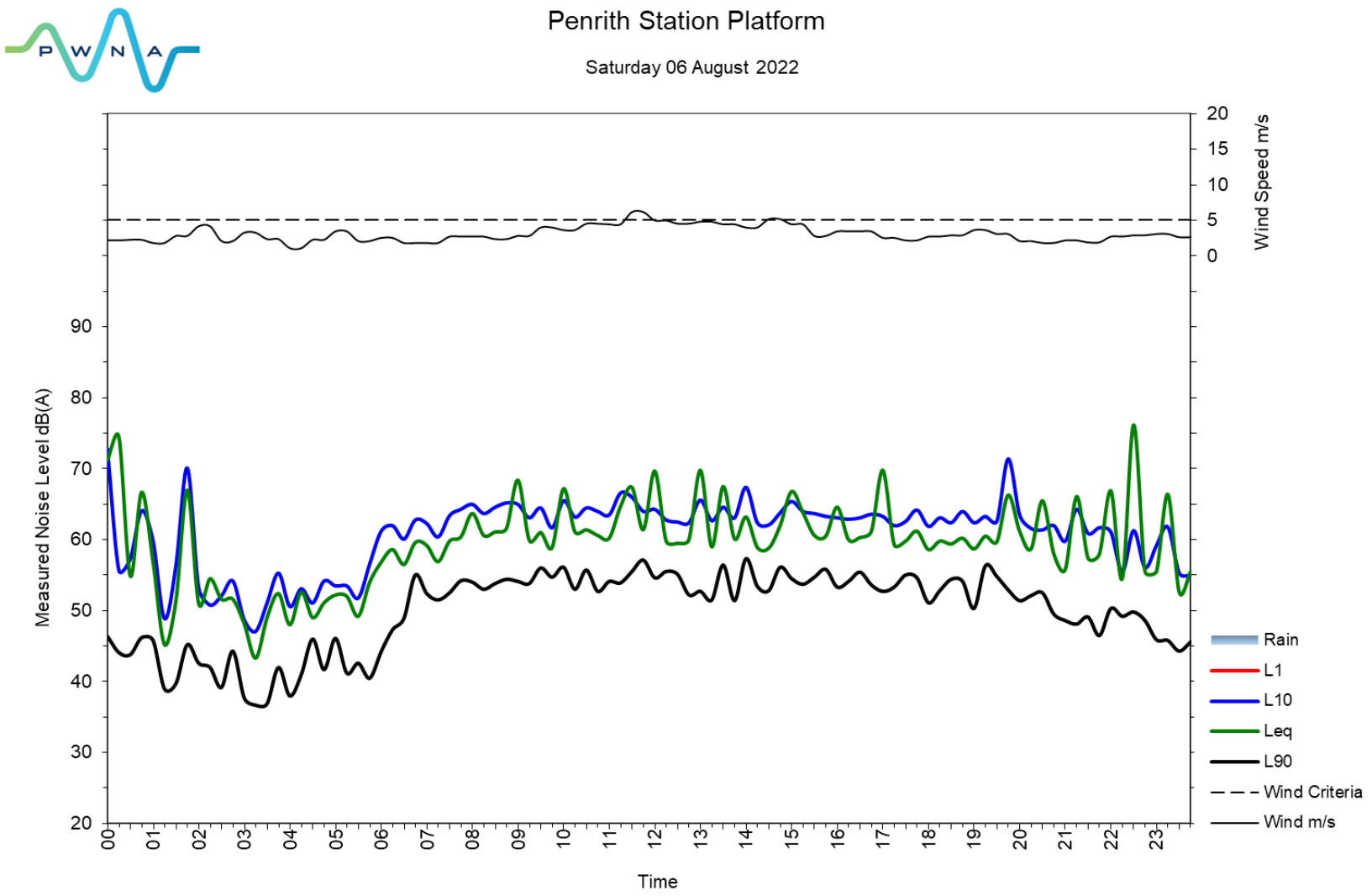
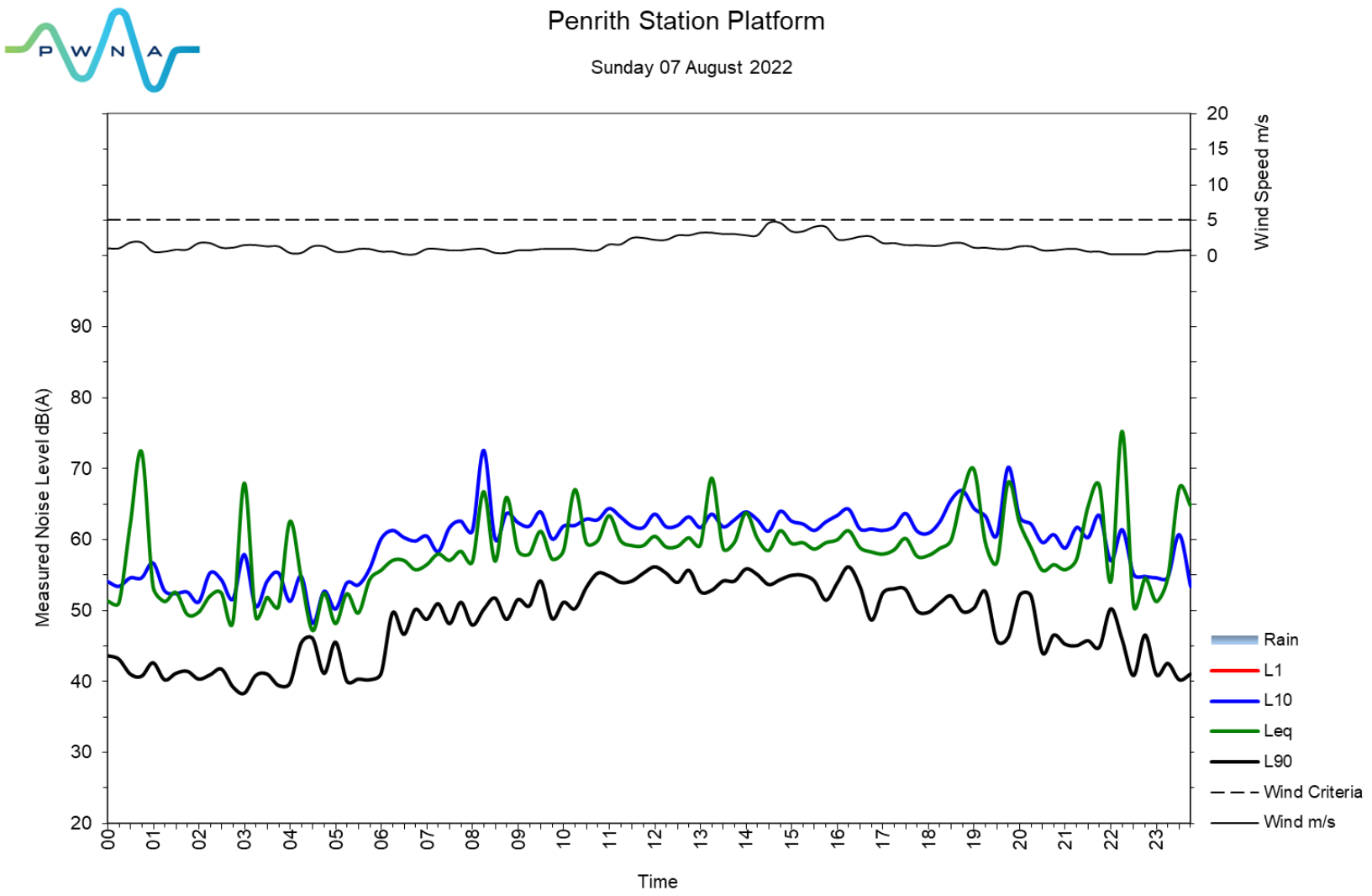
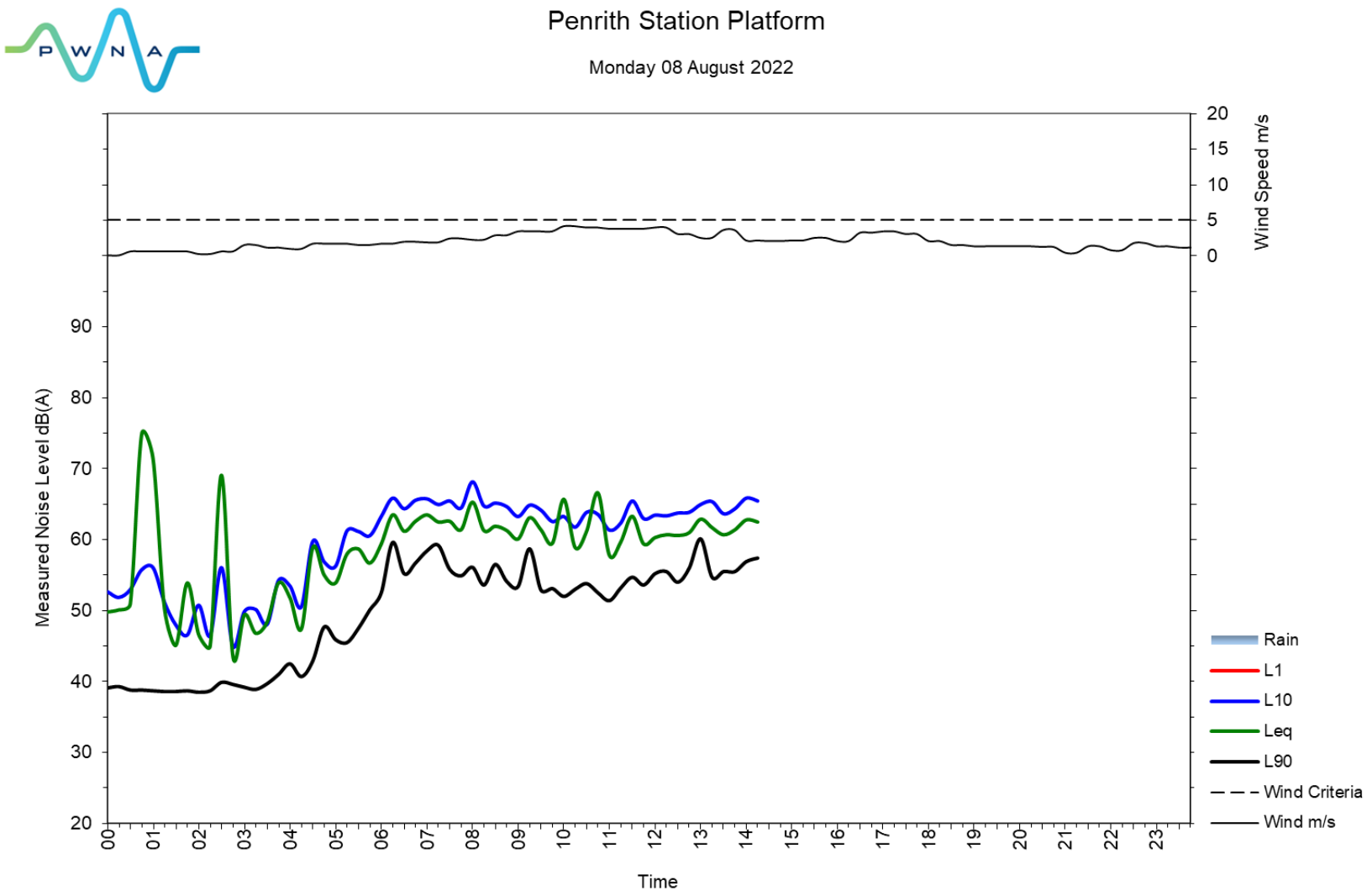
Wind Criteria
Wind m/s


Penrith Station Platform
Thursday 04 August 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

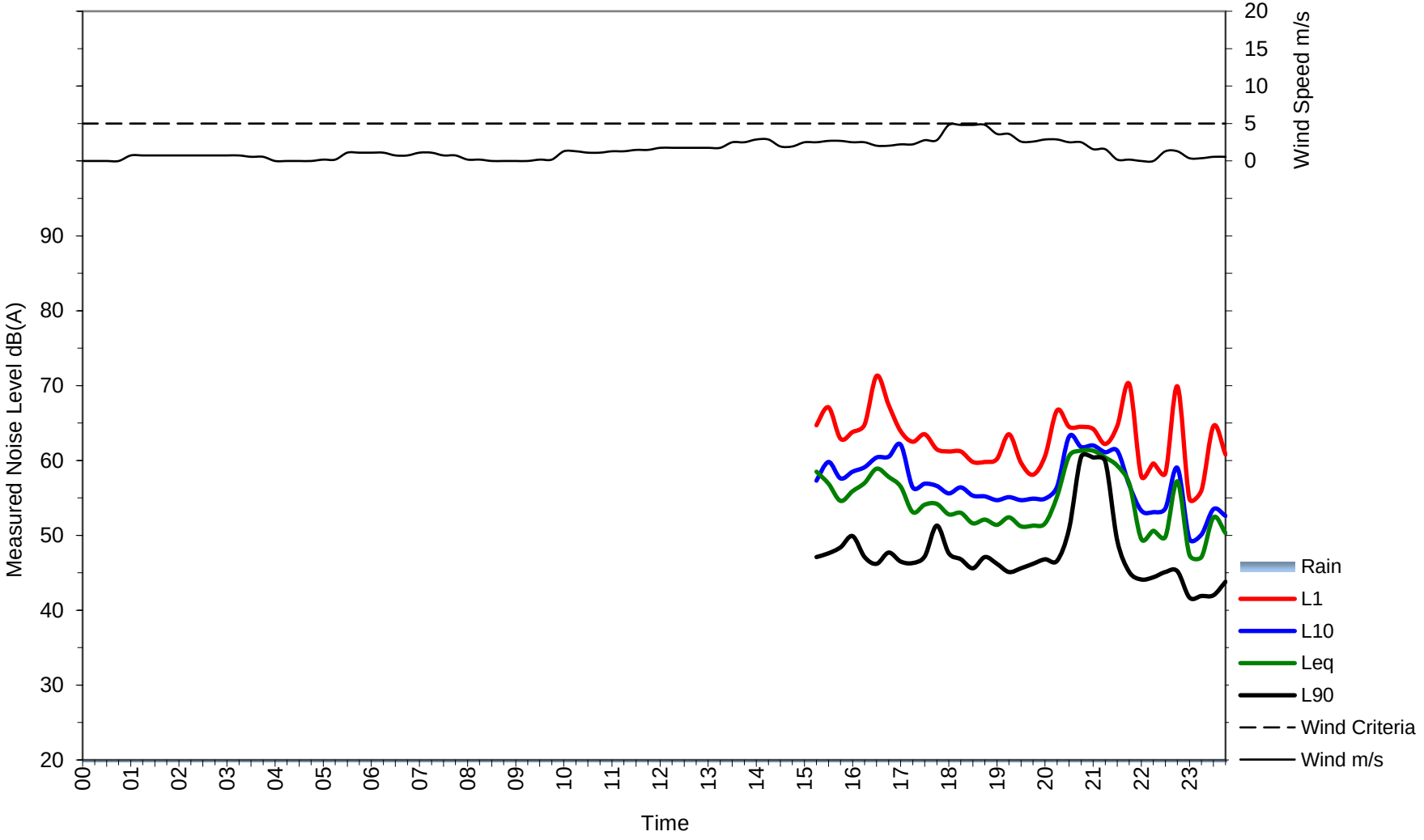

Penrith Station Platform
Friday 05 August 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

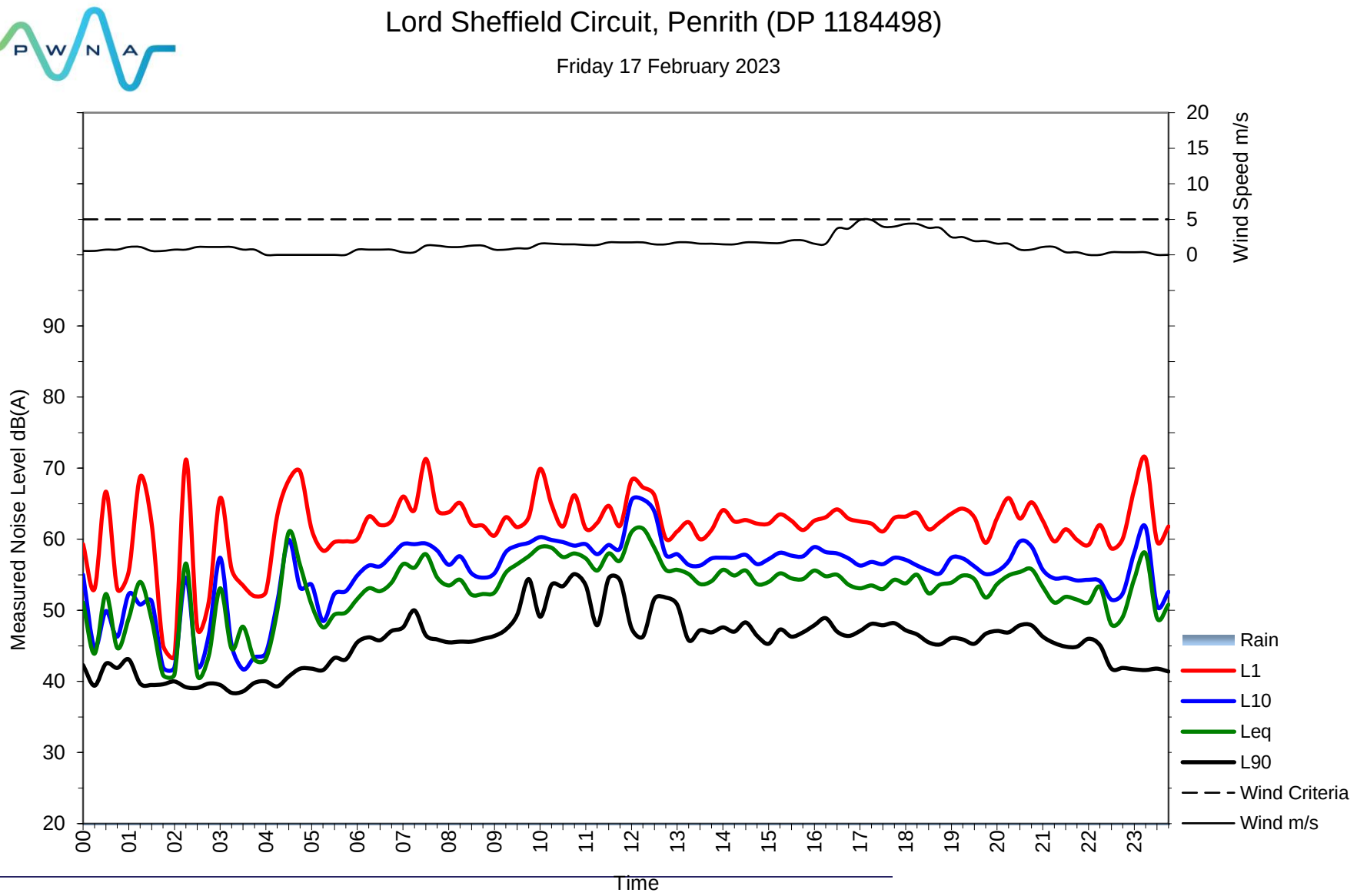

Penrith Station Platform
Saturday 06 August 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
20
30
40
50
60
70
80
90
0
5
10
15
20
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

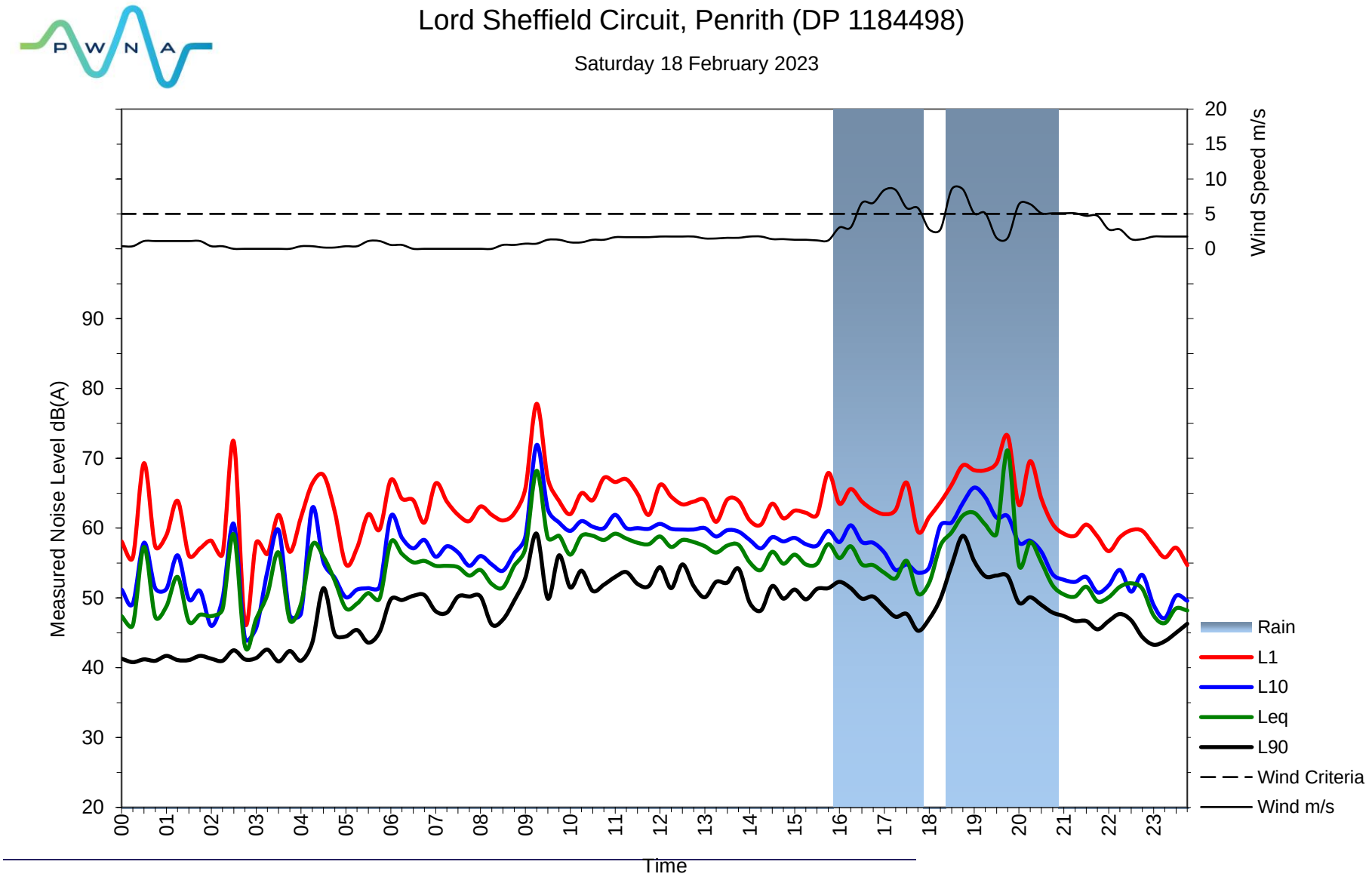

Penrith Station Platform
Sunday 07 August 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
20
30
40
50
60
70
80
90
0
5
10
15
20
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

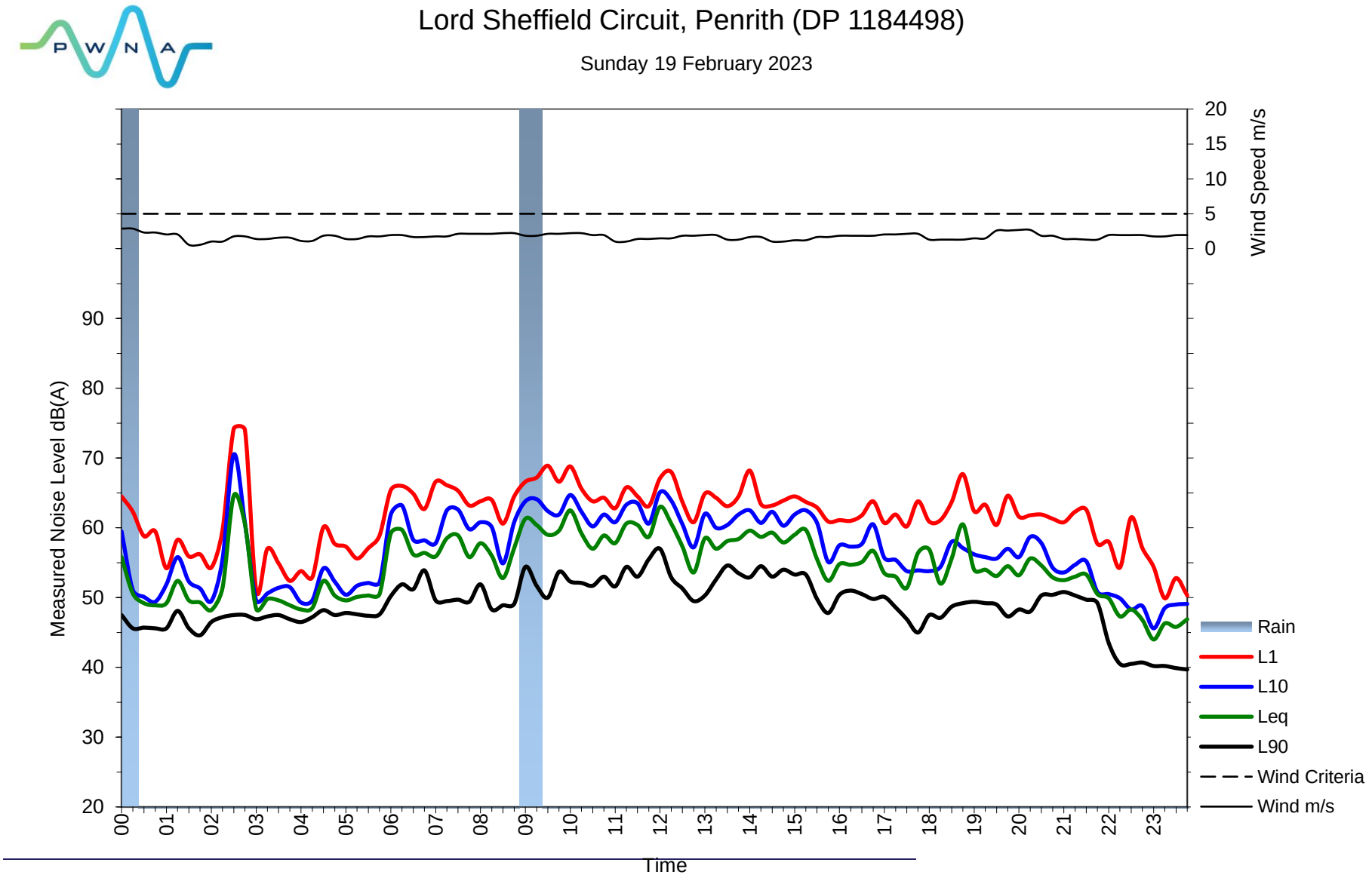

Penrith Station Platform
Monday 08 August 2022
Measured Noise Level dB(A)
Wind Speed m/s
Time
20
30
40
50
60
70
80
90
0
5
10
15
20
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

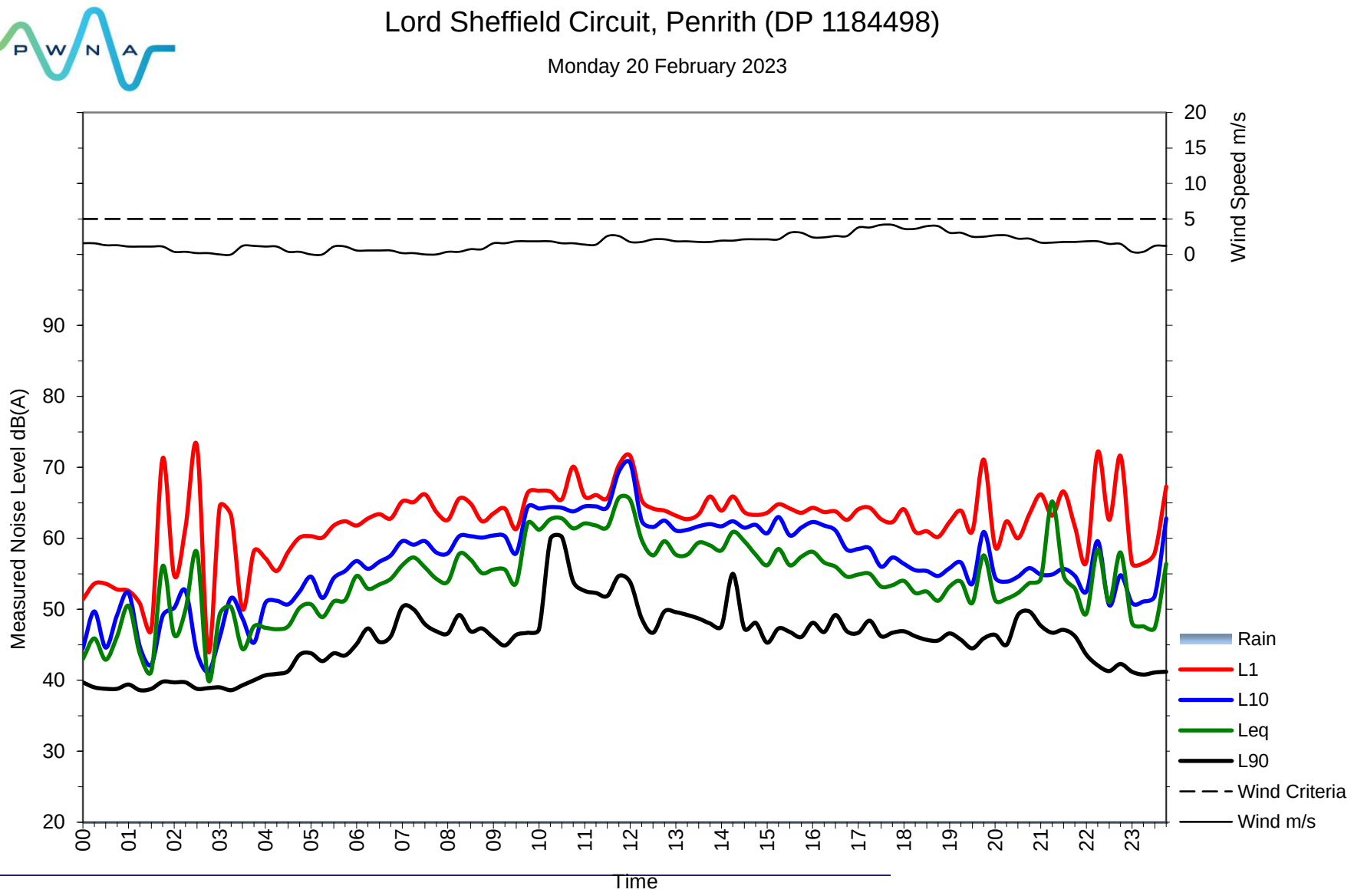
APPENDIX D: UNATTENDED NOISE MONITORING RESULTS – NM-3

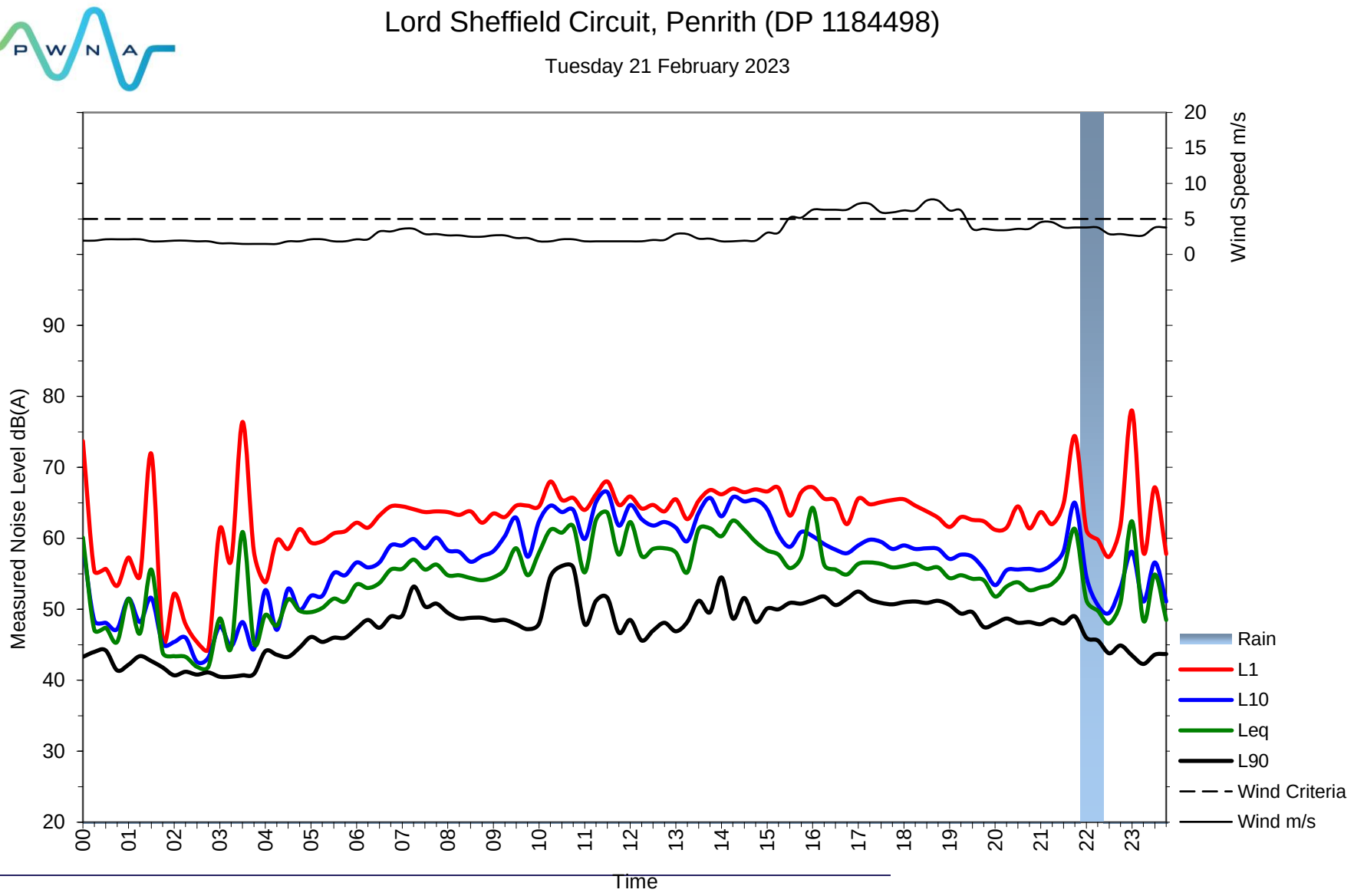

Lord Sheffield Circuit, Penrith (DP 1184498)
Thursday 16 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
20
30
40
50
60
70
80
90
0
5
10
15
20
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

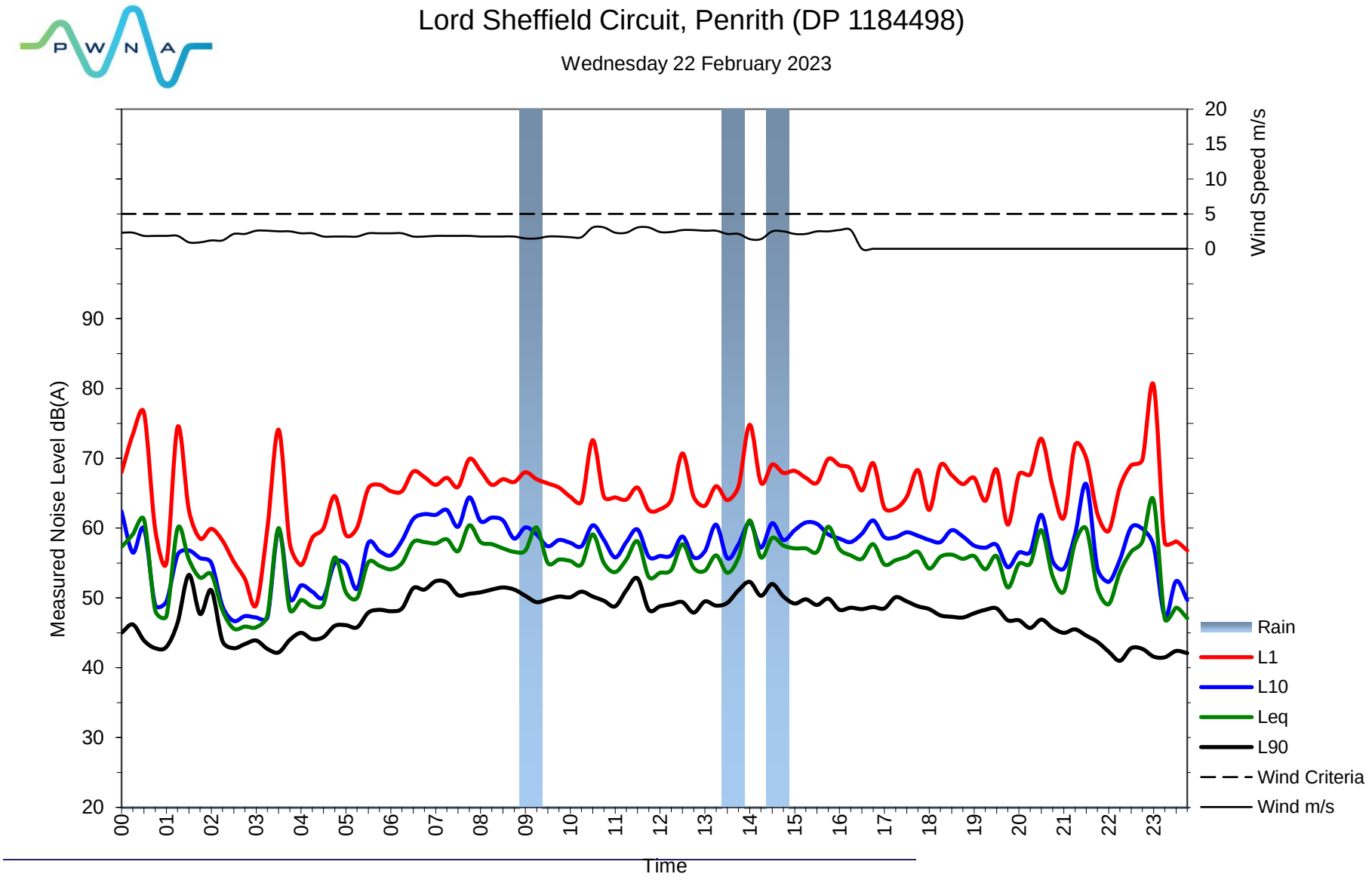

Lord Sheffield Circuit, Penrith (DP 1184498)
Friday 17 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s

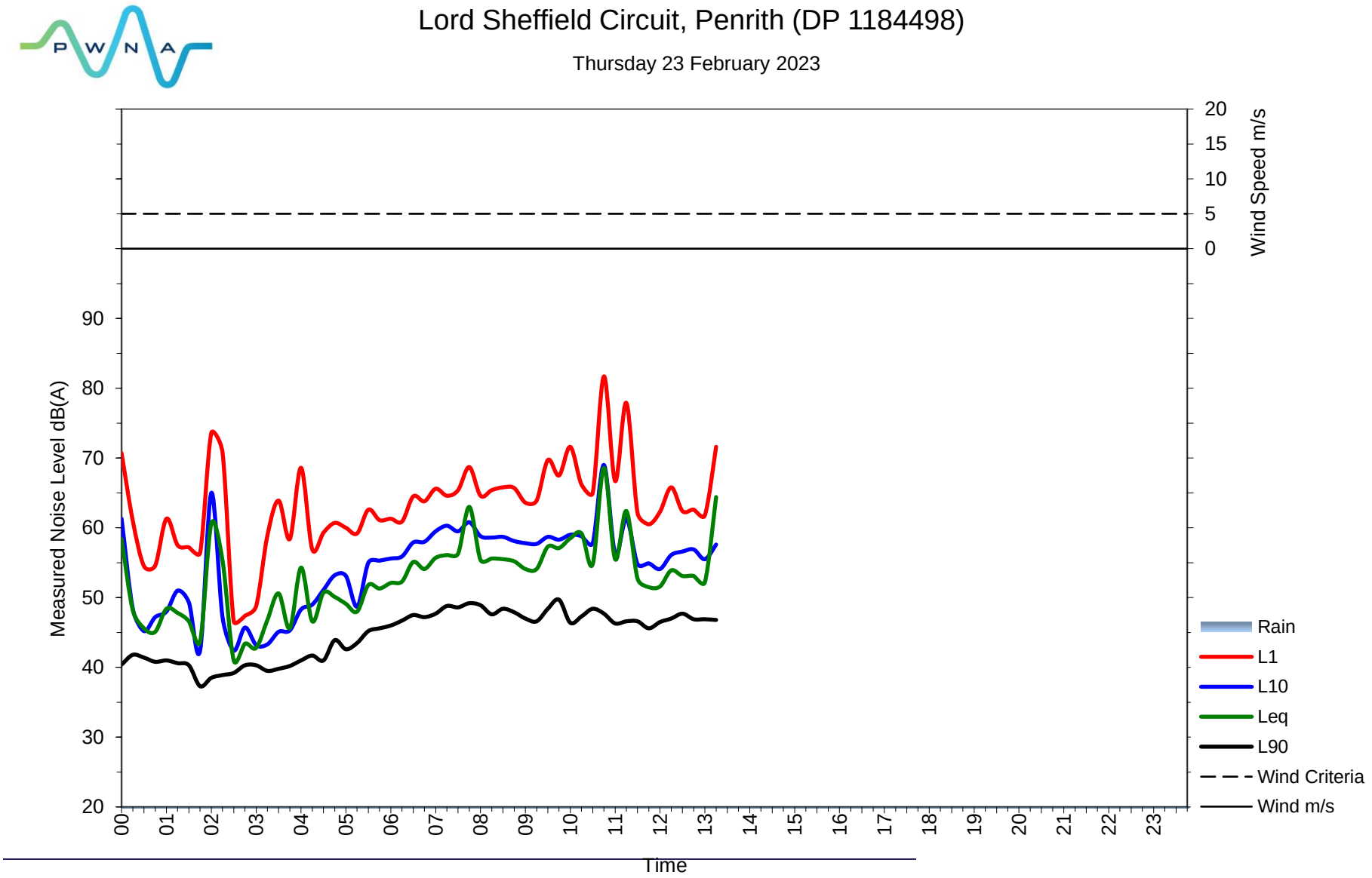

Lord Sheffield Circuit, Penrith (DP 1184498)
Saturday 18 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Lord Sheffield Circuit, Penrith (DP 1184498)
Sunday 19 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Lord Sheffield Circuit, Penrith (DP 1184498)
Monday 20 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Lord Sheffield Circuit, Penrith (DP 1184498)
Tuesday 21 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Lord Sheffield Circuit, Penrith (DP 1184498)
Wednesday 22 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s


Lord Sheffield Circuit, Penrith (DP 1184498)
Thursday 23 February 2023
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s