Kingswood Apartments and Hotel – DA Acoustic Assessment

Iris Capital
Suite 41.04, 264 George Street,
Sydney NSW 2000

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PULSE WHITE NOISE ACOUSTICS Level 5, 73 Walker Street, North Sydney NSW 2060
P 1800 4 PULSE (1800 478 573) **E** info@pwna.com.au **pwna.com.au** ABN 95 642 886 306

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PREPARED BY:

Pulse White Noise Acoustics Pty Ltd
ABN 95 642 886 306
Level 5, 73 Walker Street, North Sydney, 2060
1800 4 PULSE

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1 INTRODUCTION

Pulse White Noise Acoustics (PWNA) have been engaged to undertake an acoustic assessment of the proposed redevelopment of current Kingswood Hotel (being the north site) and associated vacant lot located south of the hotel (being the south site) and the construction of a multi-storey mixed-use buildings across both sites.

As mentioned above the project is separated across two sites (referred to the northern site and southern site). The northern site is located along the Great Western Highway and the southern site is located between Wainwright Lane and Rodgers Street. Both sites are a mixed-use building with basements, ground floor commercial and residential apartments above.

The project will also be delivered in two stages, the existing licensed venue on the northern site will remain operational throughout the construction of the southern site (stage one). Upon completion of stage one, the licensed venue will temporarily be relocated from the northern site and southern site. This relocation will allow for the demolition and construction of the northern site with the final part relocation of the licensed venue back to the northern site on ground level. The southern site venue will remain a part licensed venue part take away liquor shop.

As part of this proposal the following operational conditions are proposed, these form the basis of our assessment detailed in following sections.

- **Licensed Venue Components**
    - Operational Hours:
        - 9:00am to 3:00am, Monday to Saturday; and
        - 10:00am to 10:00pm on Sunday.
    - Patrons:
        - To conduct this assessment, we are assuming approximately 500 Patrons, as per below:

The development will be assessed against relevant statutory regulations and guidelines including the following.

- Penrith City Council document titled *Development Control Plan (DCP) 2014*.
- NSW Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline 2008 (DNRCBR)*.
- NSW Government *State Environmental Planning Policy (SEPP) INFRASTRUCTURE.*
- Australian New Zealand Standard AS/NZS 2107:2016 *Acoustics–Recommended design sound levels and reverberation times for building interiors.*
- New South Wales (NSW) Environmental Protection Authority (EPA) document titled *Noise Policy for Industry 2017 (NPI)*
- New South Wales (NSW) Department of Environment, Climate Change and Water NSW document titled *NSW Road Noise Policy (RNP) 2011*; and
- NSW Liquor and Gaming typically imposed noise conditions.
- NSW EPA Interim Construction Noise Guideline (ICNG) 2009.
- NSW EPA (formerly, Department of Environment and Climate Change) *Assessing Vibration: a technical guideline 2006 (AV-TG)*.

- Australian Standard AS 2670.2 1990 - Evaluation of Human Exposure to Whole Body Vibration - Part 2: Continuous and Shock Induced Vibration in Buildings (1 Hz to 80 Hz).
- British Standard BS 6472 - 2008 - Evaluation of Human Exposure Vibration in Buildings (1 Hz to 80 Hz).
- German DIN 4150: Part 3 – 1999 *"Effects of Vibration on Structure"* (DIN 1999).

This assessment has been undertaken based on the architectural drawings prepared by Squillace Architects for DA.

2 SITE DESCRIPTION AND SURROUNDING RECEIVERS

The site is bounded by the following:

- Great Western Highway (GWH) along the northern boundary of the site which carries a high volume of daily traffic. Located further north across the GWH is the T1, Western NSW and Blue Mountains Rail Corridor with existing residential and industrial receivers further north.
- Along the eastern boundary of the northern site is Bringelly Road which carries a moderate volume of traffic. Located further east across Bringelly Road is existing residential and commercial receivers. For the southern site it is also partially located along Bringelly Road but also adjacent to existing commercial receivers as the site shape has a reversed "L" shape.
- Located between the two sites is Waintwright Lane which carries a low volume of traffic, most residential access from properties which are located along the laneway. Located to further south beyond the southern site is Rodgers Street which carries a low volume of traffic. Situated on the other side of Rodgers Street are existing single storey residential dwellings.
- Along the western boundaries of both sites are currently two vacate blocks of land with existing multi-storey residential buildings located further west.

The nearest noise receivers to the development are detailed below:

Receiver 1 - Existing residential dwelling located across Bringelly Road to the east of the site situated at 2A Bringelly Road, Kingswood.

Receiver 2 - Existing residential dwellings located across the intersection of Santley Crescent and Bringelly Road to the southeast, situated at 22 Santley Crescent, Kingswood.

Receiver 3: Existing residential dwellings located across Rodgers Street to south of the site, situated 4 Rodgers Street and 3-5 Bringelly Road, Kingswood.

Receiver 4: Existing multi-storey apartment building to the west of the site across the adjacent vacant block from the southern site, situated 13 Rodgers Street, Kingswood.

Receiver 5: Existing commercial buildings located along the eastern boundary of the southern site, situated 1 Bringelly Road, Kingswood.

Receiver 6: Existing commercial building located across Bringelly Road from the northern site, situated 178 Great Western Highway, Kingswood.

Receiver 7: Existing commercial building located across Bringelly Road from the southern site, situated 33 Santley Crescent, Kingswood.

Receiver 8: Existing commercial buildings to the west of the site across the adjacent vacant block from the northern site, situated 190 Great Western Highway, Kingswood.

A site map has been provided below which identifies and surrounding receivers and monitoring locations, see Figure 1.

Figure 1 Site Map, Measurement Location and Surrounding Receivers – Sourced from SixMaps NSW

3 NOISE DESCRIPTORS AND TERMINOLOGY

Environmental noise constantly varies in level with time. It is therefore 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 dB(A), 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 sources of sound of an equal value results in an increase of 3dB (i.e. 60 dBA + 60 dBA = 63 dBA). A change of 1 dB or 2 dB in the level of a sound 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 and is equivalent to a level that would have been experienced had the fluctuating noise level remained constant during the measured time period.

The LA1, LA10 and LA90 levels are the levels exceeded for 1%, 10% and 90% of the sample period. These levels are sometimes thought of as the typical 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.

4 EXISTING NOISE ENVIRONMENT

Measured noise levels from both the unattended and attended noise surveys are outlined below.

4.1 Unattended Noise Monitoring

An unattended noise survey was conducted between Friday 2nd July 2021 and Tuesday 13th July 2021 in the two locations shown in Figure 1 above. All data in the graphs presented in Appendix B have not been corrected (i.e., raw data presented).

Instrumentation for the survey comprised two Rion NL42 sound level meter (serial number 00184110 and 00885460). Calibration of the logger was 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.

Charts presenting summaries of the measured daily noise data are attached in Appendix B. The charts present each 24-hour period and show the LA1, LA10, LAeq and LA90 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.

Based on the unattended noise measurements, the results of the survey have been presented below.

Regarding the measured noise levels obtained from the unattended noise monitoring we note:

- Onsite noise levels were captured during the 2021 Delta Covid NSW outbreak.
- During the monitoring period the Kingswood Hotel was not in operation due to Public Health Orders.
- However, the refrigeration plant which services the Kingswood Hotel was still active and has affected noise readings at location 1 (Great Western Highway). In particular during the evening and night period when environmental noise is lower and existing noise treatments on the plant reduce the operation of the plant resulting in longer operation.
- Location 2 (being the southern monitor) has not been affected by the mechanical plant based on the distance between its location and the plant. As such the rating background noise levels will be adopted from location 2 for all surrounding residential receivers.

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

In order to assess the acoustical implications of the development at nearby noise sensitive receivers, the measured background noise data of the logger was processed in accordance with the NSW EPA's *Noise Policy for Industry* (NPI, 2017).

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 LA90 (15minute) and LAeq noise levels are presented in Table 3.

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 067113).

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

Measurement Location	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)
Location 1 – Northern Site – Great Western Highway – See Figure 1.	41 [4]	63 [4]	55 [4]	68 [4]	54 [4]	68 [4]
Location 2 – Southern Site – Rodgers Street – See Figure 1.	44	53	42	50	36	48

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 LA90 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 LAeq 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 4: Measured noise levels for the Northern site are affected by the operation of the existing Kingswood Hotel Refrigeration Plant at the location 1 only.

4.1.2 Results in accordance with the NSW Department of Planning "Development near Rail Corridors and Busy Roads – Interim Guideline"

In determining the required façade construction for the proposed building in accordance with the internal noise level requirements of NSW Department of Planning "Development near Rail Corridors and Busy Roads – Interim Guideline" 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 "Development near Rail Corridors and Busy Roads – Interim Guideline" 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)
Location 1 – Northern Site – Great Western Highway – See Figure 1.	65 [3]	67 [3]
Location 2 – Southern Site – Rodgers Street – See Figure 1.	52	48

Note 1: For Monday to Sunday, Daytime 7:00 am – 10:00 pm; Night-time 10:00 pm – 7:00 am.

Note 2: The LAeq 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: Measured noise levels for the Northern site are affected by the operation of the existing Kingswood Hotel Refrigeration Plant at the location 1 only.

4.2 Attended Noise Monitoring

An attended noise survey was conducted on Friday 2nd July 2021 between 11:00am and 12:00pm and Tuesday 3rd May 2022 between 4:00pm and 4:30pm for the measurement along the Great Western Highway and Saturday 3rd July between 1:00am and 1:30am at the locations shown in Figure 1 above. This survey was conducted in order to verify the noise levels during the night periods being the most sensitive and within the late trading hours proposed for the licensed venue.

The attended noise measurements were conducted using a Brüel & Kjær Type 2250 sound level meter (serial number 2709757). Calibration of the sound level meter was checked prior to and following the measurements using a Brüel & Kjær Type 4231 sound calibrator (serial number 3009148). The calibrator emitted a calibration tone of 94 dB at 1 KHz. The drift in calibration did not exceed ±0.5 dB. All equipment carries appropriate and current NATA (or manufacturer) calibration certificates.

Table 3 Measured Ambient Noise Levels corresponding to the NPI's Assessment Time Periods

Measurement Location	Measured Noise Level		Measurement Observations
	LA90[1] (dBA)	LAeq[2] (dBA)	
Northern Boundary along the Great Western Highway – See Figure 1	56	66	Moderately frequent vehicle pass-bys from Great Western Highway & Rail Corridor
	61	67	

Note 1: 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 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.

In addition to the overall broadband noise levels identified above, the attended measurement at the southern noise monitor location (Location 2) was recording the associated single octave (1/1) noise spectra for the night period. These are provided below.

The use of single octave spectra is for the establishment of the patron and music acoustic criteria.

Table 4 Measured Single Octave (1/1) Spectra

Time Period	Parameter [1]	Octave Band Centre Frequency, Hz									Overall dBA
		31.5	63	125	250	500	1k	2k	4k	8k	
1:00am – 1:30am	**Location 2 – Southern Noise Monitor**										
	Measured L_{A90}	43	44	43	35	34	32	25	16	7	**36**

Note 1: 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.

5 ACOUSTIC CRITERIA

5.1 Noise Intrusion Acoustic Criteria

5.1.1 Penrith City Council – Development Control Plan (DCP) 2014

Section C12 of the Penrith City Council DCP 2014 states:

C12 Noise & Vibration

C12.1 Road Traffic Noise

Controls

1) Road traffic noise criteria including sensitive land uses

a) Council will not grant consent to development, particularly residential development, including subdivisions, unless the impact of traffic noise from freeway, arterial, designated or collector roads complies with the standards and guidelines for road traffic noise prepared by the relevant State Government authorities or agencies, as well as relevant Australian Standards.

b) Council will not grant consent to development for sensitive land uses unless it complies with the provisions and standards for road traffic noise prepared by the relevant State Government authorities or agencies, as well as relevant Australian Standards.

c) Sensitive land uses subject to road traffic noise criteria referred to in b) above include educational establishments (including schools), places of public worship, hospitals, and passive and active recreation areas.

C12.2 Rail Traffic Nosie and Vibration

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.

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.

5.1.2 NSW Department of Planning "Development Near Rail Corridors and Busy Roads – Interim Guideline 2008 (DNRCBR)

NSW Department of Planning's document DNRCBR adopts the same internal noise criteria outlined in the SEPP infrastructure above see below. (note clause 87 (i.e., rail) is not applicable to this site).

For clauses 87 (rail) and 102 (road):

If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

- *in any bedroom in the building: 35dB(A) at any time 10pm–7am*
- *anywhere else in the building (other than a garage, kitchen, bathroom, or hallway): 40dB(A) at any time.*

5.1.3 State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP)

SEPP (Infrastructure) 2007 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 for residences 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" (the Guideline).

The Guideline 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. Busy roads are defined as a freeway, tollway or a transitway *or any other road* with an average annual 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 or a high level of truck movements or bus traffic.

Figure 2 Location of 'Busy Roads'

The noise intrusion assessment of the proposed development has been carried out with respect to the traffic noise generated from the Great Western Highway. These roads are defined as a busy road since they have an average annual traffic (AADT) volume of more than 40,000 vehicles. This is shown in Figure 2 above.

According to Clause 102 (road), if the development is for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded (with windows and doors closed):

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

According to Clause 87 (road), if the development is for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded (with windows and doors closed):

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

5.1.4 Australian / New Zealand Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors - (AS/NZS 2107:2016)

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 5 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. In this report we will confine our recommendations to dBA levels, however, where the background noise appears to be unbalanced, AS/NZS 2107:2016 provides direction in terms of suitable diagnostic tools that can be used to assess the spectrum distribution of the background noise.

Table 5 Recommended Design Sound Levels and Reverberation Times

Type of Occupancy/Activity	Design sound level range dBA ($L_{Aeq,t}$)	Project Design Noise Level [1] dBA ($L_{Aeq,t}$)
Residential Buildings		
Houses and apartments in inner city areas or entertainment districts or near major roads-		
Apartment common areas (e.g foyer, lift lobby)	45 to 50	50
Living areas	35 to 45	40
Sleeping areas (night time)	35 to 40	37
Work areas	35 to 40	40
Hotels and motels-		
Bar and lounges	<50	50
Dining Rooms	40 to 45	45

Note 1: Overall recommended level for mechanical services noise and intrusive noise, combined.

Section 6.18 of AS/NZ 2107:2016 notes that the presence of discrete frequencies or narrow band signals may cause the sound level to vary spatially within a particular area and be a source of distraction for occupants. Where this occurs, the sound level shall be determined as the highest level measured in the occupied location(s).

If tonal components are significant characteristics of the sound within a measurement time interval, an adjustment shall be applied for that time interval to the measured A-weighted sound pressure level to allow for the additional annoyance. If the background sounds include spectral imbalance, then the RC (Mark II) levels indicated in the Standard should be referenced (see also Appendix D of AS/NZ 2107:2016 for additional guidance).

Generally, where the final noise levels are within +/- 2 dB of the specified level given above, the design criteria will be considered met. Both the upper and lower limits will need to be satisfied especially where privacy is important or where noise intrusion to be avoided.

5.2 Vibration Criteria

5.2.1 Penrith City Council – Development Control Plan (DCP) 2014

Section C12 of the Penrith City Council DCP 2014 states:

C12 Noise & Vibration

C12.2 Rail Traffic Nosie and Vibration

Controls

1) Rail noise and vibration

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.

As shown in Figure 3 below, the distance between the nearest boundary (being the northern boundary) and the nearest rail line is over 55m. As such no further assessment is required.

Figure 3 Rail Corridor Distance - Sourced from SixMaps NSW

5.3 Noise Emission Criteria

5.3.1 Penrith City Council – Development Control Plan (DCP) 2014

Noise emission criteria outlined in the Penrith City Council DCP 2014 are provided for Industrial and Commercial type developments. See below.

C12 Noise & Vibration

C12.4 Industrial and Commercial Development

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.

Note: In addressing the controls outlined above, the NSW EPA Noise Policy for Industry (NPI) 2017 (which has superseded the *"EPA's Industrial Noise Policy"* in 2017) will be adopted for the control of all noise from all areas of the proposed development (i.e. commercial and residential), see below.

5.3.2 NSW EPA Noise Policy for Industry (NPI) 2017

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

The NSW EPA has recently released a document titled *Noise Policy for Industry* (NSW NPI 2017) 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.

5.3.2.1 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.

5.3.2.2 Protecting Noise Amenity (All Receivers)

To limit continuing increases 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.

5.3.2.2.1 Area Classification

The NSW NPI characterises the "Urban" noise environment as an area with an acoustical environment which shows the following:

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

The residential area surrounding the proposed development falls under the "Urban" area classification with exception for the single dwelling residences along the southern side of Rodgers Street which are technically a suburban residence based on land zoning. However, based on the measured noise levels and other characteristics we believe all surrounding residences are actually Urban. For residential and non-residential receivers in an urban area, the recommended amenity criteria are shown in Table 6 below.

Table 6 NSW NPI – Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day [1]	Recommended Amenity Noise Level ($L_{Aeq, period}$) [2]
Residence	Urban	Day	60
		Evening	50
		Night	45
Commercial	All	When in use	65

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.

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.

Where existing road traffic noise is high enough to render stationary industrial noise sources effectively inaudible, the ANL can be modified so that the amenity criteria is not unduly stringent in an environment where road traffic noise is the dominant source of environmental noise. If all the conditions below are satisfied, the ANL becomes $L_{Aeq,traffic}$ minus 15 dBA. The conditions are:

- The road traffic noise is the dominant noise source.
- The existing noise is 10dB(A) or more above the acceptable ANL for the area.
- It is highly unlikely the road traffic noise levels would reduce in the near future.

5.3.2.3 Maximum Noise Level Event (Sleeping Disturbance)

Section 2.5 of the NPI states the following:

> *The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.*
>
> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - *$L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
> - *L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*
>
> *a detailed maximum noise level event assessment should be undertaken.*

As outlined in section above, the measured rating background noise level during the night hours (10:00pm to 7:00am) is 36dBAL_{A90}. Therefore, the resultant RBL + 15dB is 51dBA and for the purpose of this assessment we will adopt the minimum noise level of 52dBA L_{AFmax}.

5.3.2.4 Project Specific External Noise Emission Criteria

The intrusive and amenity criteria for industrial noise emissions, derived from the measured data, are presented in Table 7. 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. These are shown in bold text in Table 7.

Table 7 External noise level criteria in accordance with the NSW NPI

Location	Time of Day [1]	Project Amenity Noise Level, $L_{Aeq,\ period}$ [2] (dBA)	Measured $L_{A90,\ 15\ min}$ (RBL) [3] (dBA)	Measured $L_{Aeq,\ 15\ min}$ [4] (dBA)	Intrusive $L_{Aeq,\ 15\ min}$ [4] Criterion for New Sources (dBA)	Amenity $L_{Aeq,\ 15\ min}$ [4] Criterion for New Sources (dBA) [5]
Surrounding Residences	Day	55	44	53	**49**	58
	Evening	45	42	50	**47**	48
	Night	40	36	48	**41**	43
Commercial	When in use	60	N/A	N/A	N/A	**63**

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 – 1:00 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 – 1:00 am.

Note 2: Project Amenity Noise Levels corresponding to "Urban" areas, equivalent to the Recommended Amenity Noise Levels minus 5 dBA.

Note 3: L_{A90} Background Noise or Rating Background Level.

Note 4: The LAeq 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 5: According to Section 2.2 of the NSW NPI, the $L_{Aeq,\ 15\ minutes}$ is equal to the $L_{Aeq,\ period}$ + 3 dB.

Note 6: Project Noise Trigger Levels are shown in bold.

In addition, a maximum noise level criterion of 52dBA L_{AFmax} during the night period (10:00pm to 7:00am) at residential receivers also applies.

5.3.3 NSW Liquor & Gaming Acoustic Requirements

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 LA10* 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 LA10* 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 LA10 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.*

Note: NSW Liquor and Gaming criteria does not contain any requirements for commercial or industrial receivers. Noise impacts to these receivers will adopt the broadband criteria outlined in the NSW EPA NPI 2017, see above.

These criteria are applicable to noise emissions from the licensed venue component of the development, excluding noise from mechanical services. For external noise emissions, octave band spectral criteria for each assessment period have been summarised in Table 8 below.

Table 8 Liquor & Gaming NSW – L_{10} Criteria (external) – Residential Criteria Only

Operation Hours	Parameter	Octave Band Centre Frequency, Hz									Overall dBA
		31.5	63	125	250	500	1k	2k	4k	8k	
After 9:00am/10:00am to 12:00am (midnight) and After midnight to 3:00am (Worst Case Scenario)	**Monday to Saturday: 9:00am to 12:00am (midnight) Sunday: 10:00am to 10:00pm Background (RBL) + 5dBA L_{A10}**										
	Measured L_{A90} [1]	49	50	49	41	40	38	31	22	13	**42**
	Criteria L_{A10} [2]	~~54~~ 69	55	54	46	45	43	36	27	18	**47**
	Monday to Saturday: 12:00am (midnight) to 3:00am Background (RBL) + 0dBA L_{A10}										
	Measured L_{A90} [1]	43	44	43	35	34	32	25	16	7	**36**
	Criteria L_{A10} [2]	~~43~~ 69 [3]	~~44~~ 45 [3]	43	35	34	32	25	16	~~7~~ 17 [3]	**36**

Note 1: L_{A90} Background Noise or Rating Background Level.

Note 2: L_{A10} is the sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

Note 3: Criteria has been adjusted based on the threshold of hearing as outlined in International Organization for Standardization (ISO) ISO 389-7: 2019 "Acoustics — Reference zero for the calibration of audiometric equipment — Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions".

5.3.4 NSW DECCW - NSW Road Noise Policy (RNP) 2011

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

5.4 Construction Noise and Vibration Objectives

5.4.1 Construction Noise Criteria

5.4.1.1 NSW EPA Interim Construction Noise Guideline (ICNG) – DECC 2009

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 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 residential receivers have been reproduced from the guideline and are listed in the table below.

Table 9 NMLs for quantitative assessment at residences

Time of Day	Noise Management Level $L_{Aeq(15minute)}$[1,2]	How to Apply
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 Level"*** RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15minute)}$ 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 Level" 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of Day	Noise Management Level $L_{Aeq(15minute)}$[1,2]	How to Apply
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.

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 Noise Policy for Industry (EPA 2017).*

Note 3 *Requirements listed in the table above are in accordance with the Construction Hours listed in Condition C4 and C5.*

Construction noise levels at other noise receivers are outlined below:

- Construction noise levels at offices, retail outlets is not to exceed 70dB LAeq,15minute, when measured externally.

5.4.1.2 Construction Traffic Noise Criteria

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW *Road Noise Policy (RNP)* states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

5.4.2 Vibration Criteria

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.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself.

5.4.2.1 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).

5.4.2.1.1 British 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 10 and illustrated in Figure 4.

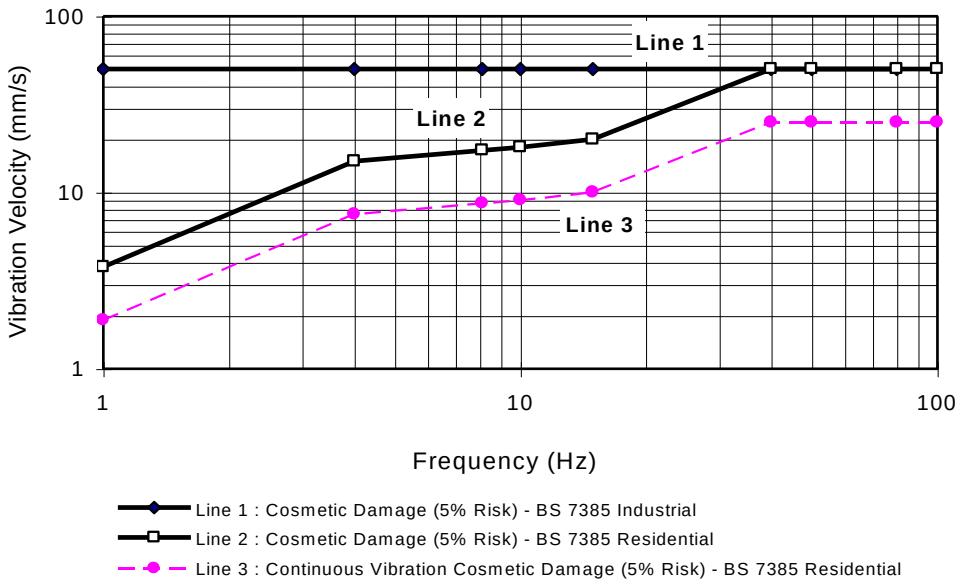
Table 10 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 4	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 10 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 10 may need to be reduced by up to 50% (refer to Line 3 in Figure 4).

Figure 4 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 10, 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 10 should not be reduced for fatigue considerations.

5.4.2.1.2 German 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 11. The criteria are frequency dependent and specific to particular categories of structures.

Table 11 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.

5.5 Ground-Borne Noise Criteria

According to the NSW EPA *Interim Construction Noise Guideline (*ICNG) 2009, the criteria for ground-borne noise at residences is defined as follows:

- Maximum internal noise levels of 40 dB $L_{Aeq(15mins)}$ between 6:00pm and 10:00pm.

It is noted that the ground borne criteria will apply for construction works undertaken outside of standard hours. That is, work conducted during the evening period Monday to Friday between 6:00pm and 7:00pm only.

6 ACOUSTIC ASSESSMENT

Assessment of each of the noise element associated with the proposal is outlined below.

6.1 Building Envelope Assessment

Preliminary façade acoustic treatments based on the external levels from surrounding roads and other commercial operations as discussed in section 5.1 above are provided below.

6.1.1 Glazing Recommendations

The recommended sound transmission loss requirement required to satisfy the specified internal noise level criteria outlined above are summarised in 5.1 below.

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).**

Table 12 In-principle Glazing Recommendations – Northern Site

Facade	Occupancy Area [1]	Minimum Glazing System Rating Requirements [1]	Indicative Construction [1]
Northern Site			
Northern Façade (Great Western Highway)	Bedrooms	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass
Eastern Façade (Bringelly Road)	Bedrooms	Rw (C;Ctr): 35 (-1;-3)	Windows with min. 10.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass
Southern Façade (Wainwright Lane)	Bedrooms	Rw (C;Ctr): 35 (-1;-3)	Windows with min. 10.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass
Western Facade	Bedrooms	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass

Note 1: These are preliminary selections will be confirmed in the detailed design stage once the layouts and façade orientations are finalised.

Note 2: Glazing recommendations have been formulated in conjunction with noise emission control mitigation measures.

Table 13 In-principle Glazing Recommendations – Southern Site

Facade	Occupancy Area [1]	Minimum Glazing System Rating Requirements [1]	Indicative Construction [1]
Southern Site			
Northern Façade (Wainwright Lane)	Bedrooms	Rw (C;Ctr): 35 (-1;-3)	Windows with min. 10.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass
Eastern Façade (Bringelly Road)	Bedrooms	Rw (C;Ctr): 35 (-1;-3)	Windows with min. 10.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass
Southern Façade (Rodgers Street)	Bedrooms	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass
Western Facade	Bedrooms	Rw (C;Ctr): 31 (-1;-3)	Windows with min. 6.38mm laminated glass
	Living Areas		
	Licensed Areas	Rw (C;Ctr): 37 (-1;-3)	Windows with min. 12.38mm laminated glass

Note 1: These are preliminary selections will be confirmed in the detailed design stage once the layouts and façade orientations are finalised.

Note 2: Glazing recommendations have been formulated in conjunction with noise emission control mitigation measures.

6.1.2 External Wall Construction

External wall constructions which are constructed from a concrete or masonry construction will be acoustically sufficient and no further acoustic upgrading is required. However, for wall systems constructed from a lightweight cladding system, the following construction is recommended.

Table 6-14 Recommended Light Weight External Wall Construction

Location	Occupancy Area [1]	External Lining	Studwork System	Internal Lining
Northern Façade along Great Western Highway	Bedrooms and Living Areas	Façade Cladding System (Assumed to be equal to 9mm Fibre Cement Sheeting)	Min. 92mm Steel Studwork with 75mm thick 14kg/m^3 glasswool insulation in the cavity	1 x 13mm Fyrchek Plasterboard **OR** 1 x 9mm Fibre Cement Sheeting
All other Facades	All other areas			1 x 13mm Standard Plasterboard **OR** 1 x 6mm Fibre Cement Sheeting

Note 1: Recommended constructions are identical for each level.

Note 2: These are preliminary selections will be confirmed in the detailed design stage once the layouts and façade orientations are finalised.

Note 3: Alternate constructions are suitable on assumption equal acoustic performance is achieved.

Note 4: Glazing recommendations have been formulated in conjunction with noise emission control mitigation measures.

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.

6.1.3 External Roof Construction

External roofs will be constructed from a concrete system and will not require any additional acoustic treatments. 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.

6.2 Engineering Services Assessment

Three mechanical/refrigeration systems are proposed to be installed; each are discussed below:

1. Kitchen Exhaust System
2. Air Conditioning Plant.
3. Toilet Exhaust System.
4. Refrigeration Plant.
5. Carpark ventilation systems
6. Electrical substation.

At this stage of the project the exact selections of the mechanical equipment to be installed are not known. However, to ensure the proposed layouts and locations for the systems are acoustically acceptable a "Proof of Concept" assessment is conducted below. The assumptions for fan selections detailed below are from our experience.

Kitchen Exhaust System

For the commercial kitchen exhaust systems, it is anticipated that the physical fans would be installed within the tenancy or vertical riser as shown on the drawings. On the assumption of the Sound Power Level above and the ductwork that is installed is acoustically treated with 50mm internal lining or attenuators (depending on the exact location/selection), compliance with the acoustic requirements outlined in section 5.1 would be achieved.

Air Conditioning System

Air conditioning condensers are recommended to have the following acoustic treatments installed.

- Condenser plant are to be isolated from the base building structure with a rubber pad.
- Night operation mode must be in operation between 9:00pm and 7:00am and provided a minimum of 4-5dBA.

Toilet Exhaust System

Toilet exhaust fans for the units will individually discharge along the façade utilising a façade louvre above the glazed elements. It is recommended that 1m with acoustic flexible ducting is used on the intake and discharge side of the fan, on this assumption compliance would be achieved.

Refrigeration Systems

It is envisaged that the refrigeration plant will be located within the basement of the future building and would be acoustically attenuated by the basement structure. All plant however is recommended to be vibration isolated.

Carpark Ventilation System

It is anticipated that basement ventilation fans will discharge on roof level utilising an inline fan. It is recommended that internally lined ductwork or inline attenuators are used on both the intake and discharge side of the fan. On this assumption, compliance would be achieved.

Electrical Substation

A substation is proposed to be located along Wainwright Lane. From our experience noise levels from the operation of a substation will be compliant with the noise emission requirements outlined in section 5.3. The façade systems outlined in section 6.1 of this report will ensure compliance with the internal noise requirements for this project.

6.3 Licensed Venue Assessments

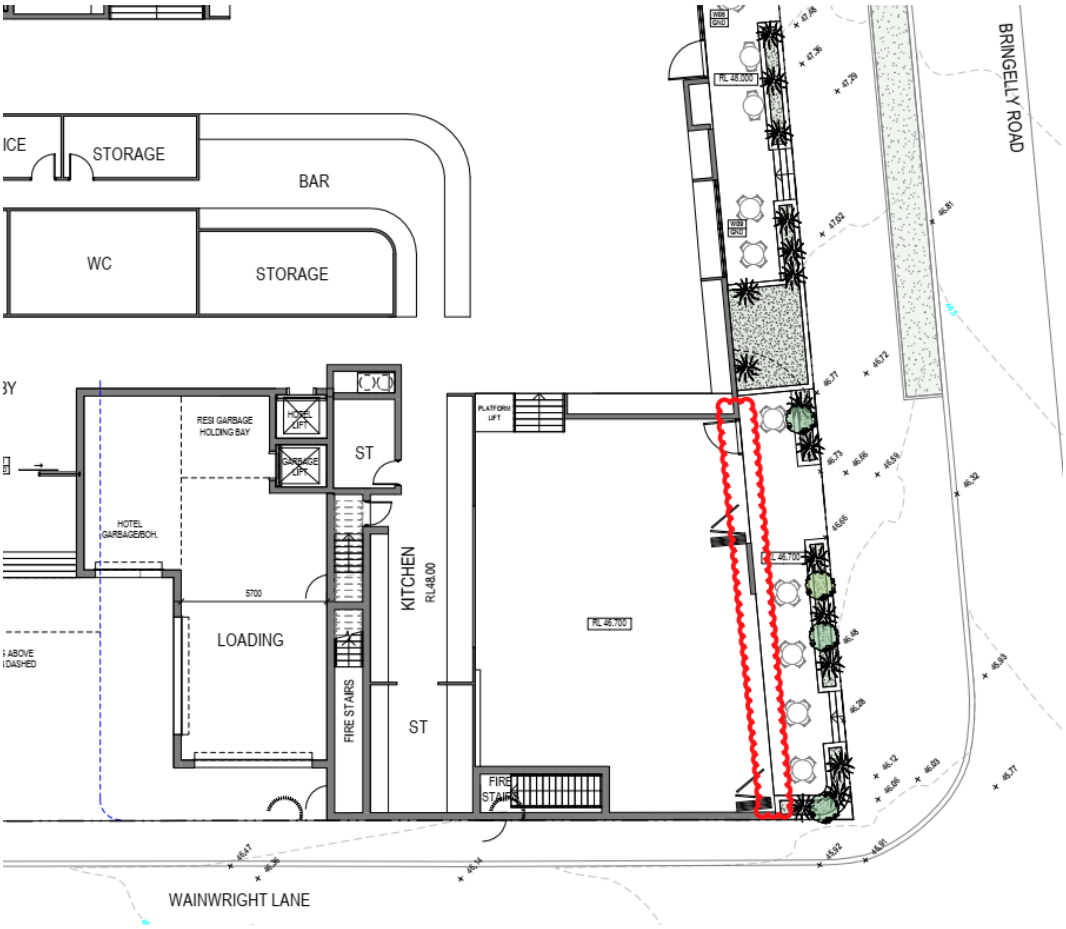
An assessment of noise from the operation of the licensed venues across both developments has been conducted and is presented below. The assessment which is presented below is the worst-case scenario being at the completion of both stages and all licenced venues operating simultaneously. Should compliance be achieved during simultaneous operation, individual operating will be compliant.

6.3.1 Assumed Source Noise Levels

The internal noise level in the internal area will consist of patron noise and background music. The internal noise level for the following operating scenario has been calculated:

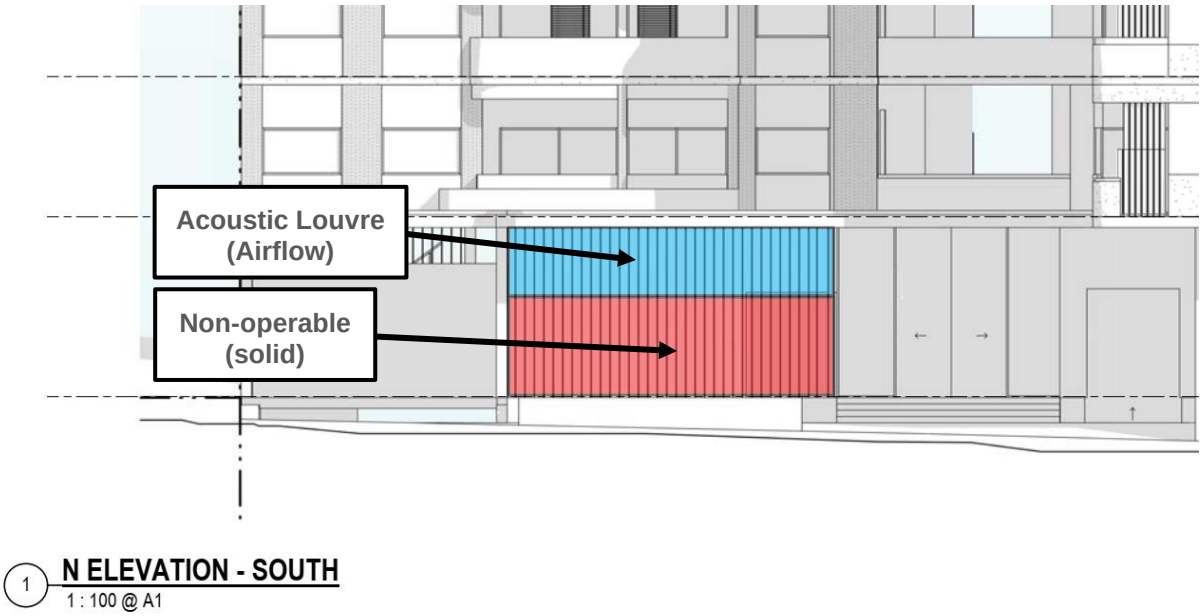
- Northern site:
    - 500 patrons in the internal areas on the northern site:
- Southern site:
    - 300 (temporary) patrons in the internal areas on the southern site:
- Background music is proposed to be played within all indoor areas across both sites during the proposed operating hours as per the following:
    - Northern Site:
        - Bistro: 70dBA
        - Sports Bar: 70dBA
        - VIP Lounge: 65dBA before midnight and 60dBA after midnight.
    - Southern Site:
        - Internal Areas: 70dBA
- Operable bi-folding windows shown along the eastern façade of the Bistro area on the northern site along Bringelly Road and identified in Figure 5 are assumed to be open until 12:00am midnight. Closed after 12:00am midnight.

Figure 5 Northern Site – Bringelly Road Bi-Folding Doors



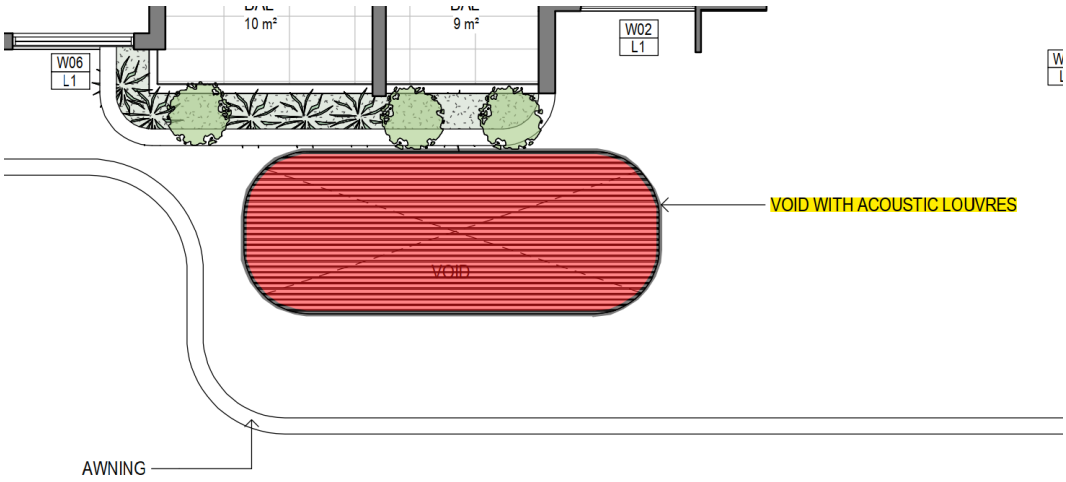
- Opening in the southern façade of the VIP gaming area within the Northern site is recommended to be constructed as per the following:
    - Finished Floor Level (FFL) to 2200mm above FFL to be solid.
    - Above the 2200mm to ceiling height a 200mm deep acoustic louvre is recommended for airflow.
    - This recommendation has been provided to protect the residential apartments located directly above which partly overlook the southern facade.

Figure 6 Northern Site – VIP Gaming Room Southern Facade



Additionally, the void on the level 1 concrete awning located above the landscaped area outside the northern site VIP gaming room is also recommended to have a 200mm deep acoustic louvre as identified in the architectural drawings.

Figure 7 Northern Site – VIP Gaming Room Awning



For the purposes of this assessment, we have assumed a person speaking with a raised voice has a Sound Power Level (Lw) of 69dBA. This has been formulated in accordance with the published noise levels from Klark Teknik (*The Audio System Designer Technical Reference*, Chapman Partnership).

6.3.2 Predicted Licensed Venue Noise Levels (Before Midnight)

Predicted noise levels to the surrounding residential receivers are based on a full capacity within the venue and during day period before midnight when the acoustic criteria is Background + 5dBA.

For the purpose of this assessment, we have assumed operable façade elements of the internal licensed areas are open before midnight, including the openings in the VIP gaming area which are always open.

Table 15 Receiver 1 – Predicted Noise Levels to 2A Bringelly Road Residences (Before Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Day, Evening, Early Night Period – Before Midnight (9/10:00am to 12:00am)										
Northern Site Contribution - L_{A10} Noise Levels	38	33	35	42	44	40	37	29	20	**45**
Southern Site Contribution - L_{A10} Noise Levels	36	16	14	17	14	11	9	0	0	**17**
Cumulative Contribution - L_{A10} Noise Levels	40	33	35	42	44	40	37	29	20	**45**
L&G NSW criterion	69	55	54	46	45	43	36	27	19	**47**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes** [1]	**Yes** [1]	**Yes** [1]	**Yes**

Note 1: A marginal exceedance has been predicted. In accordance with section 4.2 of the NSW EPA NPI, an exceedance of less than or equal to two (2) dBA is considered negligible and no further acoustic treatments are needed.

Predicted noise levels (assuming operable facades are open before mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Table 16 Receiver 2 – Predicted Noise Levels to 22 Santley Crescent Residences (Before Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Day, Evening, Early Night Period – Before Midnight (9/10:00am to 12:00am)										
Northern Site Contribution - L_{A10} Noise Levels	30	24	25	33	35	31	28	22	12	**36**
Southern Site Contribution - L_{A10} Noise Levels	10	8	6	9	6	3	1	0	0	**9**
Cumulative Contribution - L_{A10} Noise Levels	**32**	**24**	**26**	**33**	**35**	**31**	**28**	**22**	**12**	**36**
L&G NSW criterion	69	55	54	46	45	43	36	27	18	**47**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Predicted noise levels (assuming operable facades are open before mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Table 17 Receiver 3 – Predicted Noise Levels to 4 Rodgers Street & 3-5 Bringelly Road Residences (Before Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Day, Evening, Early Night Period – Before Midnight (9/10:00am to 12:00am)										
Northern Site Contribution - L_{A10} Noise Levels	28	22	24	32	33	29	26	20	10	**35**
Southern Site Contribution - L_{A10} Noise Levels	10	8	6	9	6	3	1	0	0	**9**
Cumulative Contribution - L_{A10} Noise Levels	**28**	**22**	**24**	**32**	**33**	**29**	**26**	**20**	**10**	**35**
L&G NSW criterion	69	55	54	46	45	43	36	27	18	**47**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Predicted noise levels (assuming operable facades are open before mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Table 18 Receiver 4 – Predicted Noise Levels to 13 Rodgers Street Residences (Before Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Day, Evening, Early Night Period – Before Midnight (9/10:00am to 12:00am)										
Northern Site Contribution - L_{A10} Noise Levels	29	21	23	30	32	28	25	19	8	**33**
Southern Site Contribution - L_{A10} Noise Levels	11	11	9	12	9	6	4	0	0	**11**
Cumulative Contribution - L_{A10} Noise Levels	29	21	23	30	32	28	25	19	8	**33**
L&G NSW criterion	69	55	54	46	45	43	36	27	18	**47**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Predicted noise levels (assuming operable facades are open before mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Regarding the future residential receivers located above the northern site and southern site, predicted noise levels are provided below.

Table 19 Receiver 4 – Predicted Noise Levels to 13 Rodgers Street Residences (Before Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Day, Evening, Early Night Period – Before Midnight (9/10:00am to 12:00am)										
Northern Site Contribution - L_{A10} Noise Levels	41	42	43	47	45	39	32	24	11	**45**
Southern Site Contribution - L_{A10} Noise Levels	25	18	28	26	25	27	27	18	3	**32**
Cumulative Contribution - L_{A10} Noise Levels	**41**	**42**	**43**	**47**	**45**	**39**	**33**	**25**	**12**	**45**
L&G NSW criterion	69	55	54	46	45	43	36	27	18	**47**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Predicted noise levels (assuming operable facades are open before mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

6.3.3 Predicted Licensed Venue Noise Levels (After Midnight)

Predicted noise levels to the surrounding residential receivers are based on a full capacity within the venue and during the early morning period after midnight when the acoustic criteria is most stringent.

For the purpose of this assessment, we have assumed operable façade elements of the internal licensed areas are closed after midnight, however the openings in the VIP gaming area are always open.

Table 20 Receiver 1 – Predicted Noise Levels to 2A Bringelly Road Residences (After Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Early Morning Period – After Midnight (12:00am to 3:00am)										
Northern Site Contribution - L_{A10} Noise Levels	47	27	24	28	29	26	23	16	4	**31**
Southern Site Contribution - L_{A10} Noise Levels	45	25	20	22	20	16	13	0	0	**21**
Cumulative Contribution - L_{A10} Noise Levels	**49**	**29**	**26**	**29**	**29**	**26**	**23**	**16**	**4**	**31**
L&G NSW criterion	69	45	43	35	34	32	25	16	17	**36**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Predicted noise levels (assuming operable facades closed after mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Table 21 Receiver 2 – Predicted Noise Levels to 22 Santley Crescent Residences (After Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Early Morning Period – After Midnight (12:00am to 3:00am)										
Northern Site Contribution - L_{A10} Noise Levels	38	19	17	23	24	21	18	12	-	**26**
Southern Site Contribution - L_{A10} Noise Levels	37	17	13	14	12	8	5	-	-	**14**
Cumulative Contribution - L_{A10} Noise Levels	**41**	**21**	**19**	**23**	**24**	**21**	**18**	**12**	**0**	**26**
L&G NSW criterion	69	45	43	35	34	32	25	16	17	**36**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Predicted noise levels (assuming operable facades closed after mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Table 22 Receiver 3 – Predicted Noise Levels to 4 Rodgers Street & 3-5 Bringelly Road Residences (After Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Early Morning Period – After Midnight (12:00am to 3:00am)										
Northern Site Contribution - L_{A10} Noise Levels	33	14	12	18	19	16	13	7	-	**21**
Southern Site Contribution - L_{A10} Noise Levels	32	12	8	9	7	3	-	-	-	**9**
Cumulative Contribution - L_{A10} Noise Levels	**41**	**21**	**19**	**23**	**24**	**21**	**18**	**12**	**-**	**26**
L&G NSW criterion	69	45	43	35	34	32	25	16	17	**36**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Predicted noise levels (assuming operable facades closed after mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Table 23 Receiver 4 – Predicted Noise Levels to 13 Rodgers Street Residences (After Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Early Morning Period – After Midnight (12:00am to 3:00am)										
Northern Site Contribution - L_{A10} Noise Levels	44	25	23	29	30	27	24	18	6	**32**
Southern Site Contribution - L_{A10} Noise Levels	40	20	15	16	15	11	8	0	0	**16**
Cumulative Contribution - L_{A10} Noise Levels	46	26	24	29	30	27	24	18	6	**32**
L&G NSW criterion	69	45	43	35	34	32	25	16	17	**36**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes** [1]	**Yes**	**Yes**

Note 1: A marginal exceedance has been predicted. In accordance with section 4.2 of the NSW EPA NPI, an exceedance of less than or equal to two (2) dBA is considered negligible and no further acoustic treatments are needed.

Predicted noise levels (assuming operable facades closed after mid-night) are compliant with the NSW Liquor and Gaming typical acoustic requirements formulated above.

Regarding the future residential receivers located above the northern site and southern site, predicted noise levels are provided below.

Table 24 Receiver 4 – Predicted Noise Levels to 13 Rodgers Street Residences (After Midnight)

Parameter	Octave Band Centre Frequency, Hz									Overall dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Early Morning Period – After Midnight (12:00am to 3:00am)										
Northern Site Contribution - L_{A10} Noise Levels	25	17	28	26	25	27	27	18	0	**32**
Northern Site Contribution - L_{A10} Noise Levels	11	8	17	15	13	16	15	0	0	**20**
Cumulative Contribution - L_{A10} Noise Levels	**25**	**18**	**28**	**26**	**25**	**27**	**27**	**18**	**3**	**32**
L&G NSW criterion	69	45	43	35	34	32	25	16	17	**36**
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes** [1]	**Yes** [1]	**Yes**	**Yes**

Note 1: A marginal exceedance has been predicted. In accordance with section 4.2 of the NSW EPA NPI, an exceedance of less than or equal to two (2) dBA is considered negligible and no further acoustic treatments are needed.

6.4 Loading Dock Acoustic Assessment

Two loading docks are proposed, one for each site. The northern site will have a loading dock in the rear of the property and along Wainwright Lane. For the southern site the loading dock is located within the basement with a dedicated turntable.

For the loading dock located on the northern site a review has been undertaken to determine if a noise impact on existing surrounding residences will occur. From our review the operation of the loading dock during daytime and evening times will not result in an adverse impact on the existing acoustic amenity. However, for the future residences above an increase in the required glazing construction has been allowed for to attenuate any noise during its use. Refer to section 6.1.1.

For the loading dock located on the southern site, as it is located within the basement the operational noise will not adversely impact existing residences assuming a daytime and evening time use only.

It is recommended that the loading dock is not used during the night period of 10:00pm and 7:00am.

6.5 Noise Impacts on Surrounding Roadways

Noise impacts from the increase in vehicle movements along Great Western Highway, Rodgers Street and Bringelly Road are 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 a residential receiver as summarised in the NSW EPA RNP to be barely perceptible to the average person and therefore considered acoustically acceptable.

6.6 Construction Noise & Vibration Assessment

As the project is still in a planning phase, a detailed construction noise and vibration cannot be undertaken at this stage as there several unknown variables.

As such it is recommended that a DA Condition be implemented requiring that a detailed Construction Noise Vibration Management Plan (CNVMP) be prepared prior to the issue of a Construction Certificate. The plan should be undertaken based on the noise and vibration objectives outlined in section 5.4 above.

6.7 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:

- Construction to be undertaken within the approved hours detailed within the projects Conditions of Consent (once approved).
- All plant and equipment are to be maintained such that they are in good working order.
- 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.
- 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.
- The use of percussive and concrete sawing should be undertaken behind a closed barrier when possible.
- 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.
- 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:

- Use of alternative appliances to complete the required works which result in reduced noise impacts on surrounding neighbours.
- 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.
- Construction of acoustic screening to permanently located high noise generating equipment such as pumps and generators.
- Scheduling of high noise generating works outside of noise sensitive periods if possible.
- Other site-specific treatments and controls which may become possible once works commence.

6.8 Construction Vibration Impacts

An assessment of the potential for vibration generated as part of the required construction activities on the project (including excavation, demolition, 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:

- A saw cut at the perimeter of any excavation within rock on the site to boundaries adjacent neighbouring residential properties are required to include a saw cut to the rock prior to use of any excavation or ripping.

6.9 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:

- Noise – Attended noise level measurements of typical demolition, excavation and construction activities should be undertaken on site (from time to time).
- Attended construction noise surveys of the site and surrounding impacts on neighbours should be undertaken during the following as a minimum:
    - Start of Demolition
    - Commencement of any rock breaking or sawing on the Site.
    - Periodically during the construction period (if required).
    - In response to any ongoing complaints received from neighbours.

- 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.

6.10 Community Engagement

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

- 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.
- Details of the relevant site representative where complaints can be registered.
- Details of the methodology to respond to complaints raised from the surrounding receivers.
- 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 ASSESSMENT RESULTS AND RECOMMENDATIONS

Predicted noise levels from the operation of the proposed food premise in full operation (all patrons and background music) has been predicted. To ensure compliance is achieved, the following recommendations must be implemented:

- No more than 500 patrons in the northern venue at any one time, staff not included.
- Operation hours are as per the below
  - 9:00am to 3:00am, Monday to Saturday; and
  - 10:00am to 10:00pm on Sunday.
- Glazed openings in the façade are permitted to open between 7:00am and 12:00am.
- Glazed openings in the façade must be closed after 12:00am (midnight). (Openings in the VIP Gaming area except).
- With regards to background music in all Hotel, Bistro and Sports Bar within each of the venue areas we have assumed a Sound Pressure Level (SPL) of 70dBAL$_{eq\ (1\text{-}minute)}$.
- With regards to background music within the VIP Gaming Room on the northern site areas we have assumed a Sound Pressure Level (SPL) of 65dBAL$_{eq\ (1\text{-}minute)}$ and 60dBAL$_{eq\ (1\text{-}minute)}$ after midnight.
- Acoustic Louvres are to be installed as per 6.3 above.
- All mechanical selections and layouts must be reviewed prior to installation to ensure compliance with the project requirements outlined in section 5 above.
- Removal of glass or waste should be done internally and must not be taken after 10:00pm and before 7:00am.
- A contact number must be displayed for the purposes of receiving any complaints if they arrive.
- Signs must be displayed at all exits reminding patrons to be mindful of noise when leaving the premise.
- Any speakers within the retail tenancy must be correctly isolated from the base building structure a vibration isolator.
- For noise control between the licensed venue areas and the apartments located directly above it is recommended that an acoustic ceiling is installed this should be composed from 2 x 13mm Standard Plasterboard on an isolated acoustic ceiling system.
- it is recommended that a DA Condition be implemented requiring that a detailed Construction Noise Vibration Management Plan (CNVMP) be prepared prior to the issue of a Construction Certificate. The plan should be undertaken based on the noise and vibration objectives outlined in section 5.4 above.

On the assumption the recommendations outlined are incorporated compliance with the acoustic project criteria outlined in section 5 above will be achieved.

8 CONCLUSION

Pulse White Noise Acoustics (PWNA) have been engaged to undertake an acoustic assessment of the proposed redevelopment of current Kingswood Hotel (being the north site) and associated vacant lot located south of the hotel (being the south site) and the construction of a multi-storey mixed-use buildings across both sites.

- Minimum acoustic performances and associated indicative constructions for the building envelope have been provided in section 6.1 of this report. The recommended treatments have been provided to ensure compliance with the objectives presented in section 5.

- To control noise impacts at external receivers, recommended indicative treatments for major engineering services have been provided in section 6.2. From our review we have formulated the following opinion:

    - At this stage of the project the exact selections/locations of plant items are not known. A preliminary assessment, however, has been carried out using our experience with similar types of developments and the typical plant items installed in each type of plant room.

    - From this review we recommend the selection of high-performance acoustic treatment to ensure that the operation of the plant items comply with the project criteria. Therefore, it is recommended that prior to the issue of a Construction Certificate (CC) a detailed acoustic assessment is undertaken to ensure all cumulative noise from engineering services (including the roof plant room) comply with the requirements as listed in section 5.2.

- Detailed acoustic modelling has indicated that noise from the operation of the licensed venue elements of the development are likely to result in compliance with the typically imposed NSW Liquor and Gaming acoustic requirements. To ensure compliance, recommended building and management controls are recommended in this report.

- A review of the proposed loading dock activities associated with the hotel development have been undertaken and do not believe the operation will affect the acoustic amenity of existing surrounding residential receivers.

- An assessment of the impacts associated with number of vehicles on surrounding public roads around the site and the impact is less than 2dBA and therefore is compliant with the NSW EPA RNP.

- Construction noise and vibration levels have been reviewed and assessed. it is recommended that a DA Condition be implemented requiring that a detailed Construction Noise Vibration Management Plan (CNVMP) be prepared prior to the issue of a Construction Certificate. The plan should be undertaken based on the noise and vibration objectives outlined in section 5.4 above.

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

Regards,

Matthew Furlong
Principal Acoustic Engineer
PULSE WHITE NOISE ACOUSTICS PTY LTD

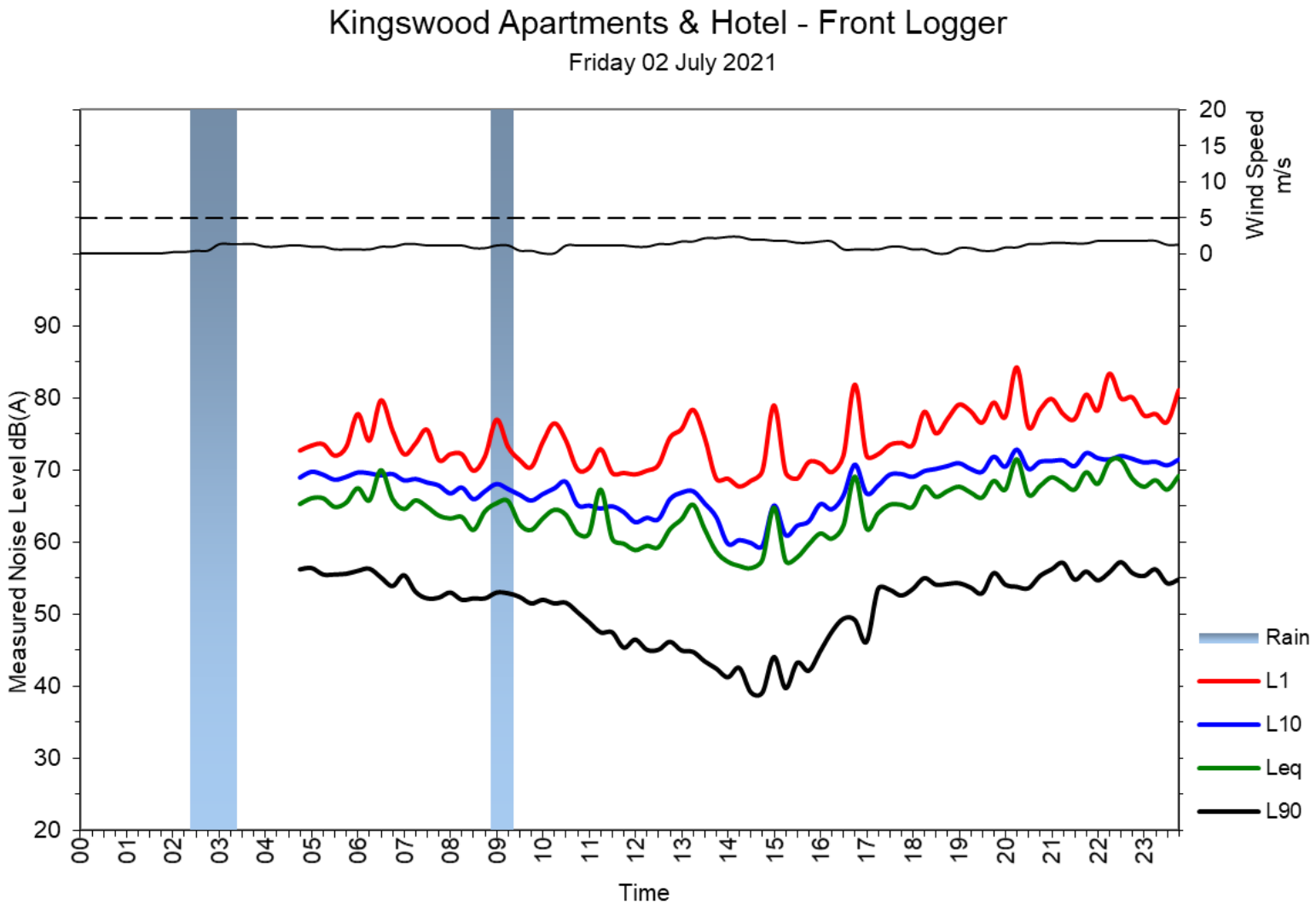
APPENDIX A – ACOUSTIC GLOSSARY

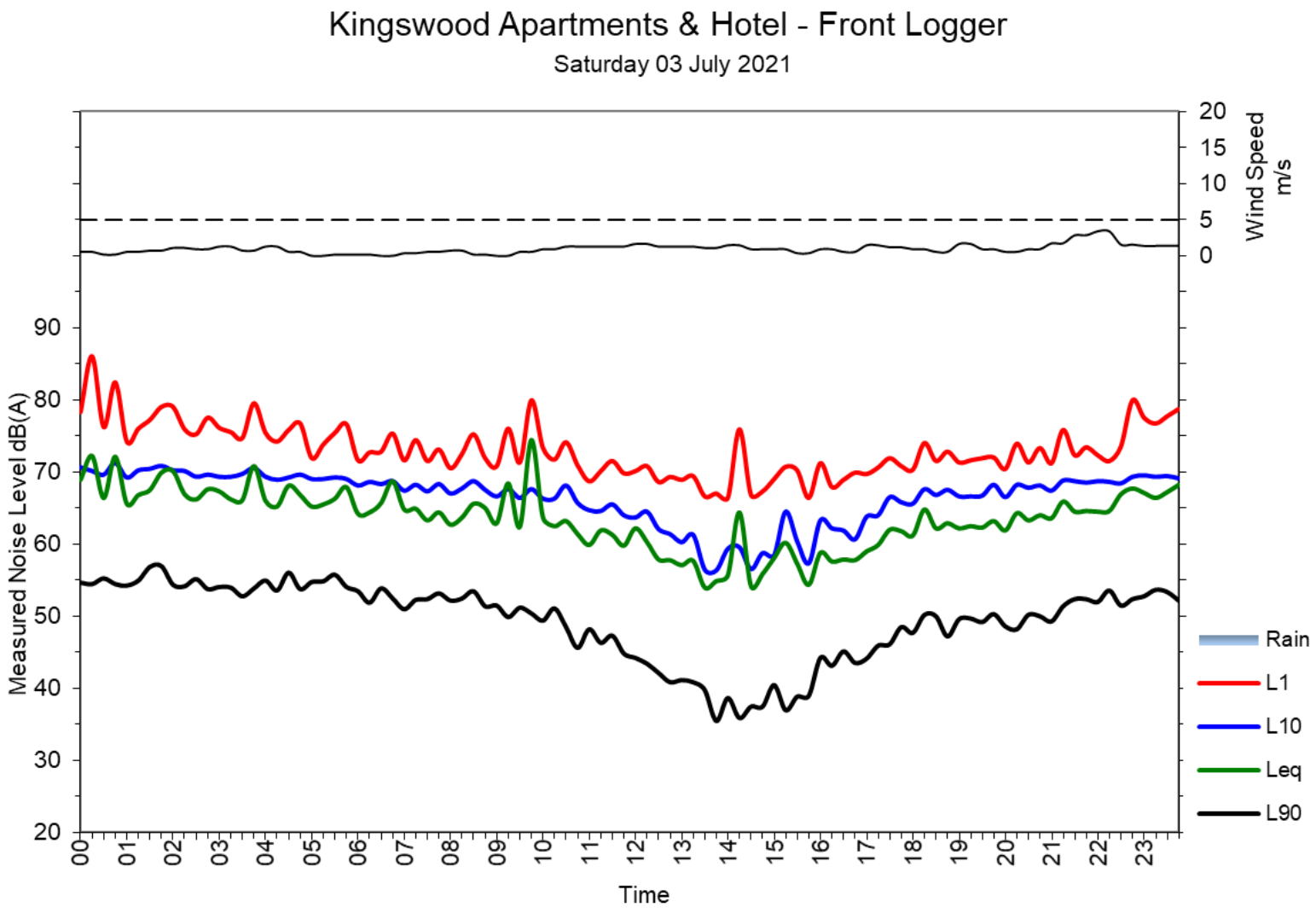
The following is a brief description of the acoustic terminology used in this report.

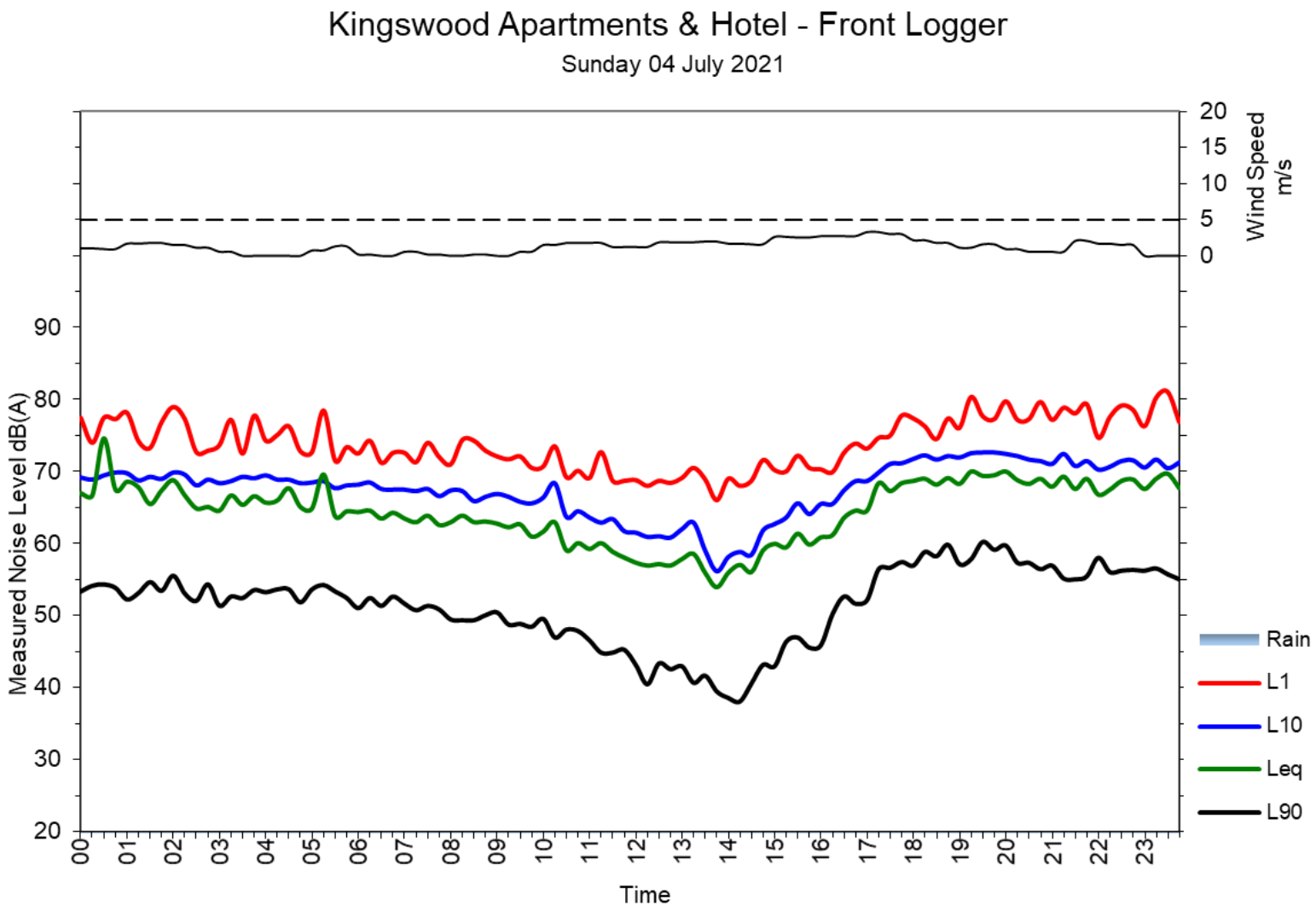
Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0dB the faintest sound we can hear 30dB a quiet library or in a quiet location in the country 45dB typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB the sound of a car passing on the street 80dB loud music played at home 90dB the sound of a truck passing on the street 100dB the sound of a rock band 115dB limit of sound permitted in industry 120dB deafening
dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the L_{A90} value

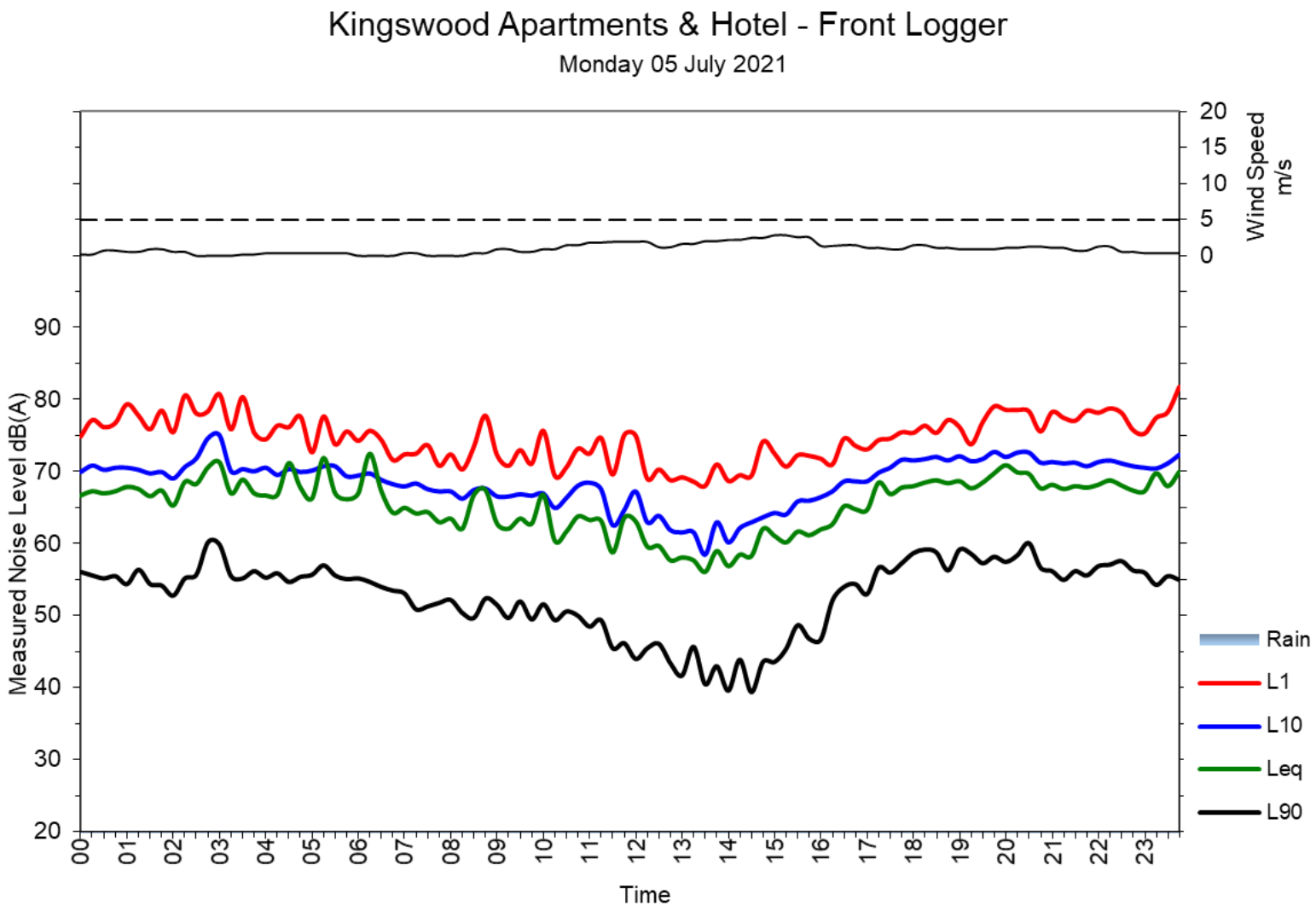
Ctr	A frequency adaptation term applied in accordance with the procedures described in ISO 717.
dB (A)	'A' Weighted overall sound pressure level
Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
NR Noise Rating	Single number evaluation of the background noise level. The NR level is normally around 5 to 6 dB below the "A" weighted noise level. The NR curve describes a spectrum of noise levels and is categorised by the level at 1000 Hz ie the NR 50 curve has a value of 50 dB at 1000 Hz. The NR rating is a tangential system where a noise spectrum is classified by the NR curve that just encompasses the entire noise spectrum consideration.
R_w	Weighted Sound Reduction Index - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single element. Calculation procedures for Rw are defined in ISO 140-2:1991 "Measurement of Sound Insulation in Buildings and of Building Elements Part 2: Determination, verification and application of precision data".
R'_w	Field obtained Weighted Sound Reduction Index - this figure is generally up to 3-5 lower than the laboratory test determined level data due to flanked sound transmission and imperfect site construction.
Sound Isolation	A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term "sound isolation" does not specify any grade or performance quality and requires the units to be specified for any contractual condition
Sound Pressure Level, L_P dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, L_W dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Transmission Loss	Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in countries other than Australia. A formal test rating of sound transmission properties of any construction, by usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. Australian Standards apply to test methods for both situations.

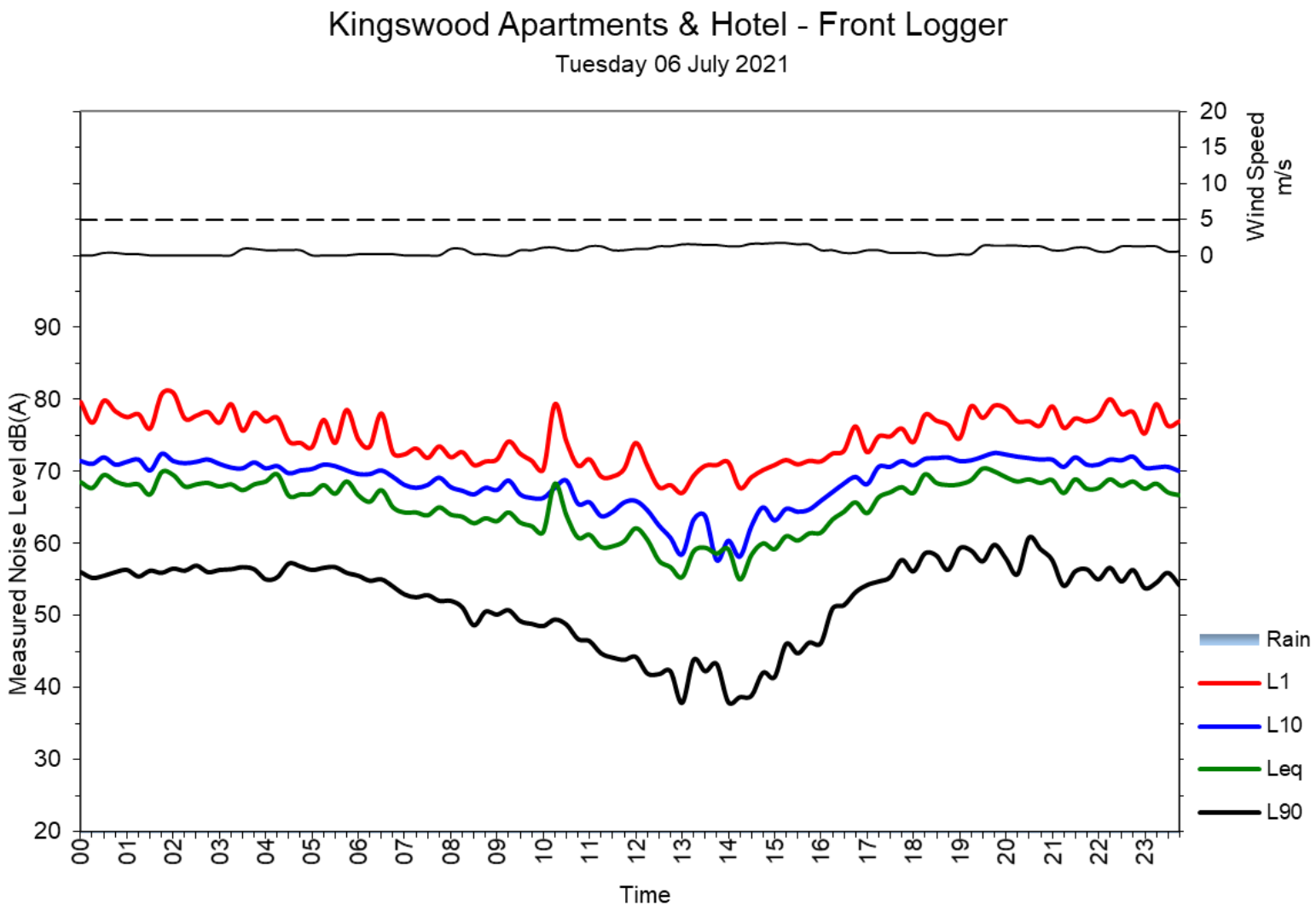
APPENDIX B – UNATTENDED NOISE MONITOR – LOCATION 1 – GREAT WESTERN HIGHWAY

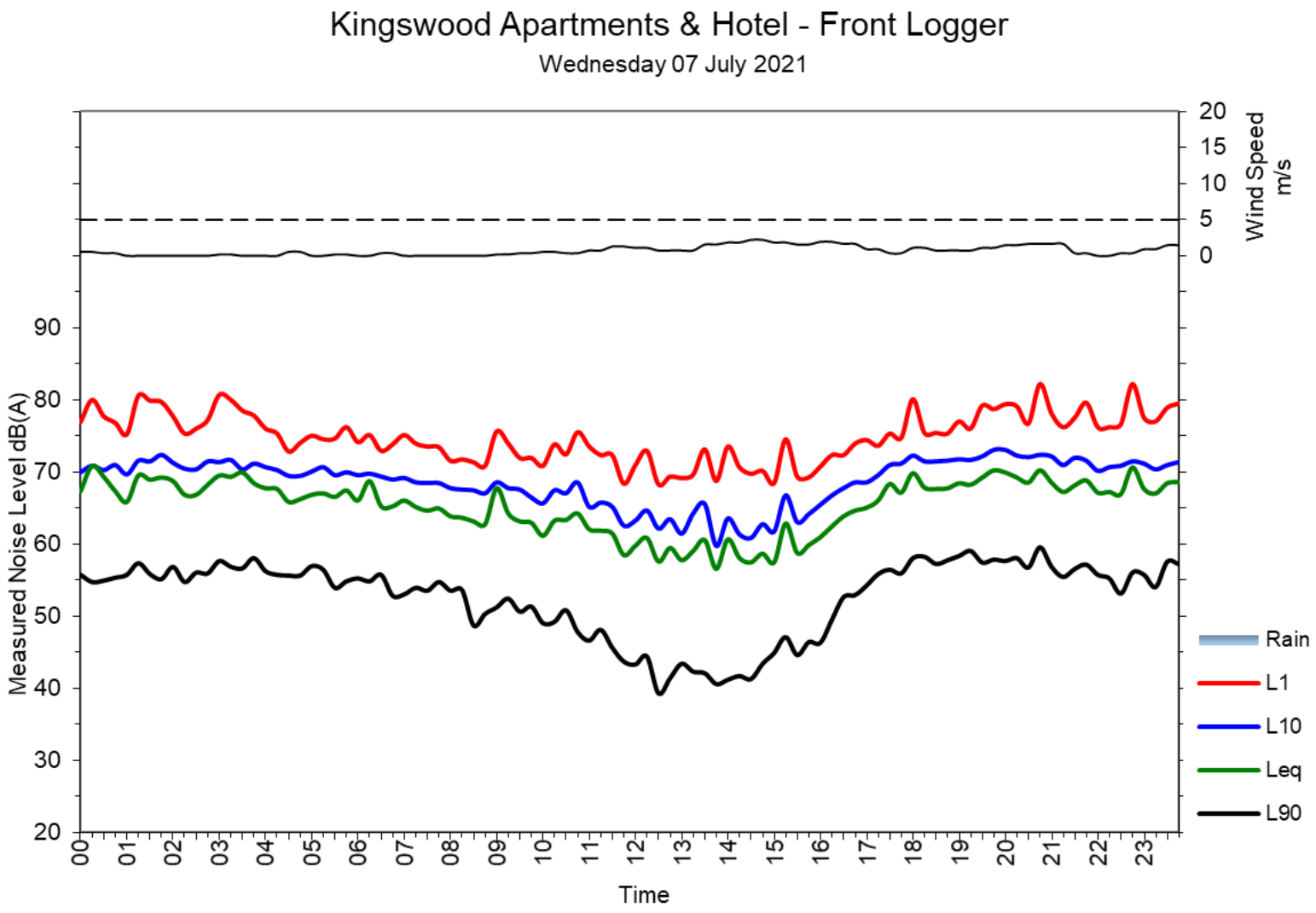

Kingswood Apartments & Hotel - Front Logger
Friday 02 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

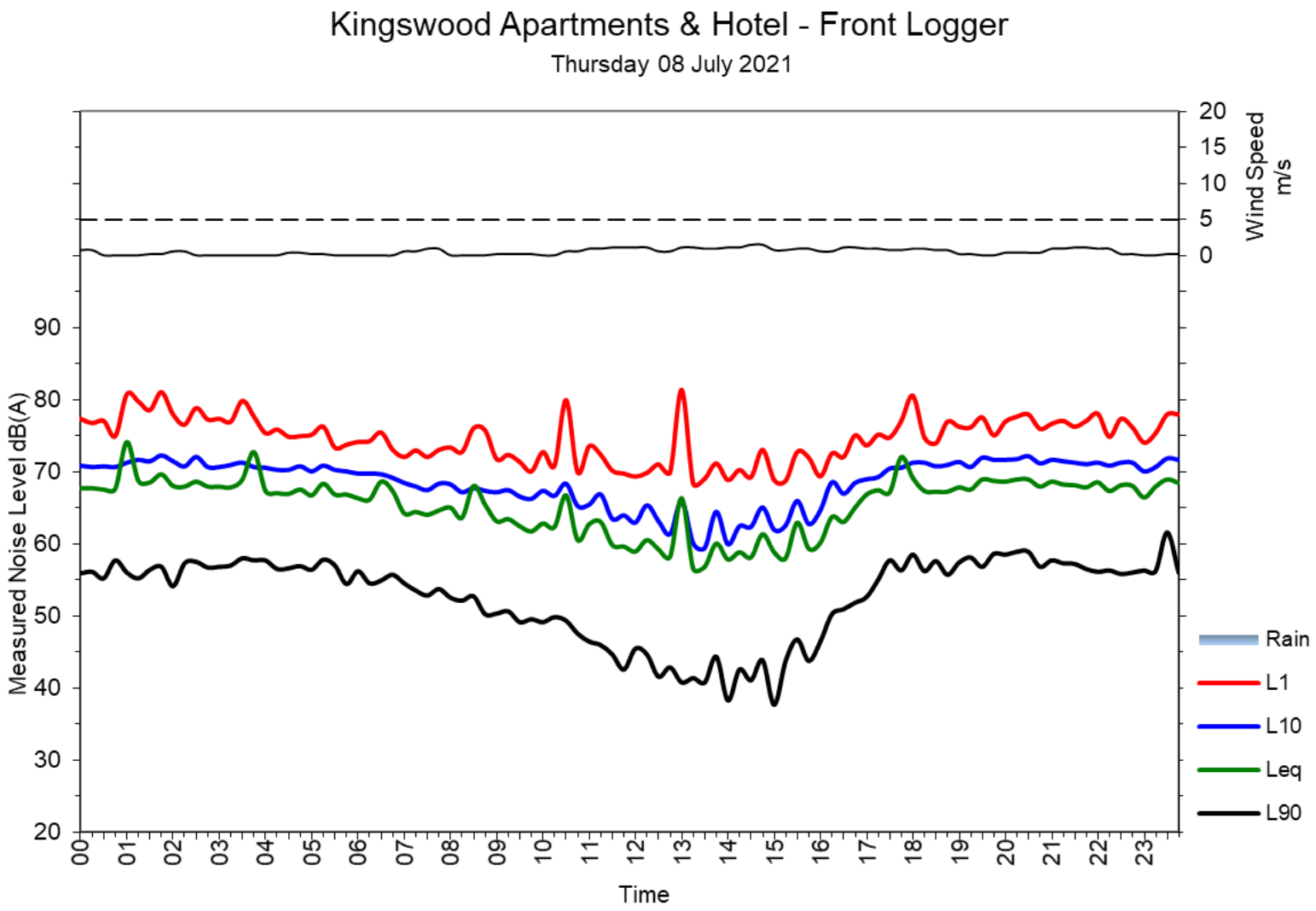

Kingswood Apartments & Hotel - Front Logger
Saturday 03 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

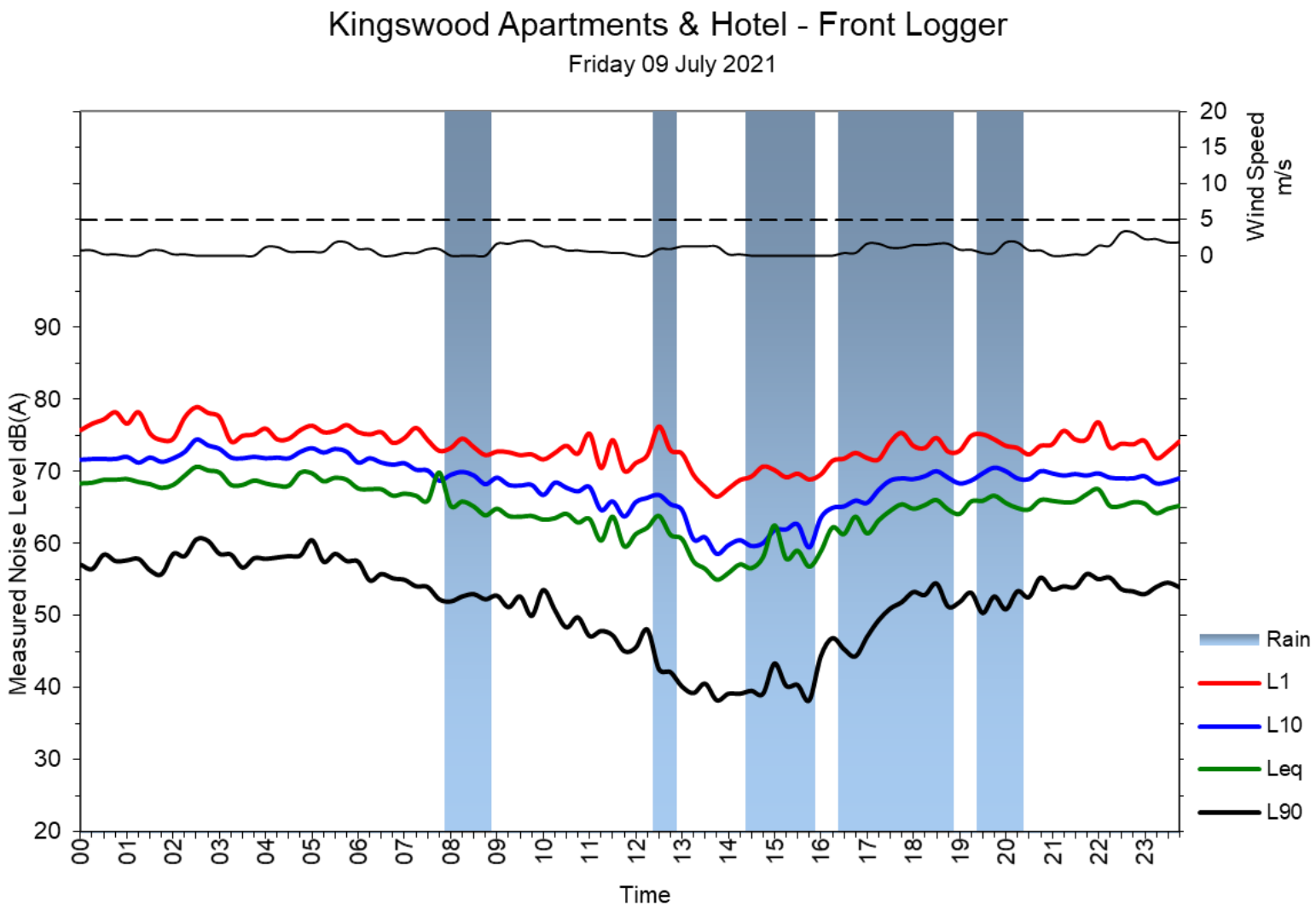

Kingswood Apartments & Hotel - Front Logger
Sunday 04 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

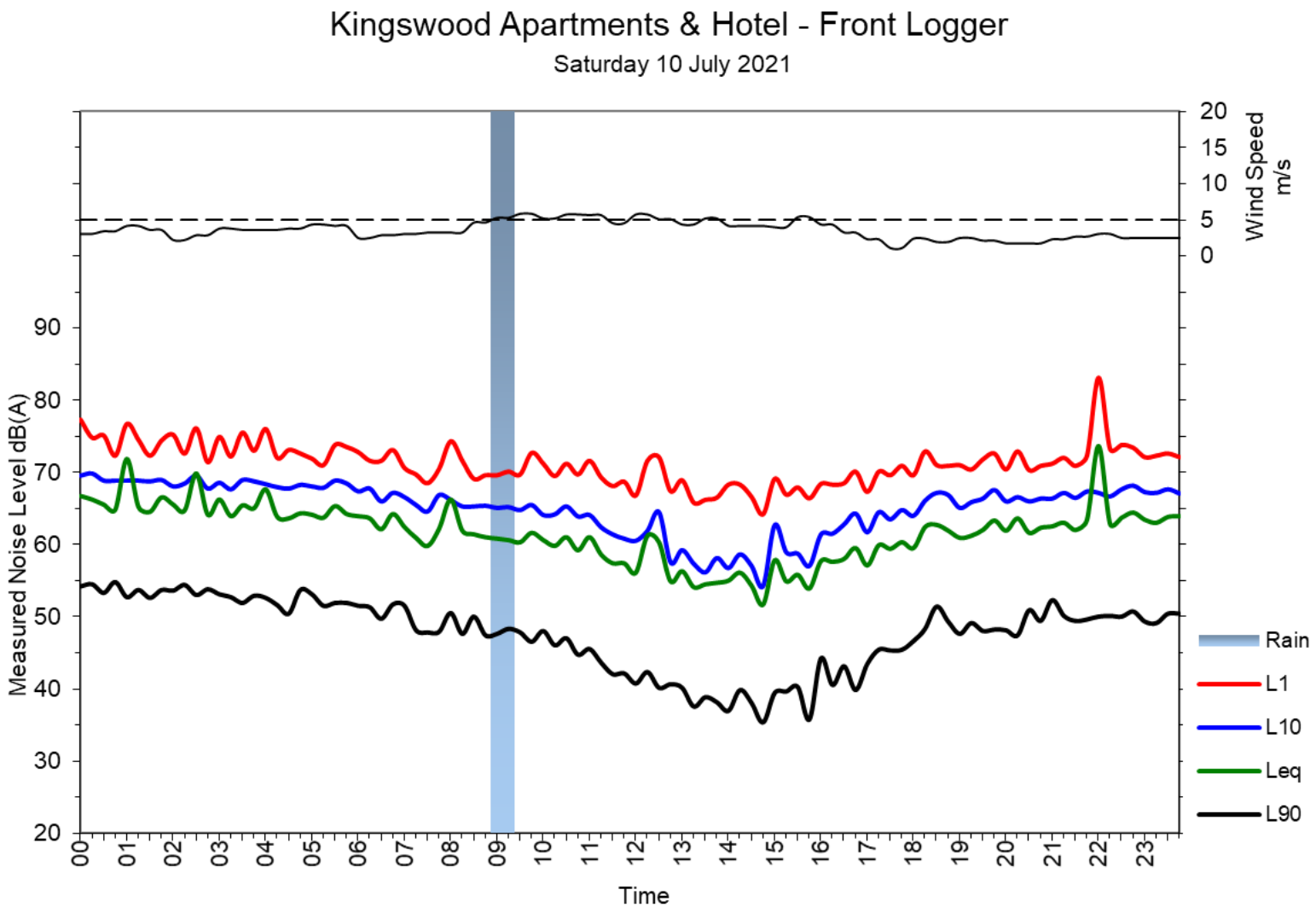

Kingswood Apartments & Hotel - Front Logger
Monday 05 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

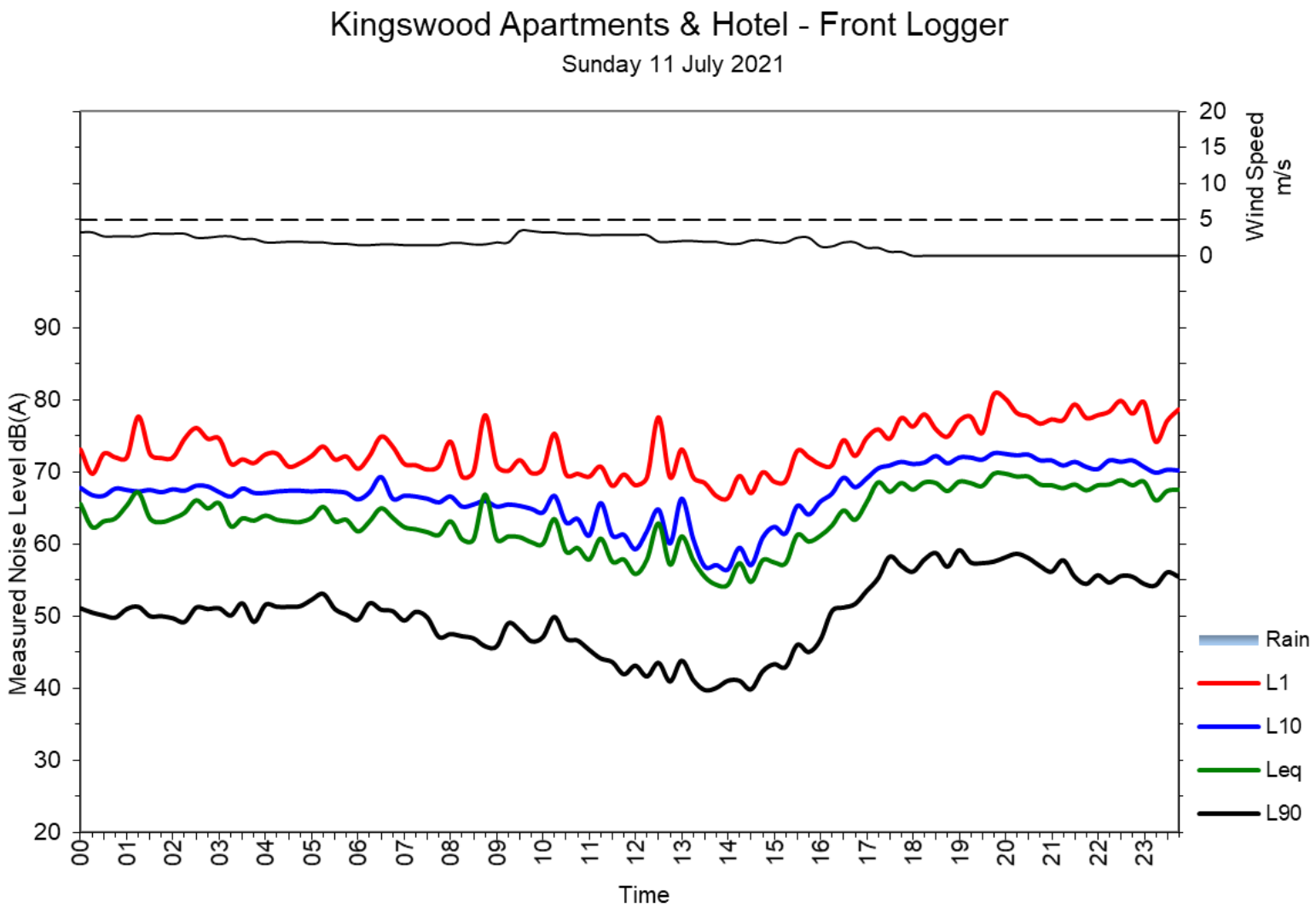

Kingswood Apartments & Hotel - Front Logger
Tuesday 06 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

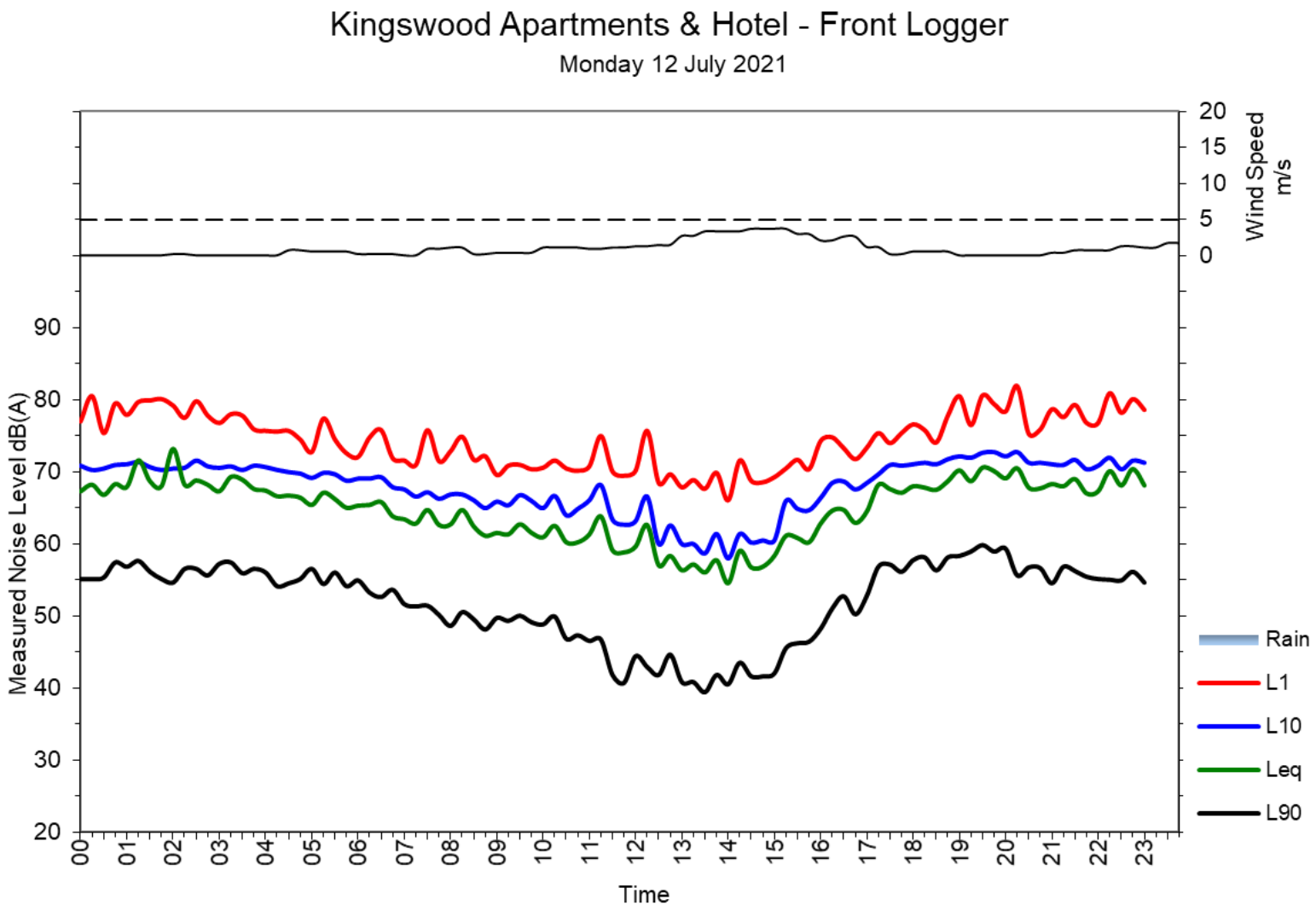

Kingswood Apartments & Hotel - Front Logger
Wednesday 07 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Kingswood Apartments & Hotel - Front Logger
Thursday 08 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

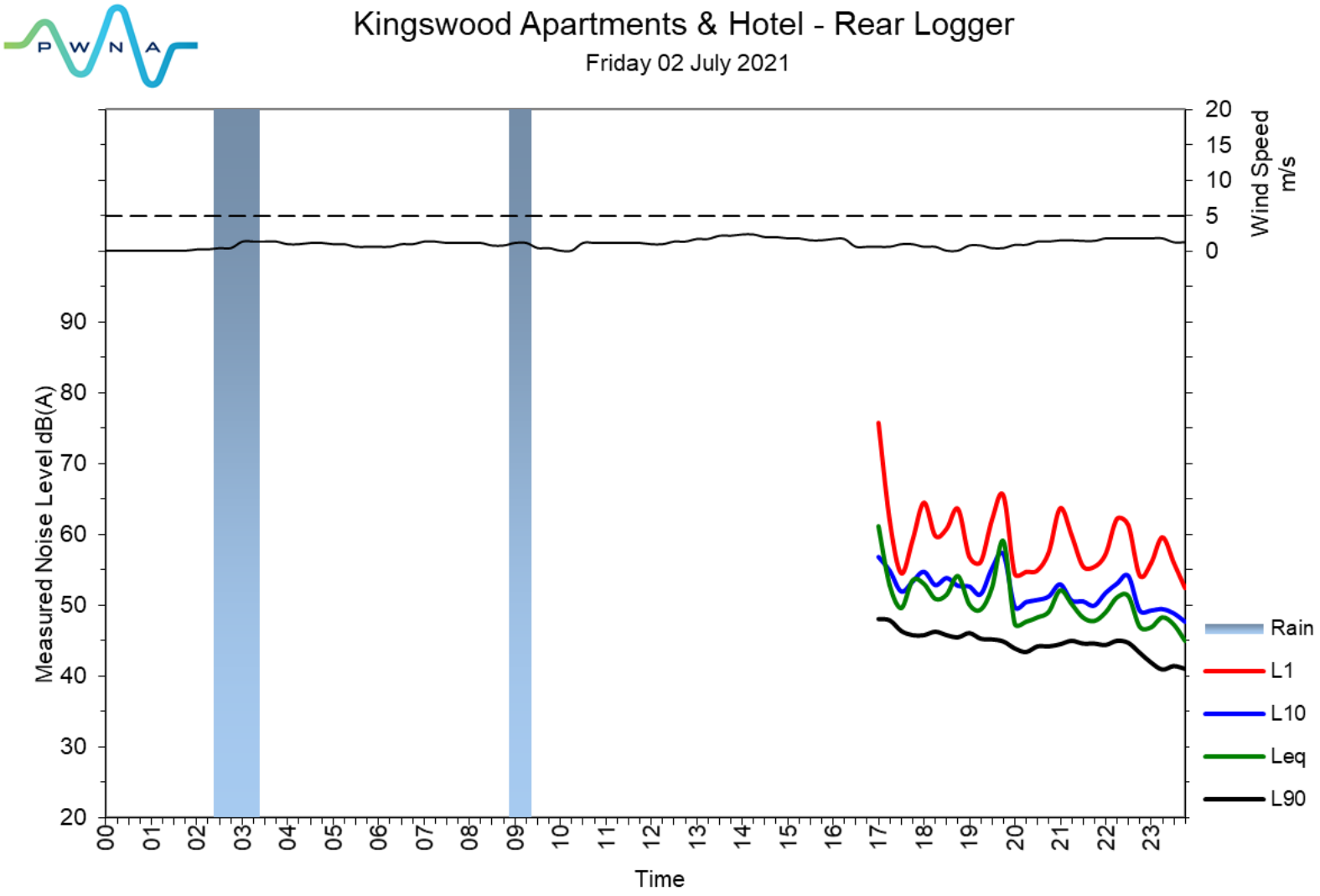

Kingswood Apartments & Hotel - Front Logger
Friday 09 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

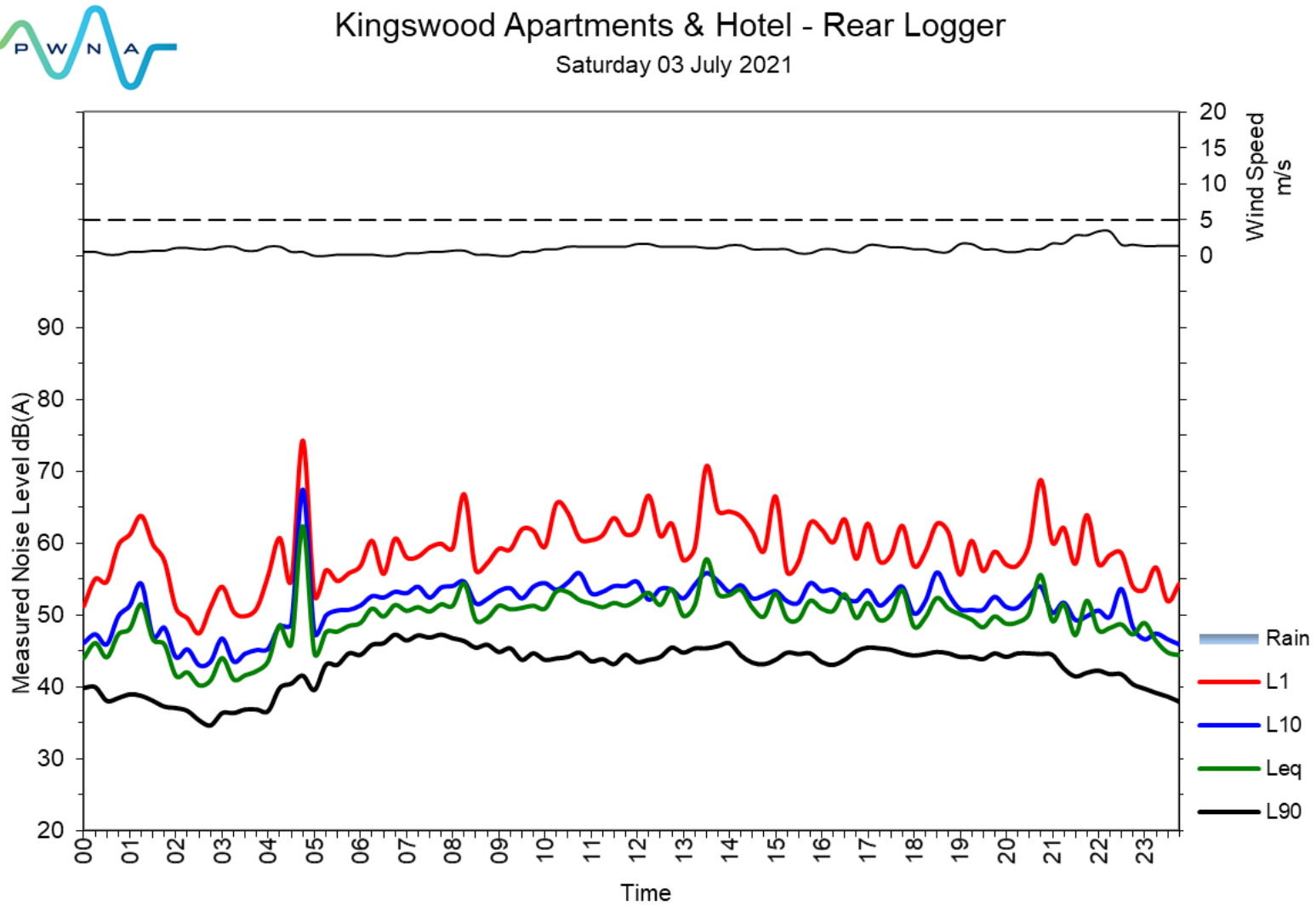

Kingswood Apartments & Hotel - Front Logger
Saturday 10 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

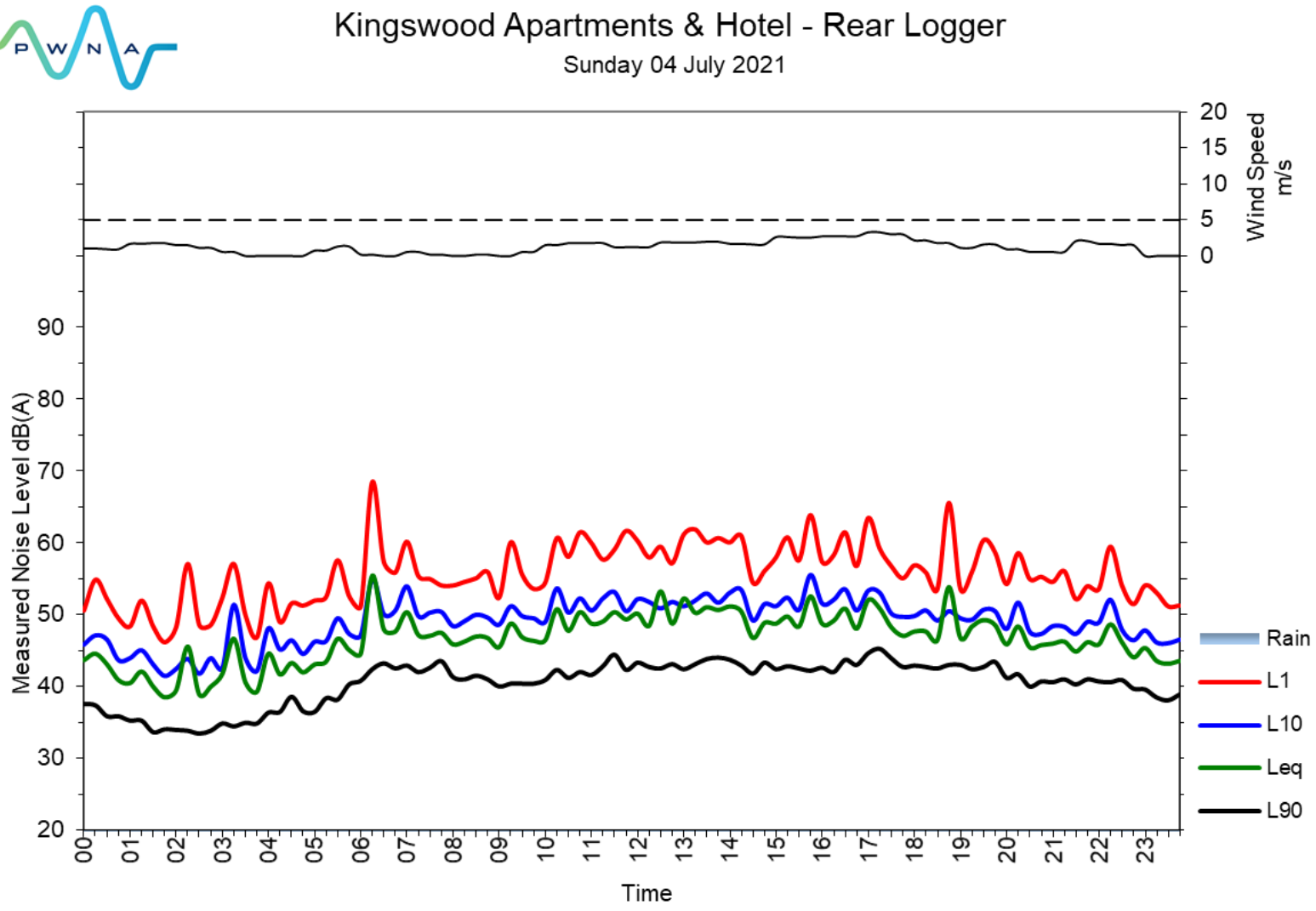

Kingswood Apartments & Hotel - Front Logger
Sunday 11 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

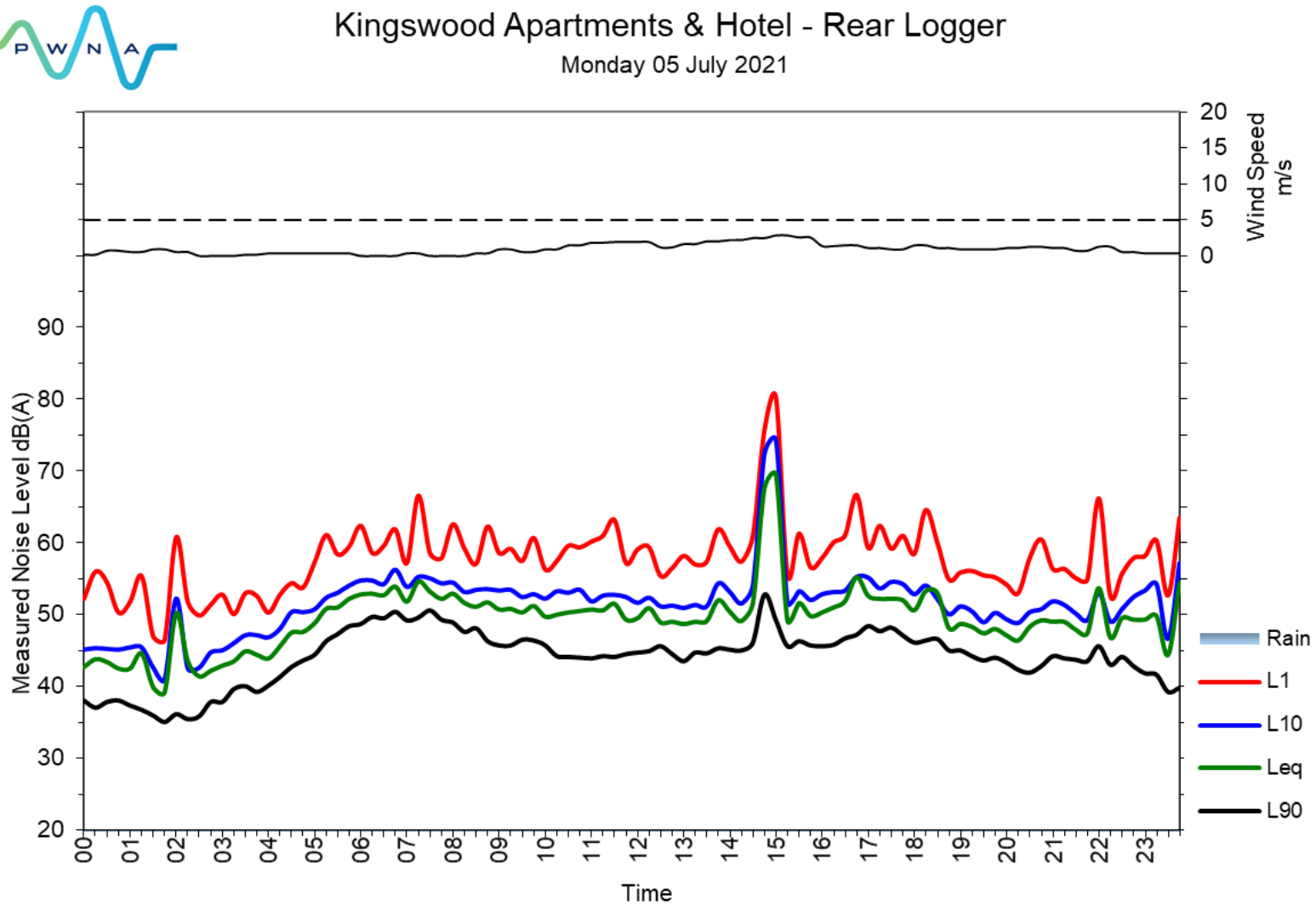

Kingswood Apartments & Hotel - Front Logger
Monday 12 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

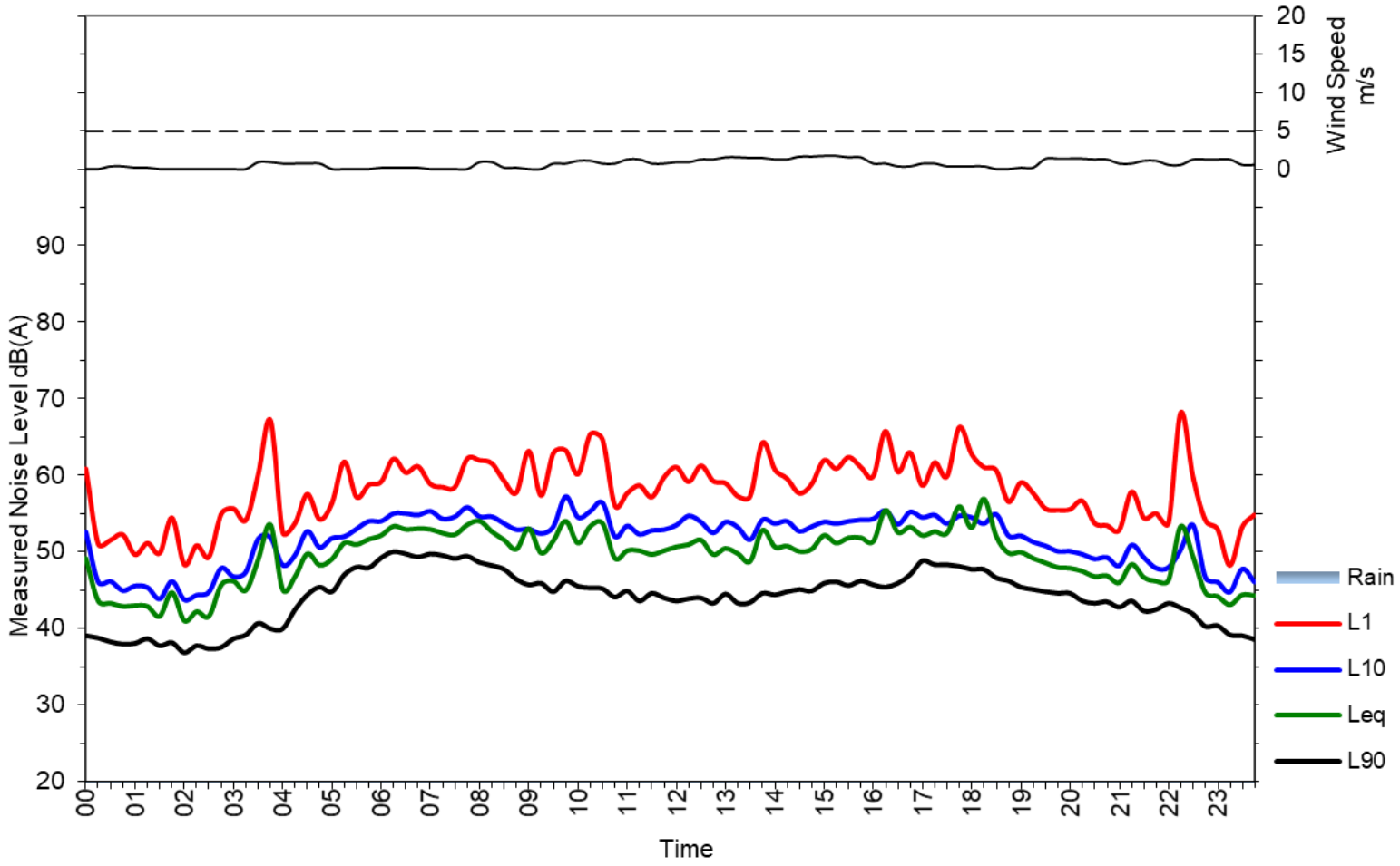
APPENDIX C – UNATTENDED NOISE MONITOR – LOCATION 2 – SOUTHERN SITE

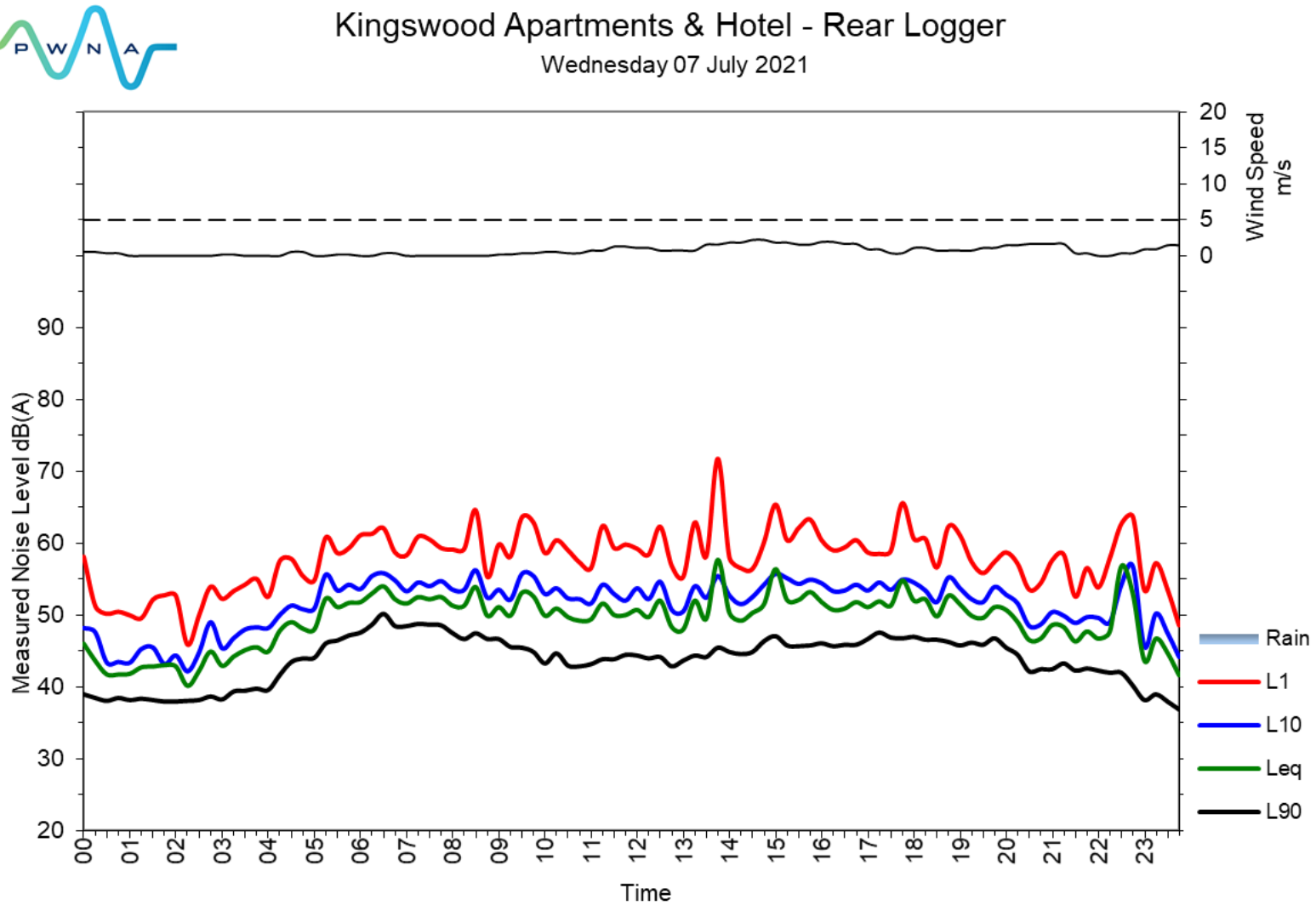

Kingswood Apartments & Hotel - Rear Logger
Friday 02 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

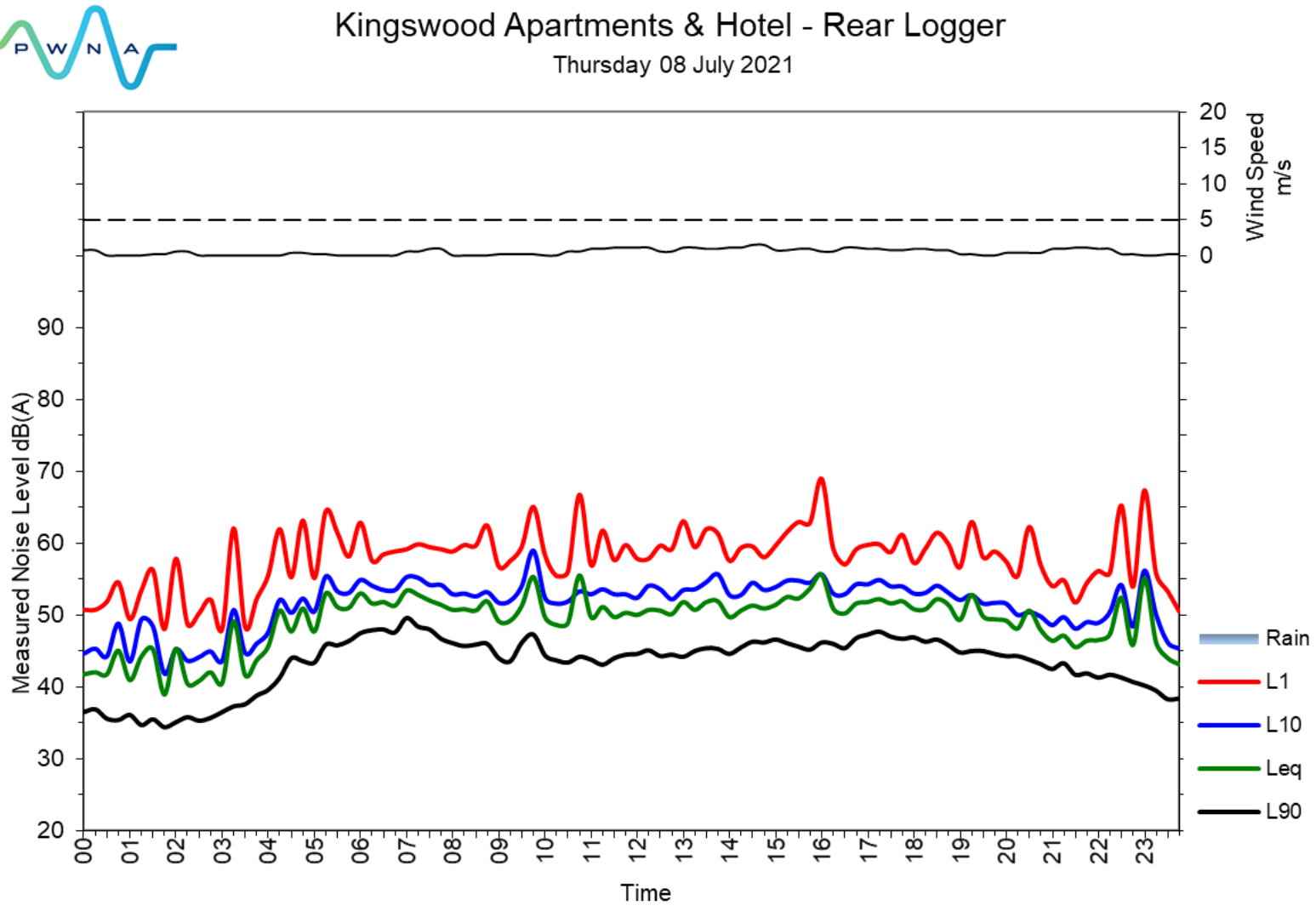

Kingswood Apartments & Hotel - Rear Logger
Saturday 03 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

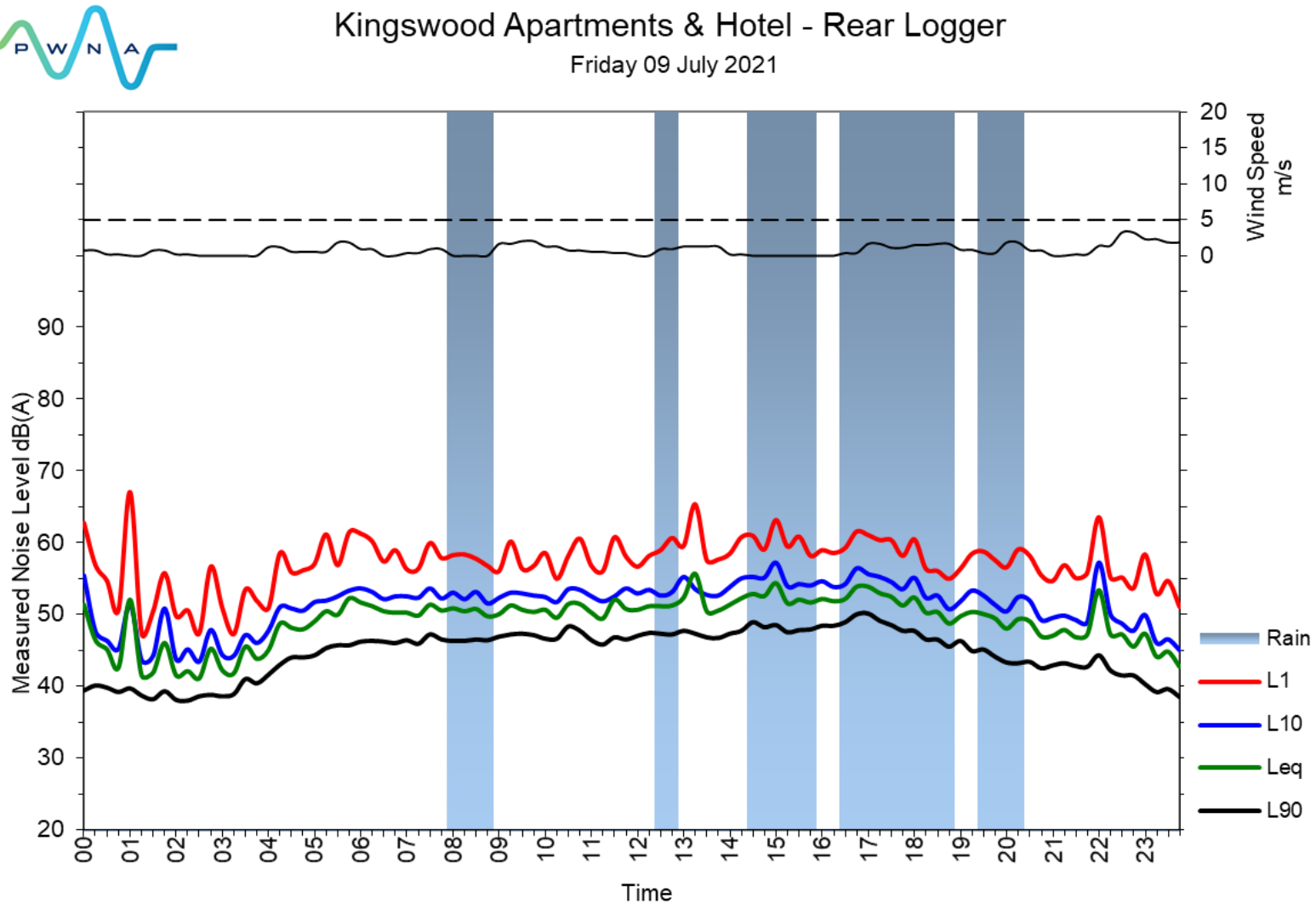

Kingswood Apartments & Hotel - Rear Logger
Sunday 04 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

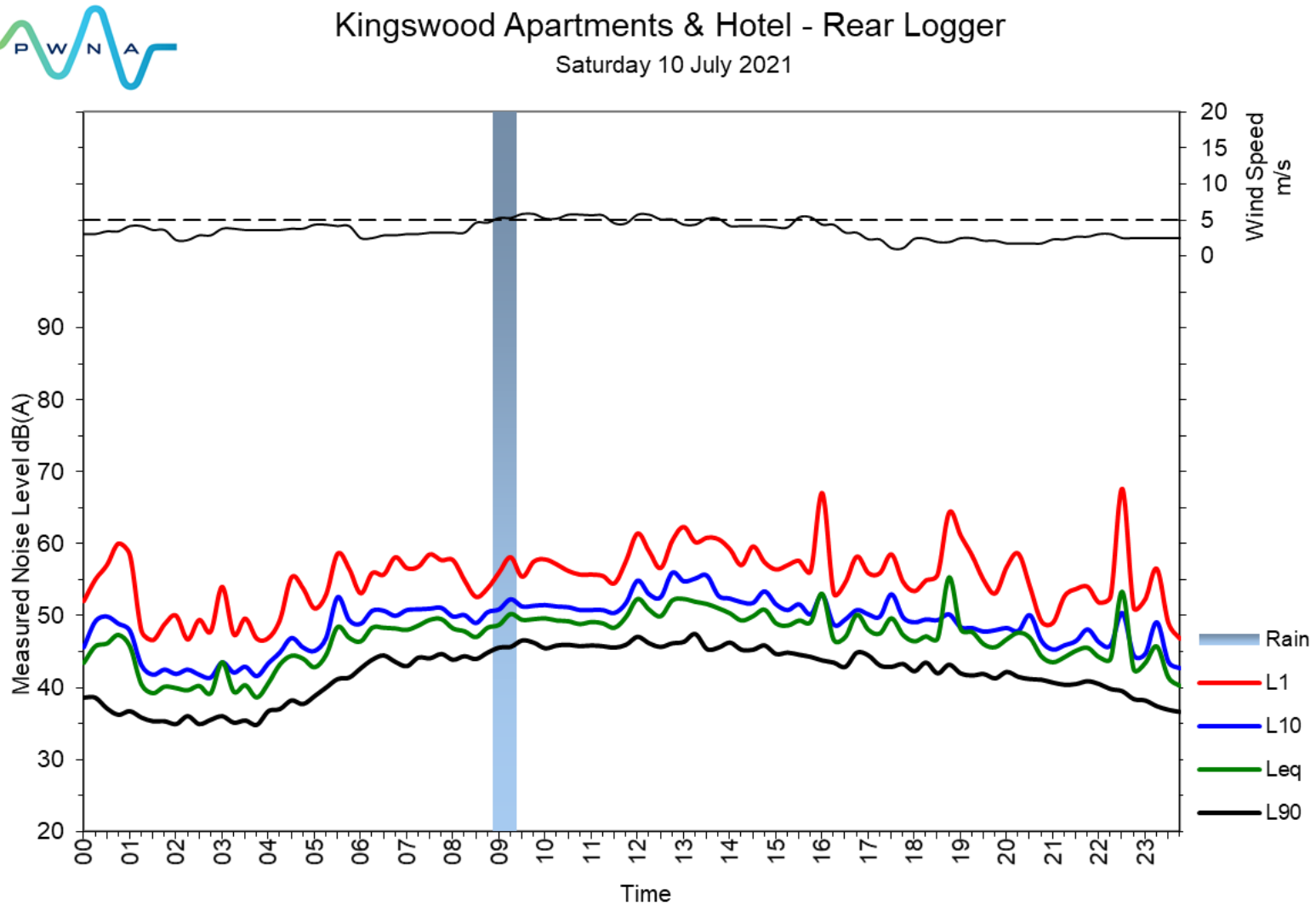

Kingswood Apartments & Hotel - Rear Logger
Monday 05 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

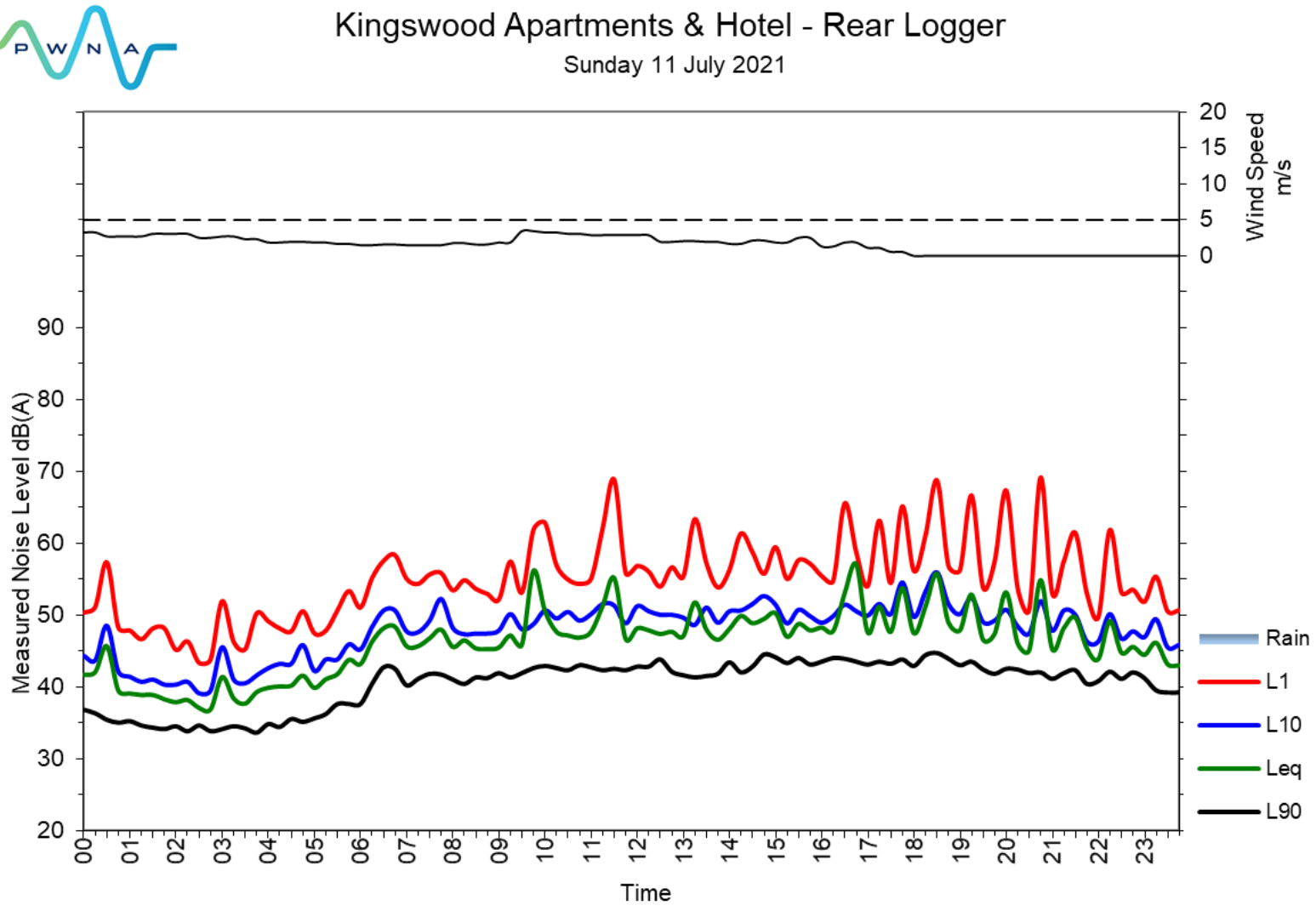

Kingswood Apartments & Hotel - Rear Logger
Tuesday 06 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

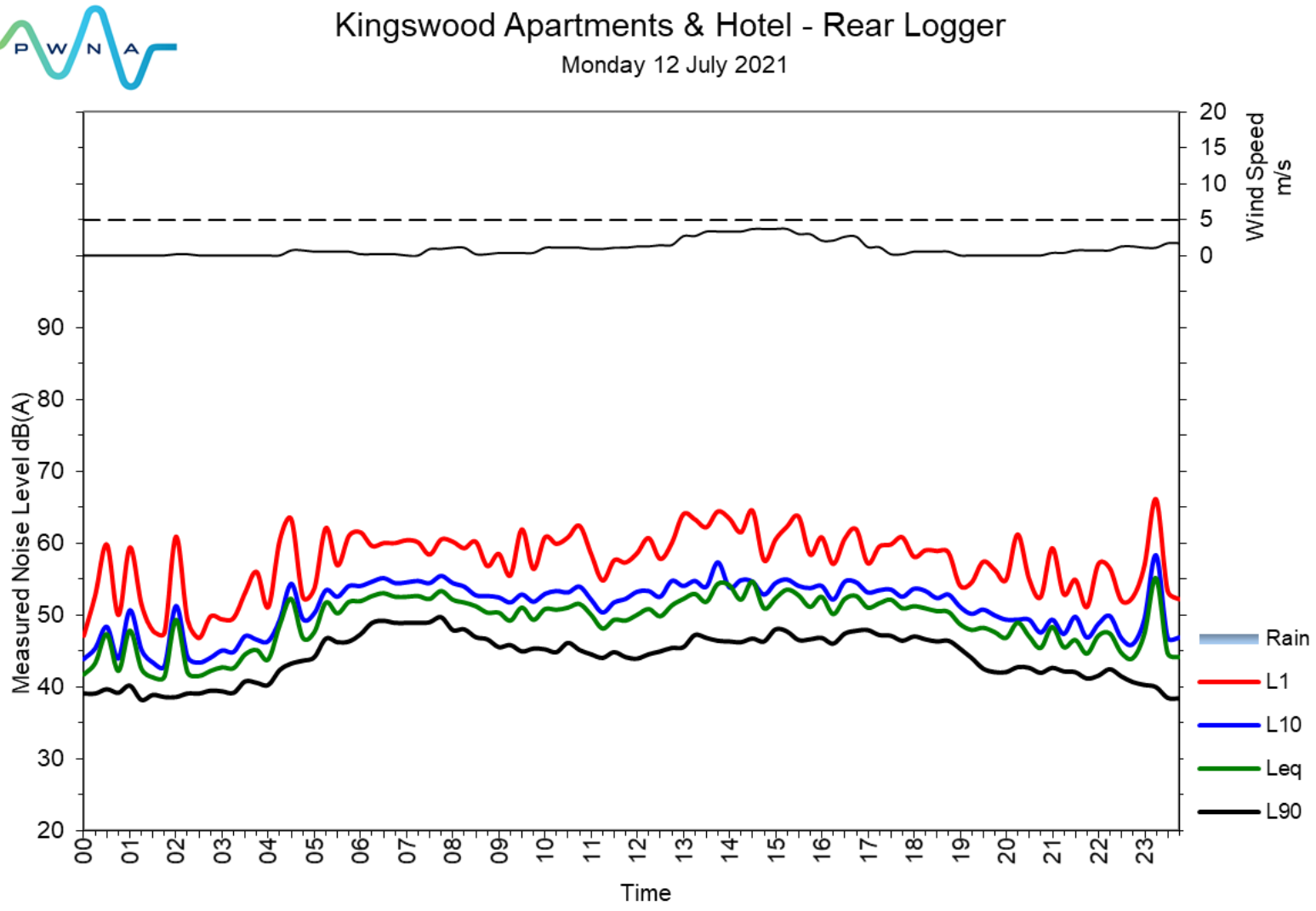

Kingswood Apartments & Hotel - Rear Logger
Wednesday 07 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90

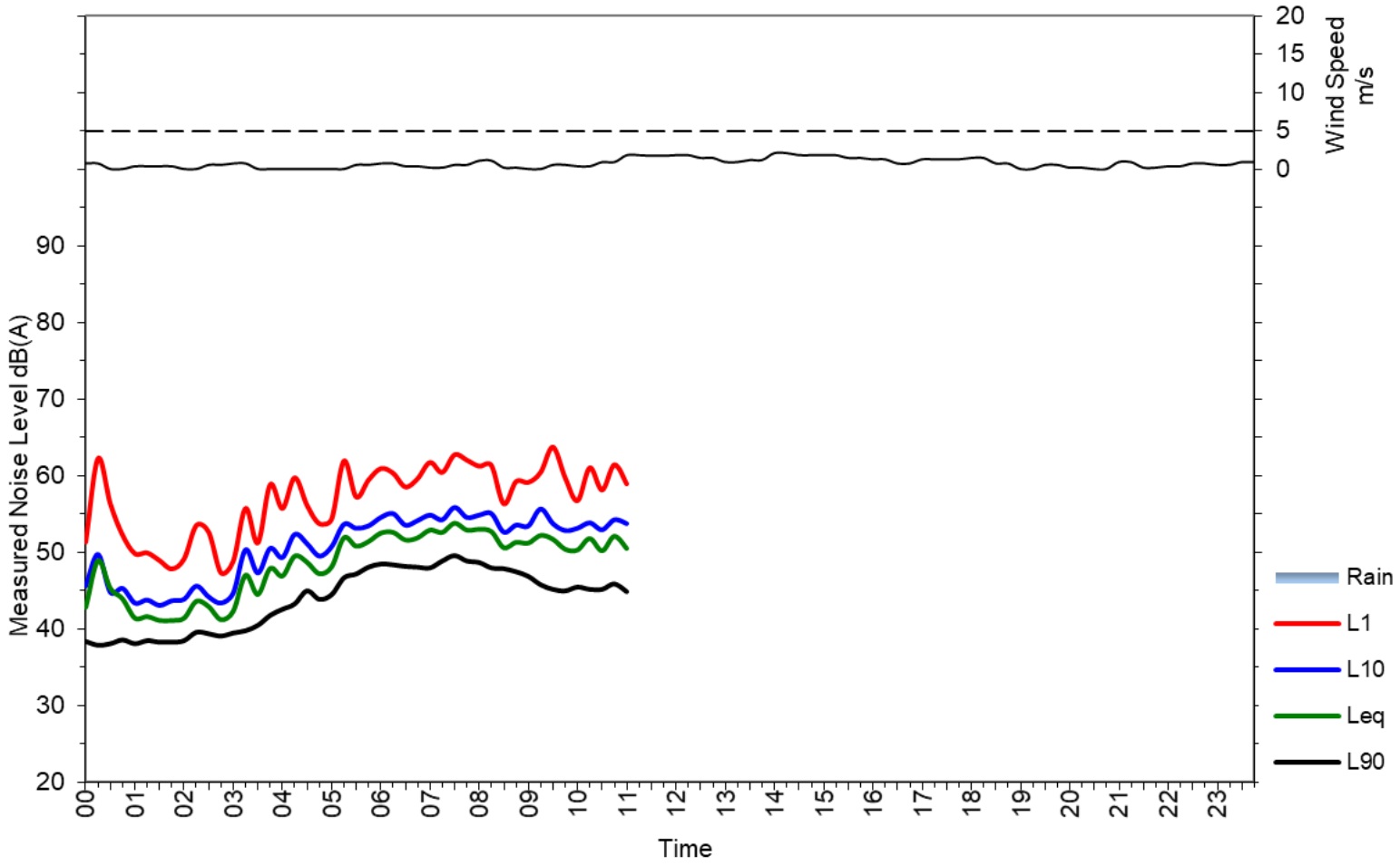

Kingswood Apartments & Hotel - Rear Logger
Thursday 08 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Kingswood Apartments & Hotel - Rear Logger
Friday 09 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Kingswood Apartments & Hotel - Rear Logger
Saturday 10 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Kingswood Apartments & Hotel - Rear Logger
Sunday 11 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Kingswood Apartments & Hotel - Rear Logger
Monday 12 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90


Kingswood Apartments & Hotel - Rear Logger
Tuesday 13 July 2021
Measured Noise Level dB(A)
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90