

# Noise Monitoring Assessment Report | August 2023

**Tweed Valley Hospital, 771 Cudgen Road, Cudgen NSW**

Prepared for: Lendlease Building Pty Ltd

Job Number: A101021.0286.00 ENM49 v0.1d | Date: 15/09/2023



**ADE**  
CONSULTING  
GROUP




# Document Information

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For and on behalf of  
**ADE Consulting Group Pty Ltd**

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# Executive Summary

ADE Consulting Group Pty Ltd (ADE) was engaged by Lendlease Group (Lendlease) to assess the levels of construction related noise generated during active works on the Tweed Valley Hospital Project and associated road upgrade works located at 771 Cudgen Road, Cudgen in New South Wales (hereinafter referred to as 'the Site').

This report summarises ambient noise data collected at three (3) locations during the monitoring period of August 2023, each device being positioned along the southern alignment of Cudgen Road and located close to, or adjacent to, sensitive receptors.

Upgrade works along Cudgen Road have concluded. The primary hospital construction has been completed, with trades remaining on site for fit outs works.

Analysis of the recorded data contained within the report for this survey period shows that there are measurable noise impacts during works to residential and commercial noise sensitive receivers located along Cudgen Road.

This report finds the following:

- The overall noise levels have shown a decrease in frequency from previous monitoring periods with regards to degree of impact, however remain consistent with the July monitoring periods findings in that:
  - Impact duration is typically no greater than 30 minutes per day as identified in this report (some exceptions apply), and mitigation measures may not be applicable due to the short nature of the potential works at the time of the noise impacts
  - Noise impacts are likely extraneous in nature and may be due to the operation of the nearby commercial premises (including customers), or, heavy plant equipment operating in short duration from the site, for example large loaded delivery trucks
- During standard hours, the Highly Noise Affected criterion is exceeded on two days (16 and 21 August), however we have not been able to receive information from the client to ascertain works on site and correlate this information with our data. For conservative worst-case assessment purposes this report makes the presumption the data we have analysed is from the Site
- ADE reached out to LendLease for comment during August, and we are still awaiting a reply.

The LendLease Construction Noise and Vibration Management Sub-Plan (CNVMSP) is still in effect for all works and is mandatory to be followed at all times.

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# 1 Introduction

## 1.1 Introduction

ADE Consulting Group Pty Ltd (ADE) was engaged by the Lendlease Group (Lendlease) to assess the levels of construction related noise during the construction of the Tweed Valley Hospital Project and associated road upgrade works. The project site is located at 771 Cudgen Road, Cudgen in New South Wales (hereinafter referred to as ‘the Site’).

At the time of noise monitoring, Lendlease were conducting ancillary construction works associated with the buildings and grounds within the actual Hospital footprint, including (but not limited to) finishing trades such as electrical, plumbing, carpentry and painting. The roadwork construction activities have concluded.

The purpose of environmental monitoring is to:

- Assess construction related airborne noise levels with regulatory requirements, development consent conditions, Australian guidelines, and international standards for construction noise management and control on construction sites that are applied to the Tweed Valley Hospital project.
- Mitigate potentially excessive noise generation through site planning and the adoption of appropriate work methods and practices where feasible and reasonable.
- Monitor and assess construction impacts likely to cause annoyance to the amenity on surrounding sensitive receivers and provide feasible and reasonable recommendations to manage the impacts identified.
- Proactively establish and maintain positive relationships with project stakeholders.

The purpose of the Environmental Noise Monitoring Assessment (ENM) report is to assess the potential impacts that construction activities from the Tweed Valley Hospital Project have on ambient noise levels on Site and assess compliance with the Tweed Valley Hospital Management Plan – Noise and Vibration.

This assessment allows for feasible and reasonable mitigation and management measures as far as practicable to be adopted for works aligned with the conditions **C4 – C7**, **C12 – C17** and **B16** from the Development Consent described in **Table 2 (Section 1.2.2)** below, as well as the relevant guideline values and noise goals from the *Interim Construction Noise Guideline (DECC, 2009)* detailed in **Section 2**.

This report uses specific terminology and to address this for the reader, a general acoustic glossary is provided in **Appendix I – Glossary**.

## 1.2 Project background

On 13 June 2017, the NSW Government announced an allocation of approximately \$534M for the development of a new hospital on a greenfield site in the Tweed Valley area. The site of the new Tweed Valley Hospital (the Project) is located at 771 Cudgen Road, Cudgen in New South Wales.

An Environmental Impact Statement (EIS) was prepared to accompany a State Significant Development Application for the Project which was assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

An overview of the project specific information is provided in **Table 1** below.

**Table 1** Project Specific Information

Site Details	
<b>Client Name:</b>	Lendlease
<b>ADE Project Number:</b>	A101021.0286.00
<b>Site Address:</b>	771 Cudgen Road, Cudgen NSW (Lot 11 DP 1246853)
<b>Date of Report:</b>	15/09/2023
<b>Development Consent</b>	SSD-10353, Health Administration Corporation. Authorised by the Minister for Planning and Public Spaces on 9 March 2020. Consent approved on 12 June 2020.
<b>Objectives:</b>	<ul style="list-style-type: none"> <li>comply with relevant guidelines and conditions <b>C4 – C7, C12 – C14</b> and <b>B16</b> of the SSD-10353 consent</li> <li>manage potential airborne construction noise impacts from construction activities which have the potential to affect the nearby noise sensitive receivers (Kingscliff TAFE and residential properties)</li> <li>establish and maintain good relationships with the neighbours and wider community.</li> </ul>
<b>Key Legislation:</b>	Protection of the Environment Operations Act 1997 (NSW) (POEO Act). The POEO Act is a key piece of environmental protection legislation and regulates activities via: <ul style="list-style-type: none"> <li>environmental protection licensing, as per schedule 1</li> <li>regulation of scheduled and non-scheduled activities</li> <li>environmental protection offences and penalties</li> <li>establishment of a general duty of care to notify environment harm.</li> </ul>

### 1.2.1 Monitoring Locations

Prior to the commencement of roadworks, and in response to the schedule of works at that time, unattended noise monitoring equipment was relocated on 17 November 2022 along the southern alignment of Cudgen Road at three designated locations.

These monitoring locations were established to assess the potential noise impacts to the nearest sensitive receivers with respect to the current active works and to ensure the roadworks controls are compliant with the requirements and conditions set out in the Tweed Valley Hospital Management Plan – Noise and Vibration.

All monitoring locations are within close proximity to the boundary of the nearest sensitive receivers (residential and commercial) that may be impacted by noise generated from the current roadworks and associated plant.

Aerial imaging and monitoring locations overview is presented in **Appendix II – Aerial**.

## 1.2.2 Development consent SSD-10353

The consent of approval conditions regarding noise are summarised below in **Table 2**.

**Table 2** Development consent conditions

Conditions of Approval Number		Condition requirements
Construction Hours	<b>C4</b>	Construction, including the delivery of materials to and from the site, may only be carried out between the following hours: (a) Between 7 am and 6 pm, Mondays to Fridays inclusive; and (b) Between 8 am and 1 pm, Saturdays No work may be carried out on Sundays or public holidays.
	<b>C5</b>	Construction activities may be undertaken outside of the hours in condition <b>C4</b> if required: (a) By the Police or a public authority for the delivery of vehicles, plant or materials; or (b) In an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or (c) Where the works are inaudible at the nearest sensitive receivers; (d) Where a variation is approved in advance in writing by the Planning Secretary or his nominee if appropriate justification is provided for the works; or (e) For the delivery, set-up and removal of construction cranes, where notice of the crane related works is provided to the Planning Secretary and affected residents at least seven days prior to the works.
	<b>C6</b>	Notification of such construction activities as referenced in condition <b>C5</b> must be given to affected residents before undertaking the activities or as soon as is practical afterwards.
	<b>C7</b>	The construction hours must include respite periods and specific times for activities during the day (outside the sensitive times), as required by condition <b>B16</b> of this consent, for the high noise generating construction activities (such as activities that would reach or exceed the Highly Affected Noise Level as defined in the ICNG).
Construction Noise Limits	<b>C12</b>	The development (including roadworks) must be constructed to achieve the project specific construction NMLs detailed in the Noise and Vibration Impact Assessment for SSDA Tweed Valley Hospital Stage 2' by JHA dated 19/09/2019. Additional mitigation measures must be implemented and any activities that are likely to exceed the NMLs or the high affected noise level of 75dB(A) in accordance with the management and mitigation measures in Appendix 3 and the approved CNVMSP required by condition <b>B16</b> .
	<b>C13</b>	Any noise generated during construction of the development must not be offensive noise within the meaning of the Protection of the Environment Operations Act 1997 or exceed approved noise limits for the site.
	<b>C14</b>	Unattended long-term construction noise monitoring must be undertaken during the duration of the Stage 2 works, consistent with the Stage 1 works in SSD-9575. The location of the loggers and the details of the monitoring methods including the reporting methods should be consistent with the CNVMSP in condition <b>B16</b> and the Stage 1 works in SSD-9575.
	<b>C15</b>	The intra-day respite periods required to be provided in the CNVMSP in condition <b>B16</b> of this development consent must be reviewed on a monthly basis, after the commencement of Stage 2 construction works, in consultation with Kingscliff TAFE and Kingscliff High School. The respite periods are to be maintained / or amended, as agreed with the identified noise receivers. The details of any amendments to the intra-day respite periods due to agreement with the Kingscliff TAFE and Kingscliff High School, must be provided to the Department for information.
	<b>C16</b>	The Applicant must ensure construction vehicles (including concrete agitator trucks) do not arrive at the site or surrounding streets outside of the construction hours of work outlined under condition <b>C4</b> .
	<b>C17</b>	The Applicant must implement, where practicable and without compromising the safety of construction staff or members of the public, the use of 'quackers' to ensure noise impacts on surrounding noise sensitive receivers are minimised.

Note: CoA **B16** refers to the Lendlease's Construction Noise and Vibration Management Sub-Plan (CNVMSP)

## 2 Noise criteria

### 2.1 NSW Interim Construction Noise Guideline

The standard construction hours are defined in the *Interim Construction Noise Guideline* (ICNG, DECC 2009) as:

- Monday to Friday 07:00 hrs to 18:00 hrs
- Saturday 08:00 hrs to 13:00 hrs
- No work on Sundays or Public Holidays.

**Table 3** below provides guidance noise management levels (NML) for residential premises for airborne construction noise, reproduced from the ICNG.

**Table 3** Guideline noise levels for residential premises, airborne construction noise (ICNG)

Time of Day	Noise Management Level dBA Leq,15min	How to apply
Standard hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or Public Holidays	Noise Affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise <ul style="list-style-type: none"> <li>• where the predicted (or measured L<sub>Aeq</sub>(15 minute) is greater than the noise affect level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level</li> <li>• 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</li> </ul>
	Highly Noise Affected >75 dBA	The highly noise affected level represents the point above which there may be a strong community reaction to noise <ul style="list-style-type: none"> <li>• where noise is above the 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: <ul style="list-style-type: none"> <li>■ 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</li> <li>■ If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times</li> </ul> </li> </ul>
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> <li>• a strong justification would typically be required for works outside the recommended standard hours</li> <li>• the proponent should apply all feasible and reasonable work practices to meet the noise affected level</li> <li>• where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community</li> </ul>

Note: RBL refers to Rating Background Level, as defined in the Noise Policy for Industry (EPA, 2017) and outlined in the Management Plan



## 2.2 Other sensitive land uses and commercial receivers

There are several sensitive land uses including residential properties and commercial receivers identified within the chainage of Cudgen Road where roadworks is currently being undertaken. These include:

- Mate and Matt’s Farm Fresh Fruit and Vegetable (approximately 10 m south/south-east)
- Hardy Electrical and Solar (approximately 10 m south/south-east)
- Kingscliff TAFE (an educational facility approximately 10 m south/south-east)
- Kingscliff Library (approximately 380 m north-east)
- Tweed Regional Aquatic Centre (approximately 130 m east)
- Kingscliff High School (approximately 500 m south/south-east)
- Jack Julius Park - passive recreational area (approximately 650 m south-east).

**Table 4** below outlines the noise management levels for non-residential land use.

**Table 4** Noise at sensitive land uses (other than residences)

Land use	Management Level $L_{Aeq,15\text{ minute}}$ (applicable when properties are in use)
Industrial premises	External noise level 75 dBA
Office, retail outlets and other commercial properties	External noise level 70 dBA
Classrooms at school and other educational institutions	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dBA
Community centres	Refer to the recommended ‘maximum’ internal levels outlined in AS2107 for specific uses

Note: The internal noise level criteria shown above is adjusted by +10 dB to conservatively assume internal to external noise level differences. This is representative of windows being opened to provide ventilation.  
Office, retail and other commercial properties external noise level applies to all local business premises along Cudgen Road including Mate and Matt’s, and Hardy Electrical and Solar.

Other sensitive receptors not defined in the ICNG require noise level criteria to be derived from Australian Standard AS2107:2016.

The AS2107 noise level criteria are generally provided as internal levels, and an internal-to-external correction of +10 dB has been applied to assume a conservative noise level with a setting of an open window for ventilation to discern potential impact to a sensitive receiver.

The public library to the north-east would have an external noise management level of 55 dBA, this is provided in **Table 5** below.

**Table 5** NMLs for ‘Other Sensitive Receivers’ based on AS2107

Land use	Noise Management Level $L_{Aeq,15\text{min}}$	
	Internal	External
Public Library	45 dBA	55 dBA

Note: The Noise and Vibration Impact Statement was prepared under AS2107:2000. This standard has been superseded by AS2107:2018

## 2.3 Residential noise criteria summary

The measured background noise levels are used to determine the noise management level (NML) for the Project.

These NMLs are summarised below in **Table 6**.

**Table 6** Noise Management Level (dB LAeq,15min) for residential receivers

NCA	Logger ID <sup>1</sup>	Standard hours (RBL +10)	Out of hours (RBL +5)			Sleep Disturbance (RBL +15) dB LA <sub>Max</sub>
		Day	Day	Evening	Night	
NCA-A/1	n/a	55	50	48	43	53
NCA-B/2	005, 006, 007	57	52	44	41	52
NCA-C/3	n/a	59	54	48	39	52

Note: Cudgen Road Upgrade Works currently operate within OOH periods

Note: All loggers are currently positioned within NCA-B/2

Note 1: Logger ID based on Acoustic Studio Report. ADE CNVIS naming convention reverts to numerical, NCA corresponds to NCA definitions outlined in both the Management Plan and the ADE CNVIS

# 3 Results overview

## 3.1 Survey instrumentation and methodology

This monitoring report covers the monitoring period of the whole calendar month of August 2023. Unattended noise monitoring was operated at three (3) locations using Class 1 four-channel Svantek SVAN 958AG Sound & Vibration Analysers.

The monitors are enclosed in a weather resistant environmental case which is placed on the ground and covered with a tarp to aid in keeping temperatures below 60°C preventing temperature related failures, and moisture intrusion. Images relating to the installation of the loggers are provided in **Appendix II – Aerial** and **Appendix IV – Site Photographs**.

A summary of the noise and vibration monitoring equipment is provided in **Table 7** below.

**Table 7** Noise and Vibration equipment deployed

Make	Model	Serial Number	Location	Calibrated on	Calibration Due
Svantek	SVAN958AG	98323	005	12/10/2022	12/10/2024
Svantek	SVAN958AG	92835	006	18/02/2022	18/02/2024
Svantek	SVAN958AG	92834	007	09/03/2022	9/03/2024
Svantek	SV-33B	104340	n/a	13/02/2023	13/02/2024

The noise monitoring equipment continuously measures the ambient noise environment’s A-weighted Sound Pressure Level in 15-minute intervals during the daytime, evening, and night-time periods throughout the monitoring period. All equipment carries current National Association of Testing Authorities (NATA) calibration certificates, and the calibration is checked on average once per month to ensure calibration drift does not exceed  $\pm 1$  dB.

The height of the microphone is no less than 1.2 m, and no greater than 1.5 m above ground level. A compliant wind shield is placed on each microphone to reduce any wind interference during the measurements.

### 3.1.1 Analysis methodology

The three environmental noise and vibration loggers are located in relatively close proximity to each other. Legitimate construction noise impacts (such as the operation of graders, excavators, vibratory rollers, water/loading trucks etc) would be measurable at all three loggers with varying noise levels, identified through graphical analysis.

Noise data exceeding the general ambient noise environment (dominated by road traffic noise) are investigated further to determine whether site impact may be present, or extraneous noise data is the dominant source of the alert.

Additional verification is undertaken and the event is disregarded if it cannot be demonstrated that the event occurred as a result of activities conducted on the Site or within the road corridor where roadworks are underway.

Vibration impacts that are also recorded at these locations can be correlated with measured noise impacts particularly where large/heavy plant equipment are in use near the logging devices. Higher than anticipated noise levels and increased vibration energy provides correlative data where plant such as rollers, heavy loaded trucks, graders, piling, excavating, or other vibration intensive plant equipment are within perceptible distances from the devices or sensitive receivers.

The correlation strengthens the confidence in monitoring works impacting the devices and nearby receivers, decreasing erroneous reporting of traffic noise/extraneous noise as site impact.

Weather data is collected from the Australian Weather Station located in Coolangatta (ID 040717) and the measured noise data is correlated with recorded weather conditions which exhibited significantly less than preferred conditions with some days of high wind conditions and precipitation resulting in 17 partial days to be removed from analysis in line with acceptable analysis and reporting exclusion requirements set out in the NPfI and AS1055.

## 3.2 Results

Processed noise monitoring data demonstrates that the ambient noise environment is dominated by road traffic noise compounded by fauna and insect activity.

The data has also shown that construction activities during all phases of the roadworks have had the potential to exceed the lower noise limit at the adjacent sensitive receiver as these works have moved closer to the logger locations as elements of the works progressed.

**Table 8** below presents the overall unattended measurement results during the survey period at each of the three locations.

**Table 8** Unattended noise monitoring results (overall – August 2023)

Logger ID	Measured noise levels, dBA												
	Average noise level (Leq)			L <sub>10,ave</sub> noise level			Background noise levels (RBL)			RNP defined noise level (Leq) <sup>A</sup>			
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day		Night	
										15 hr	1 hr	9 hr	1 hr
L.005	61	54	53	65	57	56	47	39	37	60	62	53	55
L.006	59	55	54	62	59	57	46	39	36	58	60	54	57
L.007	57	53	52	60	56	55	45	39	35	56	58	52	55

Note A: The EPA document Road Noise Policy (RNP, 2011) is used to provide road traffic noise levels for the 15-hour day and 9 hour night-time period, and the busiest daytime/night-time 1-hour. These levels are for historical correlation purposes

The results of the unattended monitoring in August show a substantial decrease in recorded noise intensive works undertaken at both the hospital premises and the road works along Cudgen Road due to works completing at both locations.

Fewer workdays presented data in which noise impacts are recorded at each of the three locations, with the exception of the following dates:

- Monday 7 August
  - Location L.005 measured variable noise levels ranging from 66 dBA Leq to 73 dBA Leq
- Tuesday 8 August
  - Location L.005 measured variable noise levels ranging from 68 dBA Leq to 74 dBA Leq
- Monday 14 August
  - Location L.005 measured variable noise levels ranging from 68 dBA Leq to 71 dBA Leq
- Tuesday 15 August
  - Location L.005 measured variable noise levels ranging from 62 dBA Leq to 71 dBA Leq throughout the whole day
- Wednesday 16 August
  - Location L.005 measured short term noise levels peaking at 78 dBA Leq approximately 11:30 hrs
    - This noise level is correlated with data captured at L.006, noise levels up to 67 dBA Leq

- Monday 21 August
  - Location L.005 measured short term noise levels peaking at 75 dBA Leq approximately 08:30 hrs, and 77 dBA Leq approximately 09:45 hrs
- Wednesday 23 August
  - Location L.005 measured short term noise levels peaking at 73 dBA Leq approximately 08:45 hrs
    - Noise level correlated with data captured at L.006 measuring noise peaking at 65 dBA Leq, and data captured at L.007 noise peaking at 62 dBA Leq
  - This event is likely a noisy pass by from local traffic which produces significant noise levels. Alternatively, this noise event could be Site impact due to operation of large mobile equipment (ie large trucks such as delivery trucks).

ADE reached out to Lendlease for comment during periods of noise levels producing alarms on our cloud systems. As of the preparation of this report we are still awaiting on a reply. As such, we are unaware of the works conducted on site, and are unable to confirm or clarify any of the data presented above and throughout this report.

Daily noise graphs are presented in **Appendix V – Noise Graphs**.

### 3.3 Discussion

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Analysis of the processed noise and vibration data shows that noise impacts have steadily decreased as roadworks have completed. Only minor trade works within the primary hospital footprint are proceeding.

The decrease in overall noise levels is noted, as construction activities for the Cudgen Road upgrade works were scheduled for completion in July to August 2023, heavy plant is no longer required to carry out necessary construction activities described in past monitoring reports.

The impacts noted in this report (ENM49) describes short term but high intensity noise events, likely from the site. These events could be extraneous in nature, and likely related to operation of nearby commercial premise, however ADE have been unable to confirm

Site specific mitigation measures remain necessary at this stage of the works, including the continuation of letterbox drops and community notification. However, implementation of some mitigation measures may not be considered reasonable for works occurring in short durations (<1 hour), that are outlined in this report.

The Noise and Vibration Management Sub-Plan is required to be adhered to at all times until the main works have completed.

## 4 Conclusion

ADE was commissioned by Lendlease to assess the levels of construction related noise during active works on the Tweed Valley Hospital Development Project, located at 771 Cudgen Road, Cudgen in New South Wales.

This report summarises the analysed ambient noise data collected at three locations throughout August 2023, positioned along the south and southwest alignment of Cudgen Road. At the time of preparing this report and the monitoring period in which it covers, CD Civil have completed road works along Cudgen Road, and Lendlease have completed superstructure works with trades remaining on site.

Noise Management Level exceedances (exclusive of existing traffic noise) have been identified. ADE reached out to Lendlease for comment however as of the preparation of this report we are still waiting a reply.

In summary:

- The overall noise levels have shown a decrease in frequency from previous monitoring periods with regards to degree of impact, however remain consistent with the July monitoring periods findings in that:
  - Impact duration is typically no greater than 30 minutes per day as identified in this report (some exceptions apply), and mitigation measures may not be applicable due to the short nature of the potential works at the time of the noise impacts
  - Noise impacts are likely extraneous in nature and may be due to the operation of the nearby commercial premises (including customers), or, heavy plant equipment operating in short duration from the site, for example large loaded delivery trucks
- During standard hours, the Highly Noise Affected criterion is exceeded on two days (16 and 21 August), however we have not been able to receive information from the client to ascertain works on site and correlate this information with our data. For conservative worst-case assessment purposes this report makes the presumption the data we have analysed is from the Site

The projects Noise and Vibration Management Sub-Plan is mandatory to be followed at all times works are underway on the Site.

# Appendix I – Glossary

## 1 Sound Pressure Level

Defined as:

$$L_p = 10 \log_{10} \left( \frac{p^2}{p_{ref}^2} \right) \text{ dB}$$

In the above equation,  $p$  is the sound pressure fluctuation relative to atmospheric pressure, and  $p_{ref}$  is 20 microPascals ( $2 \times 10^{-5}$  Pa), the approximate threshold of hearing.

Sound or noise is the sensation produced at the ear by small fluctuations in atmospheric pressure. Human ears are sensitive to changes to sound pressure over a wide range, from 20 microPascals to 60 Pascals, in lieu of using a linear scale to represent this range, a logarithmic scale is adopted to better handle

## 2 Sound Power Level

Sound power level cannot be directly measured using a microphone, it does not change with distance and is not influenced by atmospheric conditions. The sound power level refers to the total energy of the sound, and is reference to 1 Pico Watt.

## 3 Weighting and Loudness

The overall level of a sound is usually expressed as dB(A) and not dB. Weighting refers to the human ear's frequency response to sound. Typically, sound is measured with an A-weighted filter which reduces the significance of lower frequencies and very high frequencies, increasing the importance of mid-frequencies (500 Hz to 4 kHz), and being a good measure of the "loudness" of a sound.

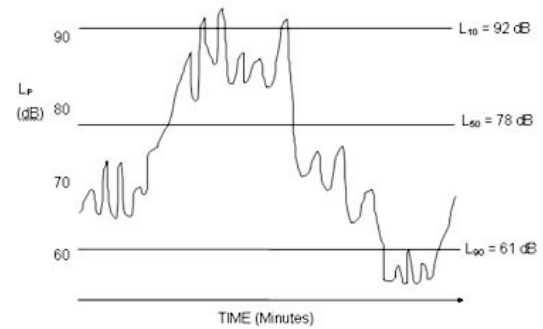
A change of 1 to 2 dB(A) is difficult to detect, whilst a change of 3 to 5 dB(A) corresponds to a small but noticeable change. A 10 dB(A) change corresponds to a doubling or halving in apparent loudness.

## 4 Noise Metrics and Statistical Noise Levels

- i)  $L_{Aeq}$  - The time averaged A-weighted sound pressure level for the interval, as defined in AS1055.1. It is generally described as the equivalent continuous A-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time. It can be considered as the average sound pressure level over the measurement period.
- ii)  $L_{Amin}/L_{Amax}$  - Minimum or Maximum A-weighted noise level detected during the measuring period. It refers to the minimum background noise detected or the maximum  $L_p$  measured.
- iii)  $L_{A90}$  - A-weighted noise level which is exceeded for 90% of the measuring period. It is usually used as

the descriptor for background noise level during the measurement period.

- iv)  $L_{A1}$  - Noise level which is exceeded for 1% of the measurement period.
- v)  $L_{A10}$  - Noise level which is exceeded for 10% of the measurement period. The  $L_{A10}$  is often referred to as the average *maximum* noise level.



## 5 Background Noise

The underlying level of noise present in the ambient noise, excluding the noise source which is under investigation, when extraneous noise is removed.

## 6 Ambient Noise

Ambient noise of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources.

## 7 Vibration

The mechanical oscillations occurring about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random. Vibration is most commonly expressed in terms of displacement, velocity, acceleration and frequency, all of which are related

## 8 Velocity

The rate of change of displacement, is a vector quantity. (Fatigue indicator).

## 9 Acceleration

The rate of change of velocity, is a vector quantity. (Indicator of force).

## 10 Frequency

The number of times a periodic function or vibration occurs or repeats itself in a specified time, often 1 second – cycles per second. Frequency is measured in Hertz.

## 11 Hertz

The unit of frequency or pitch of a sound. One hertz equals one cycle per second.

**12 Peak Particle Velocity (PPV)**

The greatest instantaneous particle velocity during a given time interval if measurements are made in 3-axis. The resultant Peak Particle Velocity (PPV) is the vector sum i.e. the square root of the summed squares of the maximum velocities, regardless of when in the time history those occur.

**13 Root Mean Square rms**

The rms value of a set of numbers is the square root of the average of their squares. Best used when assessing building damage.

**14 Vibration Dose Value VDV**

The Vibration Dose Value (VDV) is used for assessing intermittent vibration. A cumulative measurement of the vibration level received over an 8-hour or 16-hour period. Best used when the structure is occupied.

**15 Logarithmic Scale**

Comparing frequency with large amplitude differences be accomplished using a logarithmic scale. Critical vibration components usually occur at low amplitudes compared to the rotational frequency vibration. These components are not revealed on a linear amplitude scale because low amplitudes are compressed at the bottom of the scale, however a logarithmic scale shows prominent vibration components equally well at any amplitude.

**16 Accelerometer**

A vibration sensor whose electrical output is directly proportional to the acceleration component of the vibration. The two most common accelerometer types are the traditional charge type and the IEPE, integrated electronic piezoelectric type with a built-in line-drive amplifier to enable the output signal to be transmitted over 'longer cable runs'.

**17 Geophone**

Geophones measure velocity by means of a magnetic core surrounded by an electrical coil. When the surface vibrates, the geophone housing moves however the coil stays stationary, thus the movement of the magnet in the coil causes an electrical current which is calibrated to velocity of vibration.

**18 Short-term vibration**

Vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated.

**19 Long-term vibration**

All types of vibration not covered by the definition of 'short-term vibration'

**20 Impulsive vibration**

Rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration. It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short (typically <2 seconds). Impulsive vibration (no more than 3 occurrences) in an assessment period is

assessed on the basis of weighted rms acceleration, and peak particle velocity.

**21 Continuous vibration**

Continuous vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms acceleration.

**22 Intermittent vibration**

Defined as interrupted periods of continuous (e.g., a drill) or repeated periods of impulsive vibration (e.g., a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources (e.g., pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce Continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by). This type of vibration is assessed on the basis of vibration dose value.



## Appendix II – Aerial Imaging

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ADE Monitoring locations, site location (including CD Civil's Cudgen Road Upgrade works) are presented below.



C:\Users\David.O'Brien\ADE Consulting Group Pty Ltd\ENM-Working - A101021.0286.Land Lease Tweed Hospital\GIS\A101021.0286.0.0 TVH Environmental Monitoring.gaz

0 100 200 m  
 Tweed Valley Hospital Development Project  
 Environmental Noise, Vibration, and Dust Monitoring  
 Location Overview  
 Image: Nearmaps | Scale 1:4500 | GDA 1994 Zone 56

**Legend**  
 - - Roads  
 ■ Cudgen Road Upgrade Works Locations  
 ◆ Loggers  
 ■ Tweed Valley Hospital Development Project

## Appendix III – References

Standards, policies, and guidelines used for the assessment of noise are as follows:

- ADE Group Consulting Pty Ltd – Cudgen Road Upgrade Construction Noise and Vibration Impact Statement, Prepared for CD Civil, Version 1.0, 6 September 2022 (ADE Reference A103022.1044.00)
  - Addendum Version 1.1, 3 April 2023
- AS 1055:2018 Acoustics – Description and measurement of environmental noise
- AS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors
- AS 2659.1-1998 Guide to the use of sound measuring equipment – Portable sound level meters
- Development Consent SSD-10353, Department of Planning, Industry and Environment – Tweed Valley Hospital Stage 2 – 12 July 2020 (approval)
- Interim Construction Noise Guideline (ICNG, NSW Department of Environment and Climate Change DECC, 2009)
- Noise Policy for Industry (NPfi, EPA 2017)
- Transport for New South Wales Construction Noise and Vibration Strategy (TfNSW, 2019)
- Tweed Valley Hospital Management Plan – Noise and Vibration, Revision 7.0, Lendlease Building Pty Ltd
  - Tweed Valley Hospital – Noise and Vibration Impact Assessment for State Significant Development (SSD), SVM-2370, Revision: Issue 2, 17 October 2018 – Acoustic Studio

## Appendix IV – Site Photographs

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Photograph 1 Representative photograph of monitoring location 007 – Residential, as observed 17/04/2023



Photograph 2 Representative photograph of monitoring location 005 – Solar Industry, as observed 17/04/2023

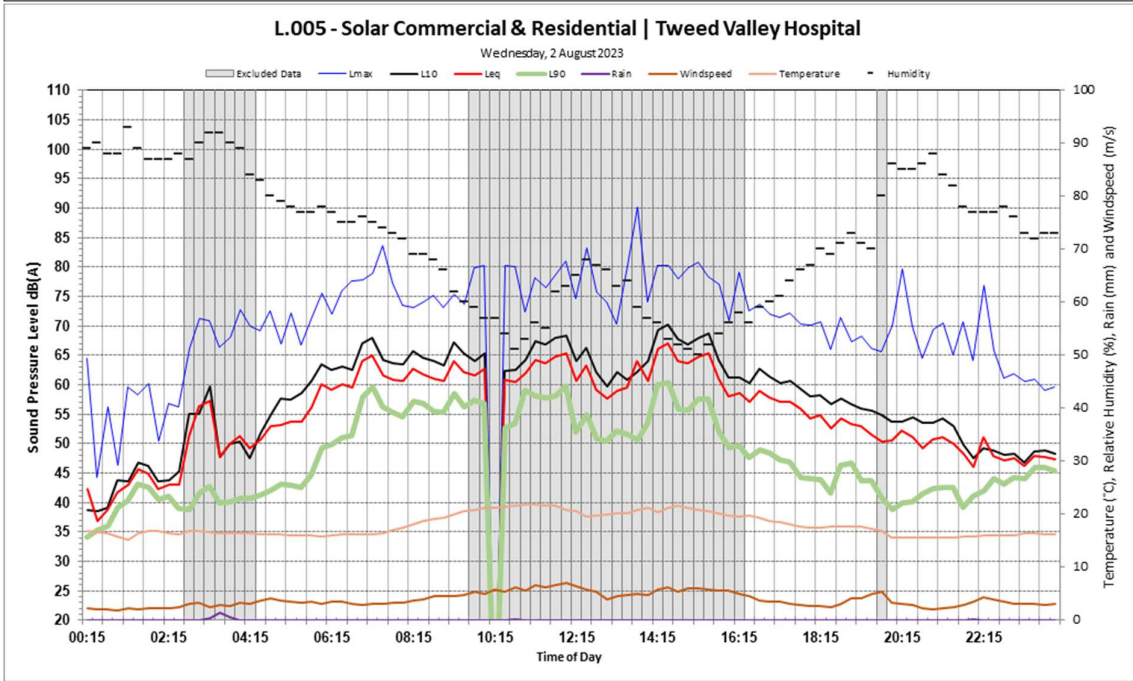
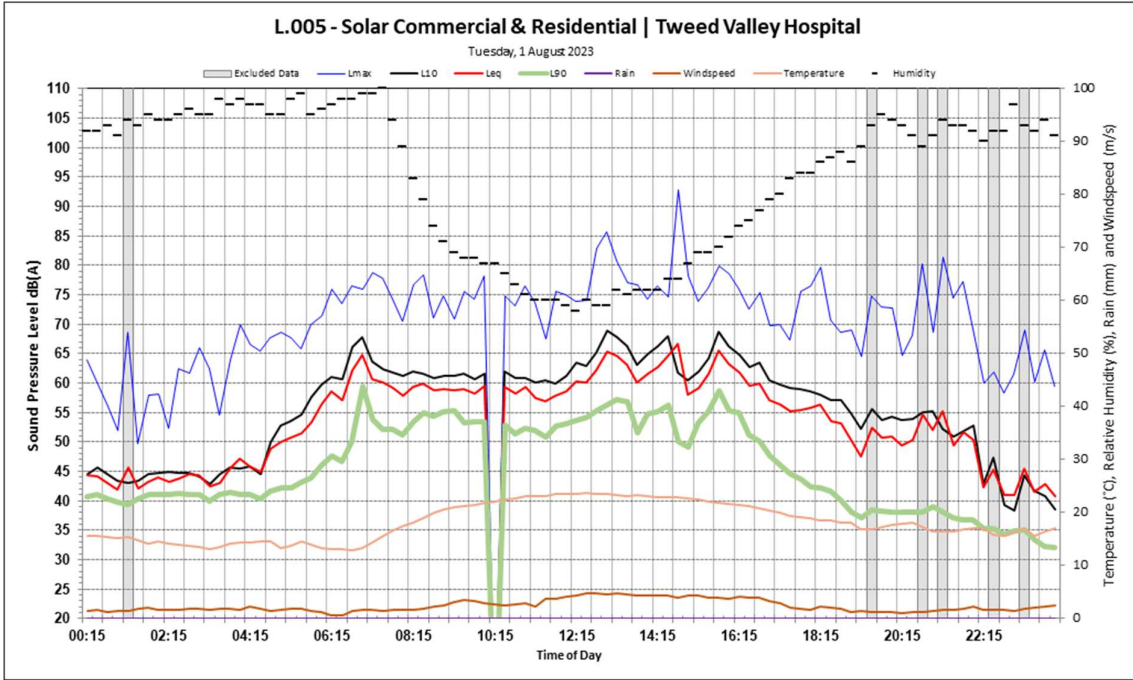


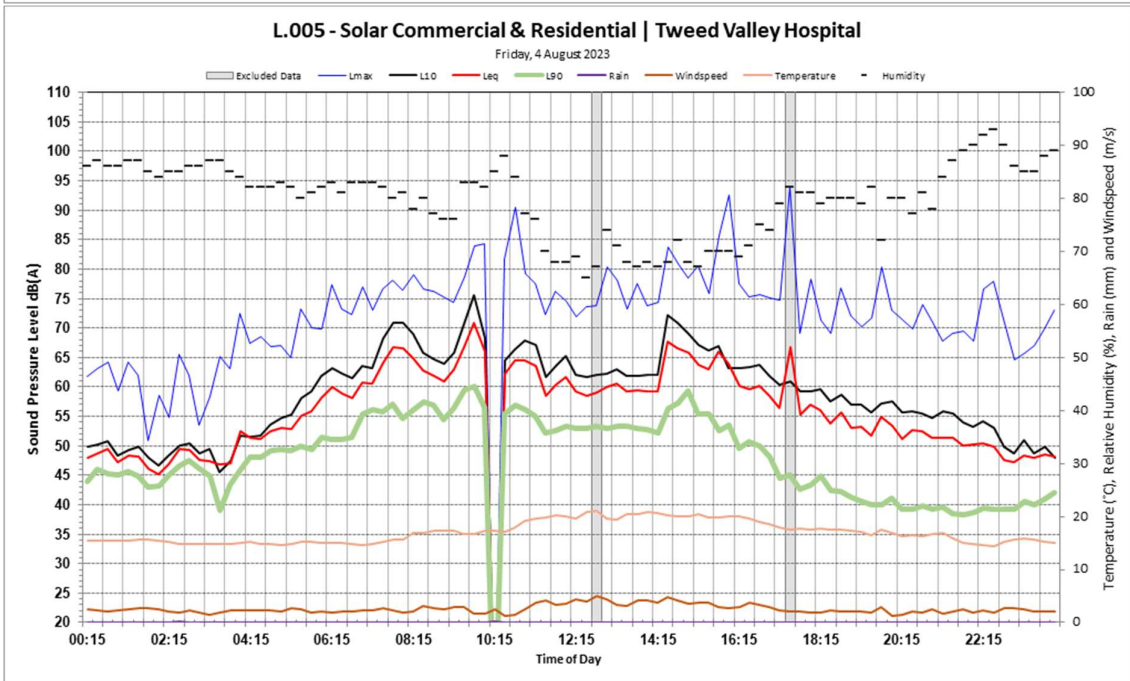
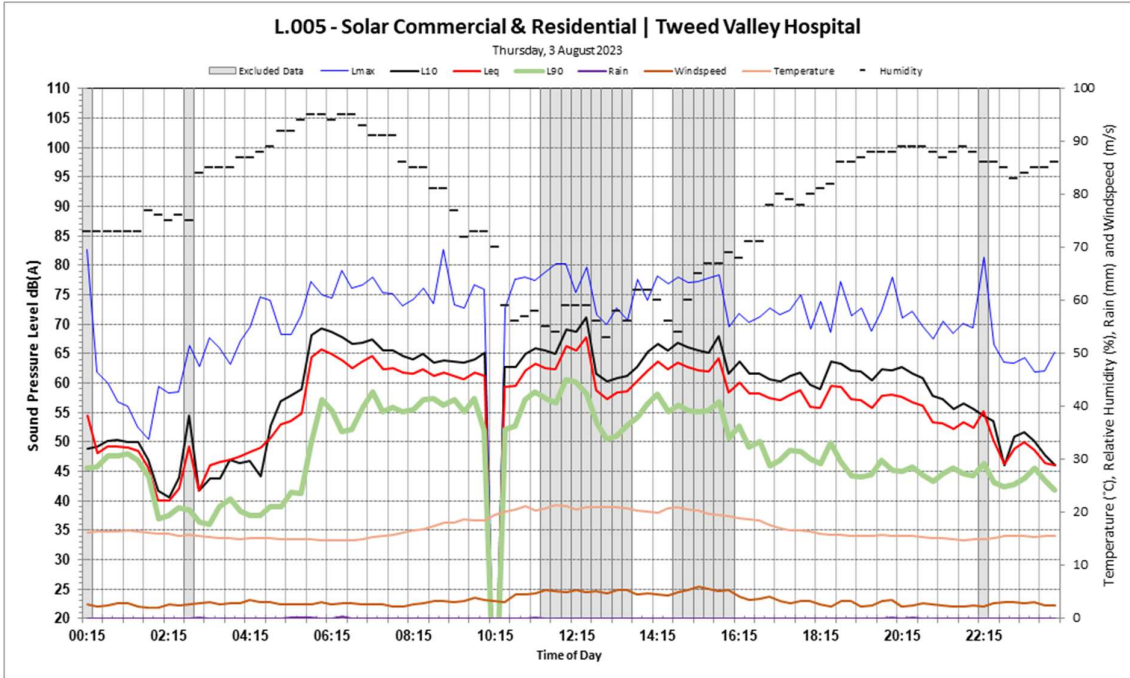
Photograph 3 Representative photograph of monitoring location 006 – Mate and Matts, as observed 17/04/2023

## Appendix V – Noise Graphs

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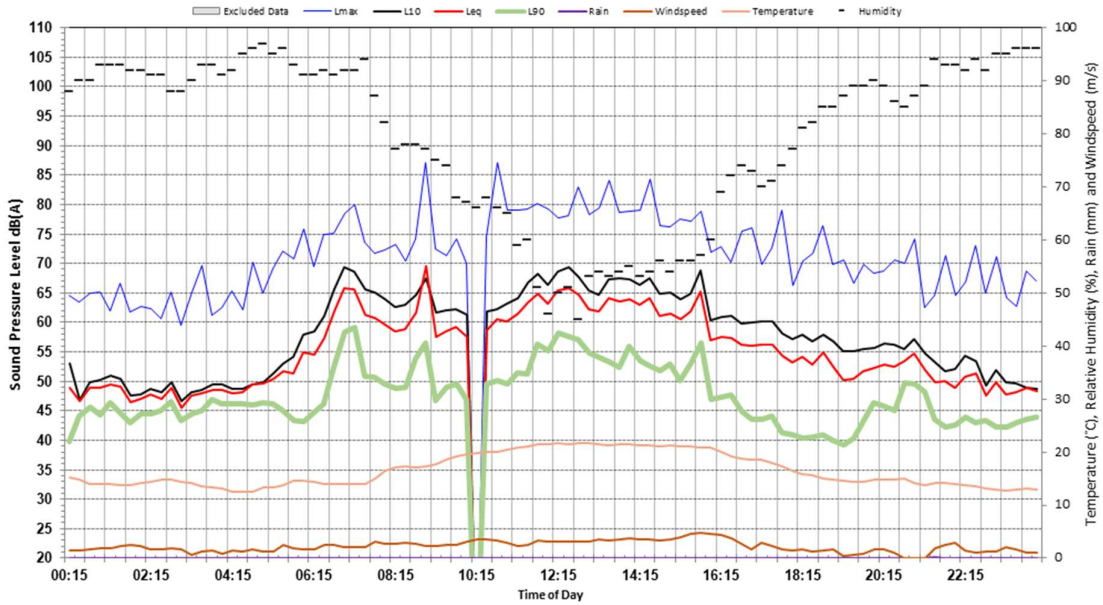






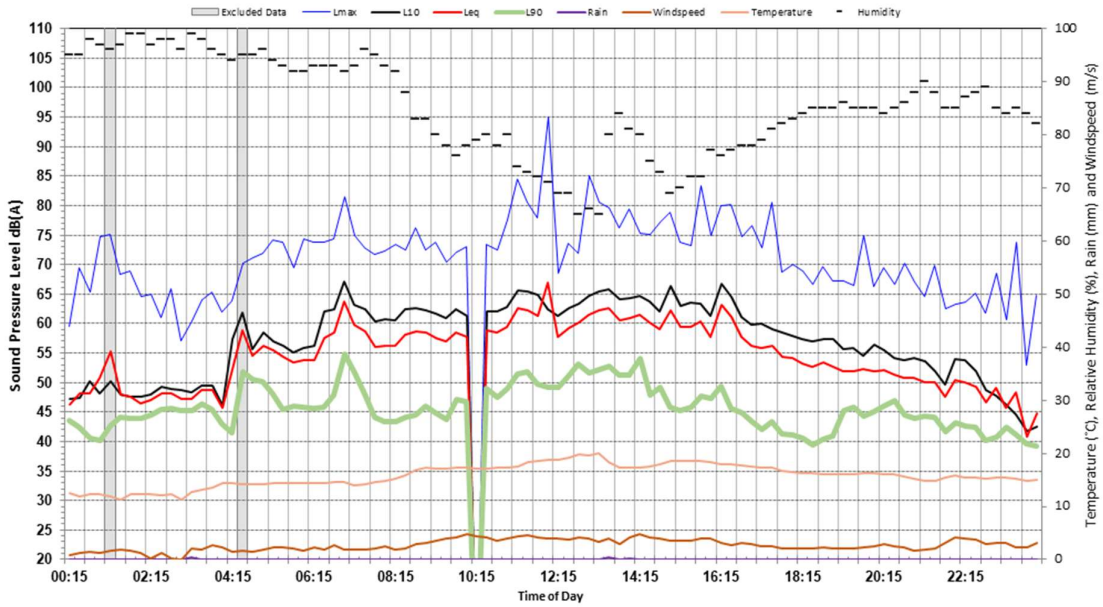
### L.005 - Solar Commercial & Residential | Tweed Valley Hospital

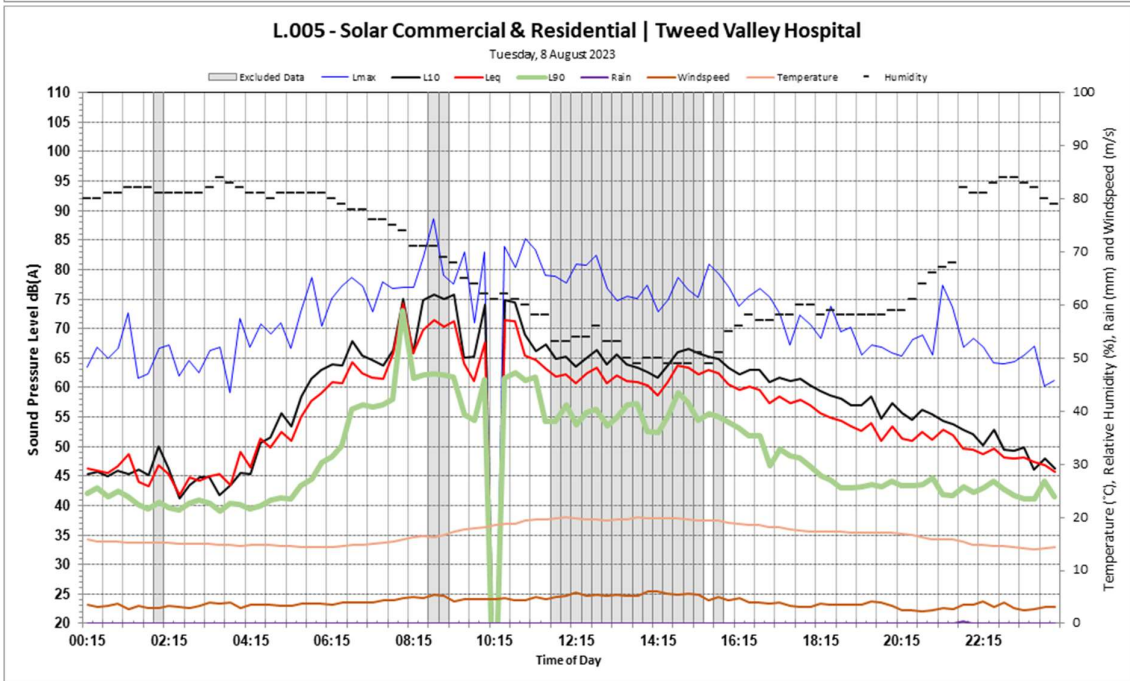
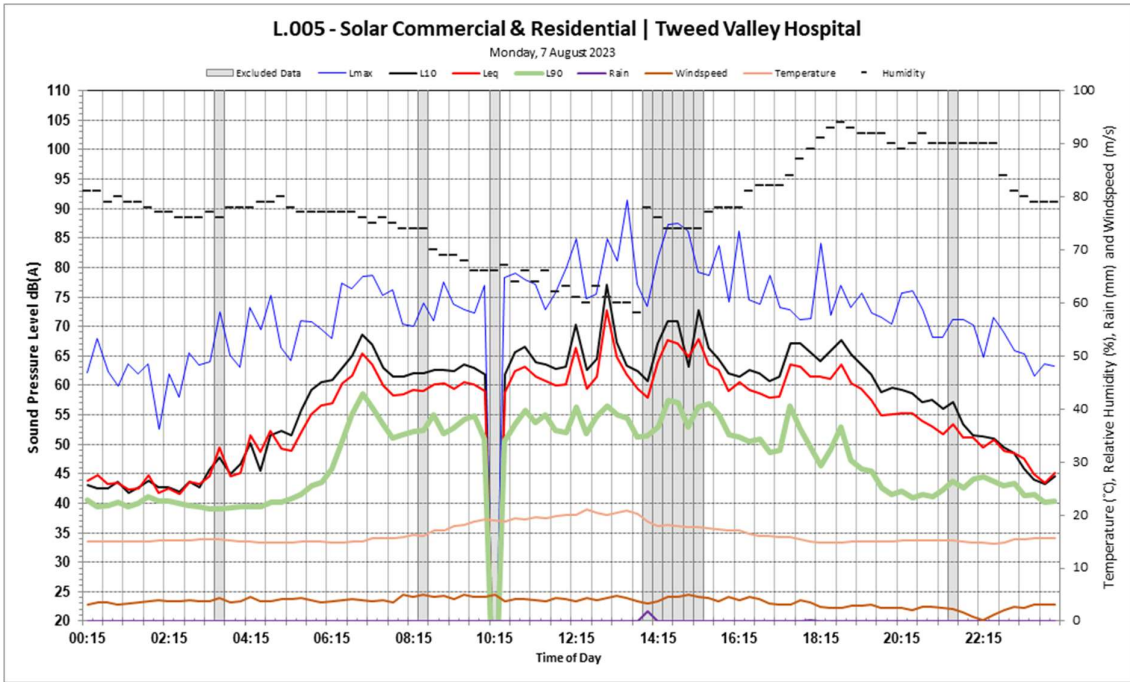
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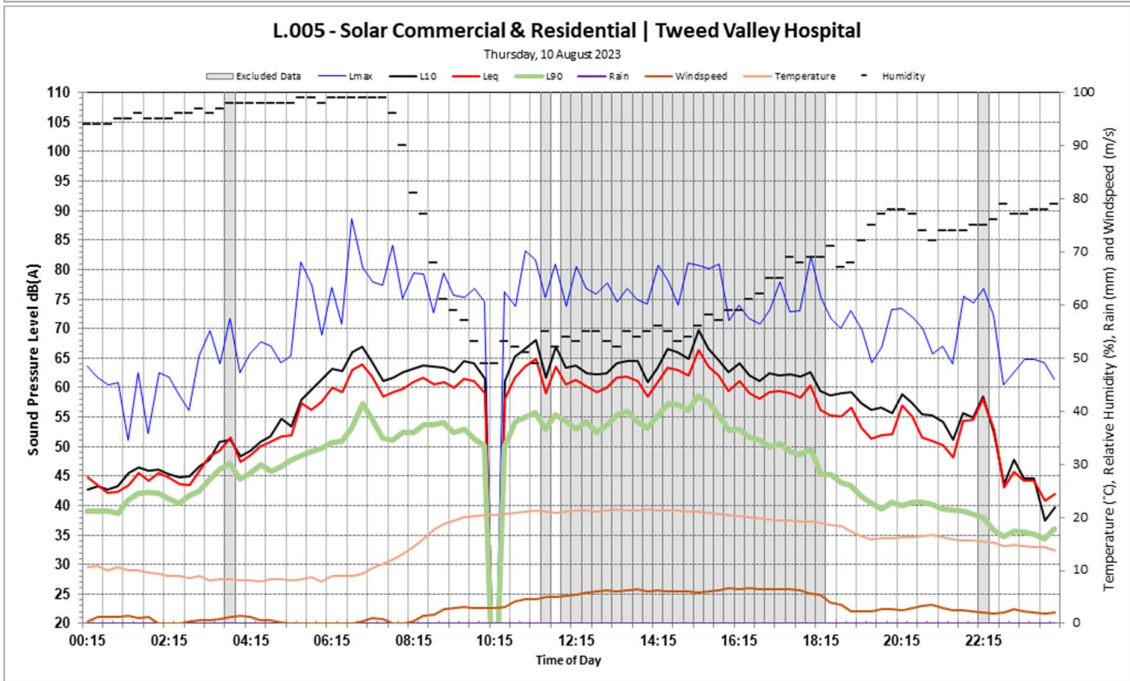
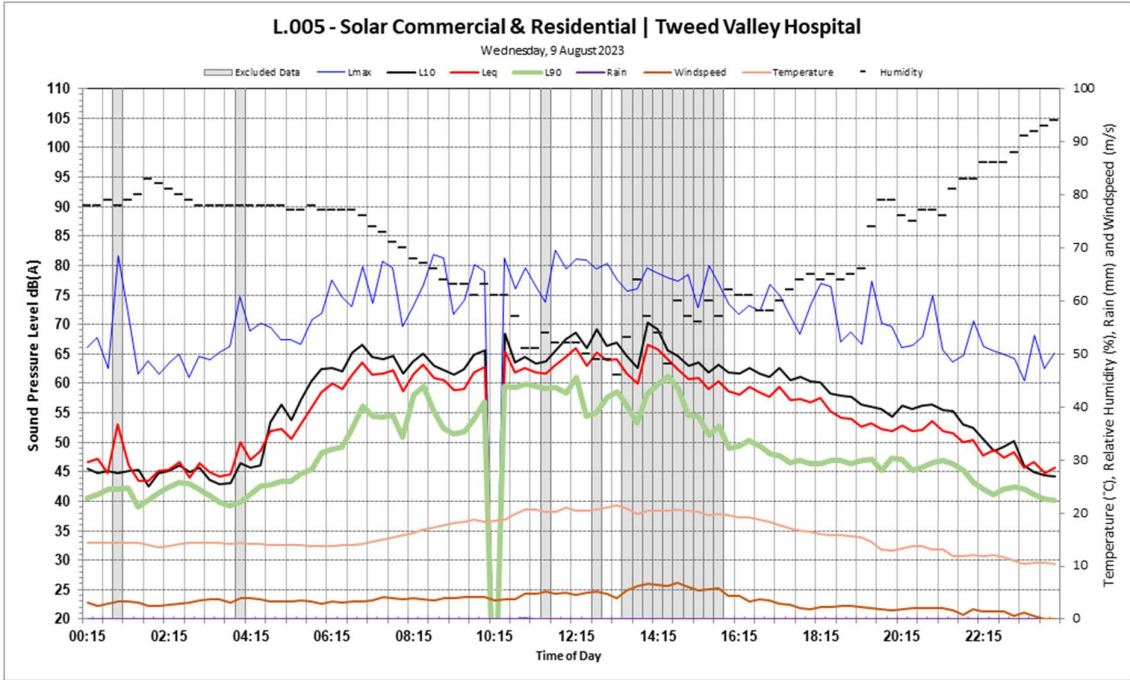


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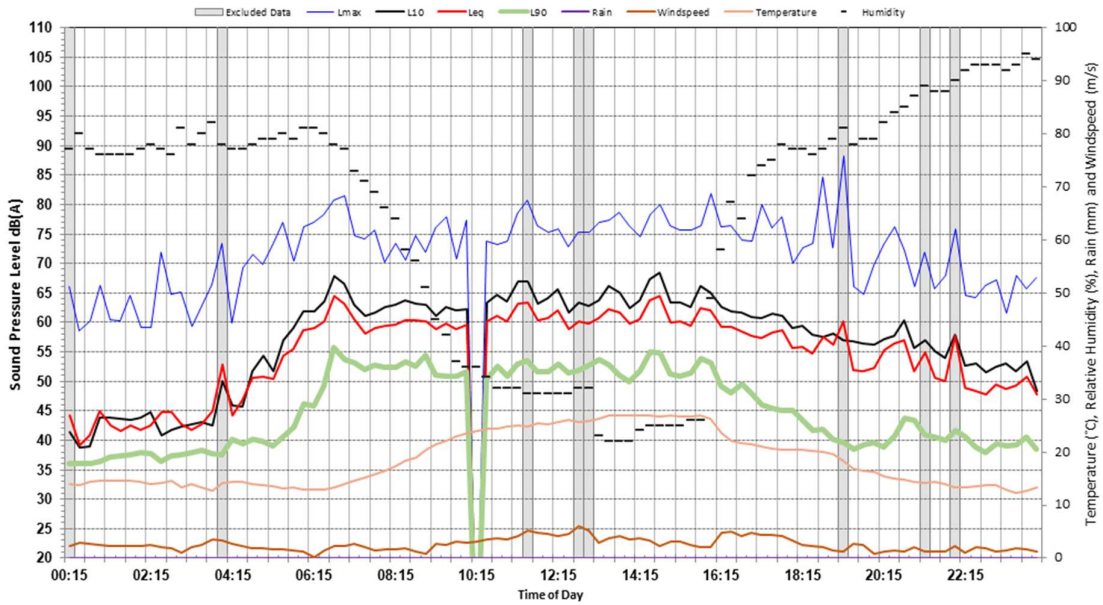






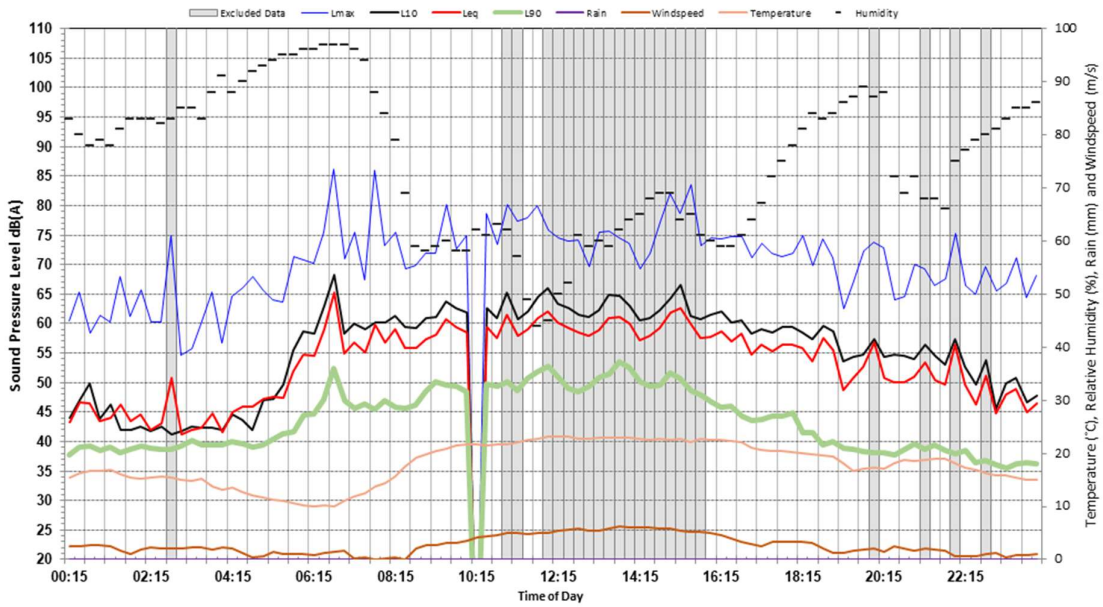
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Friday, 11 August 2023



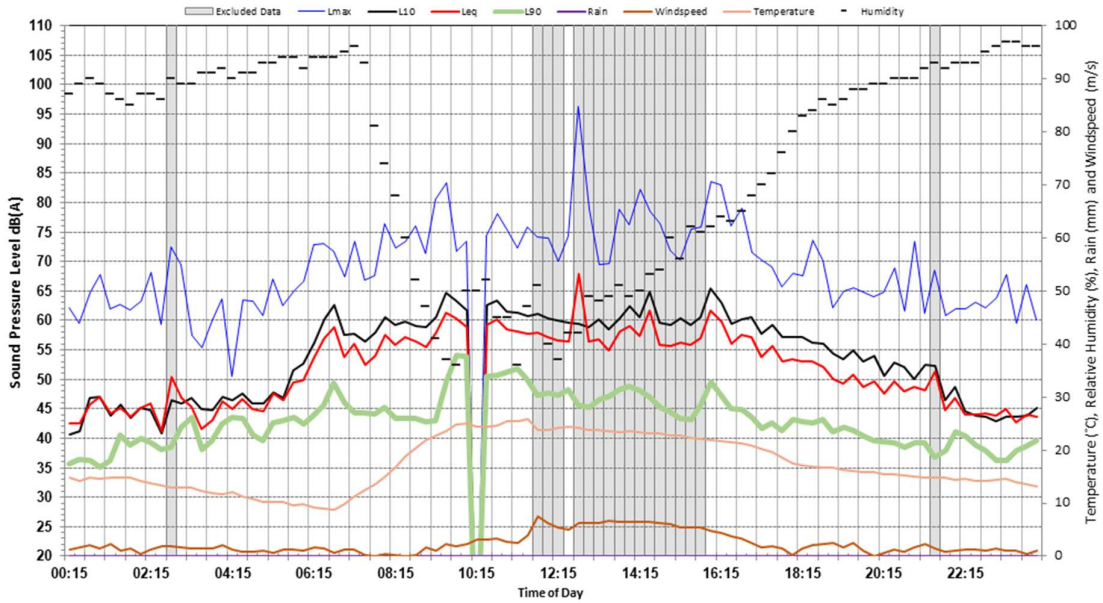
### L.005 - Solar Commercial & Residential | Tweed Valley Hospital

Saturday, 12 August 2023



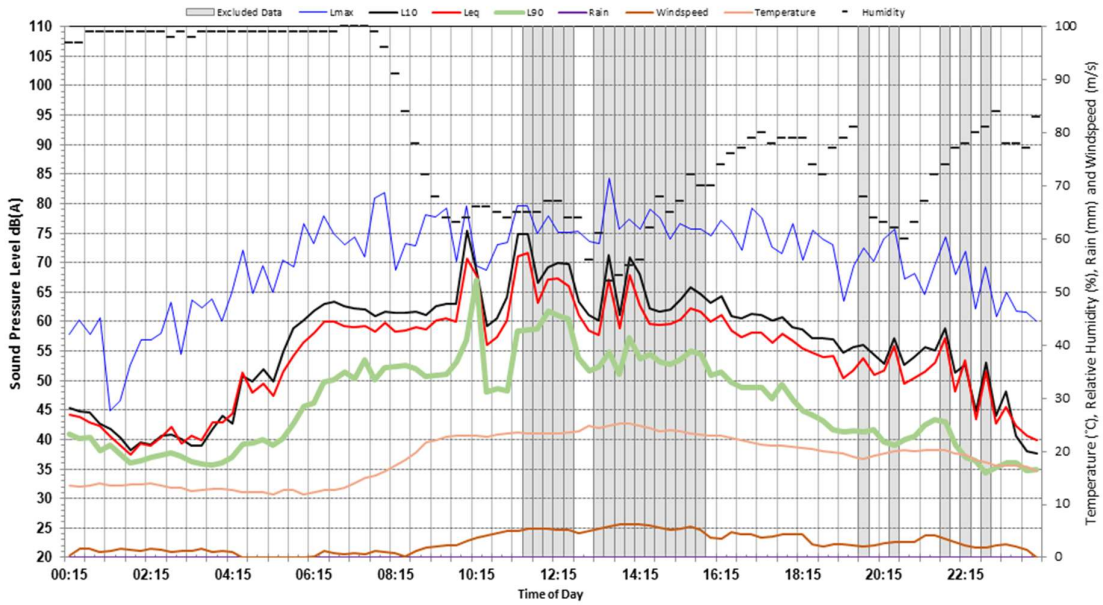
### L.005 - Solar Commercial & Residential | Tweed Valley Hospital

Sunday, 13 August 2023



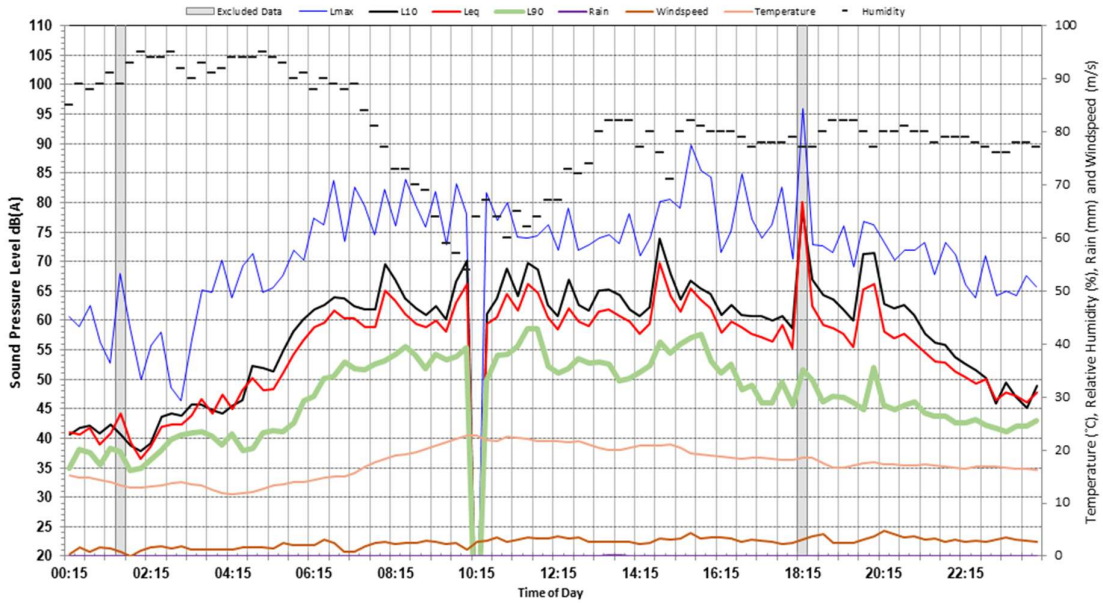
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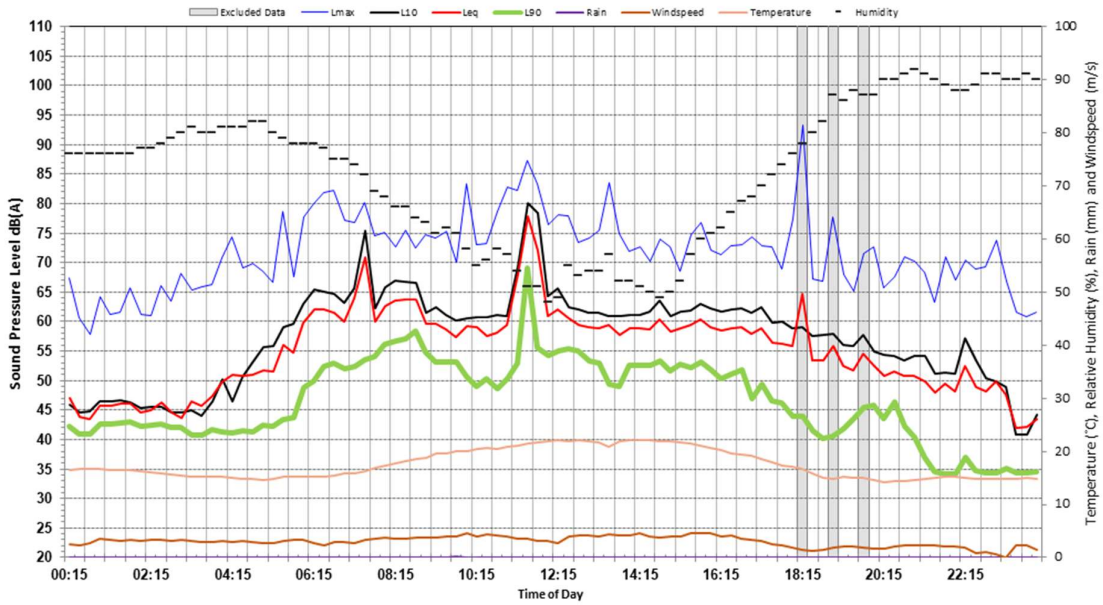
### L.005 - Solar Commercial & Residential | Tweed Valley Hospital

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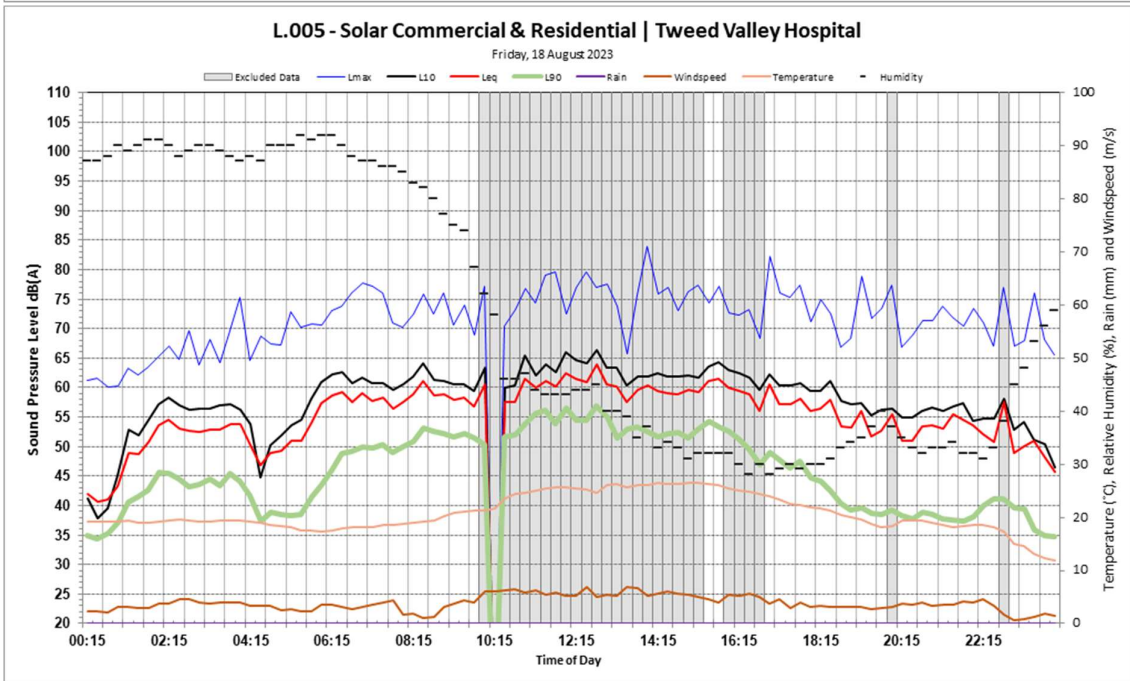
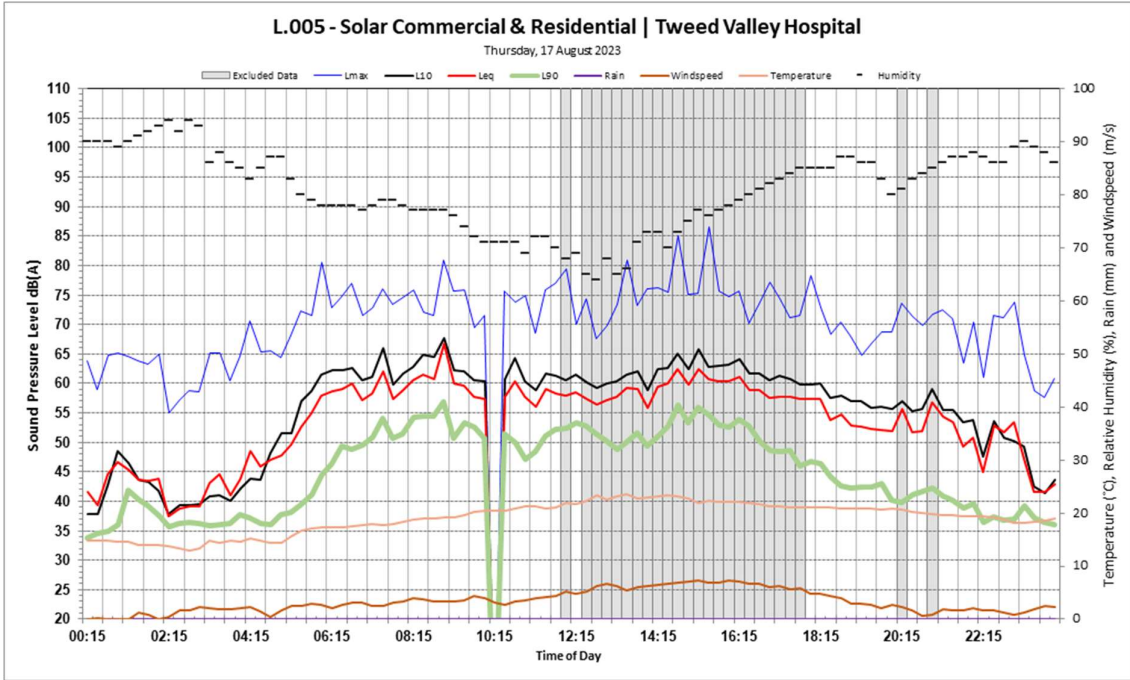


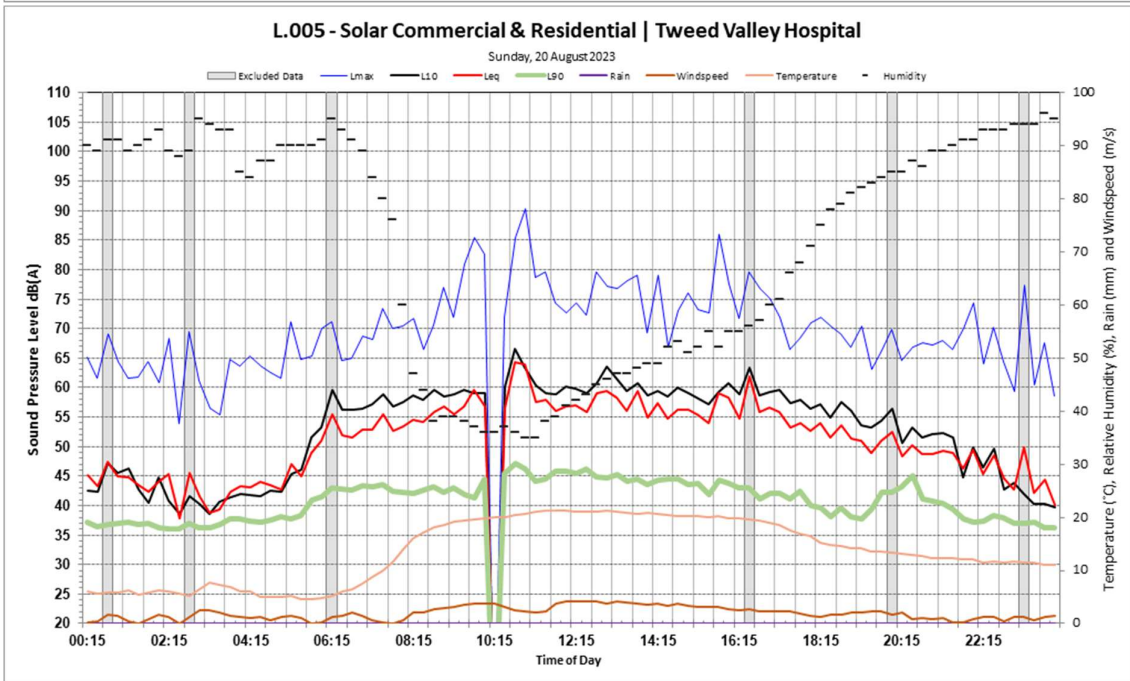
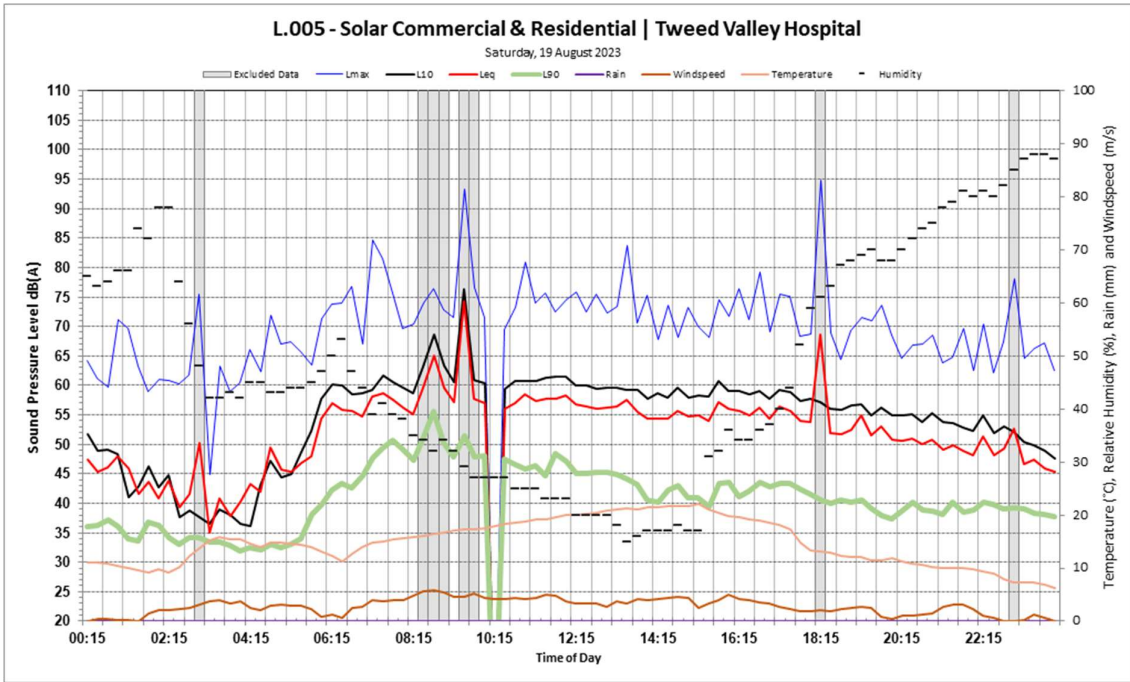
### L.005 - Solar Commercial & Residential | Tweed Valley Hospital

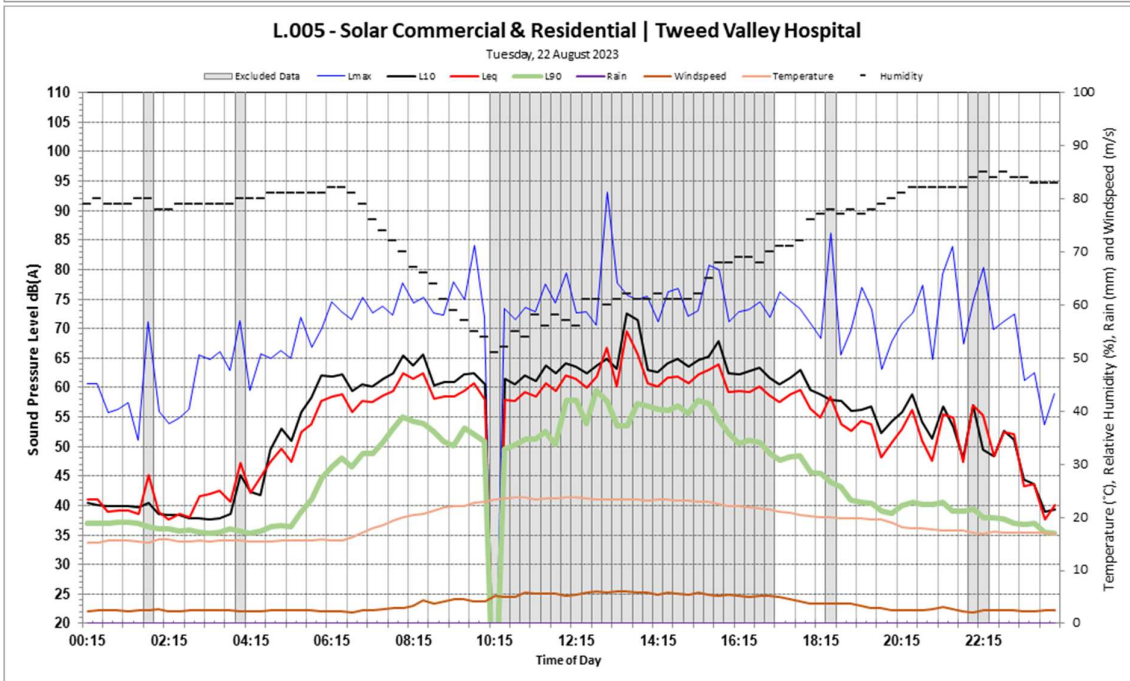
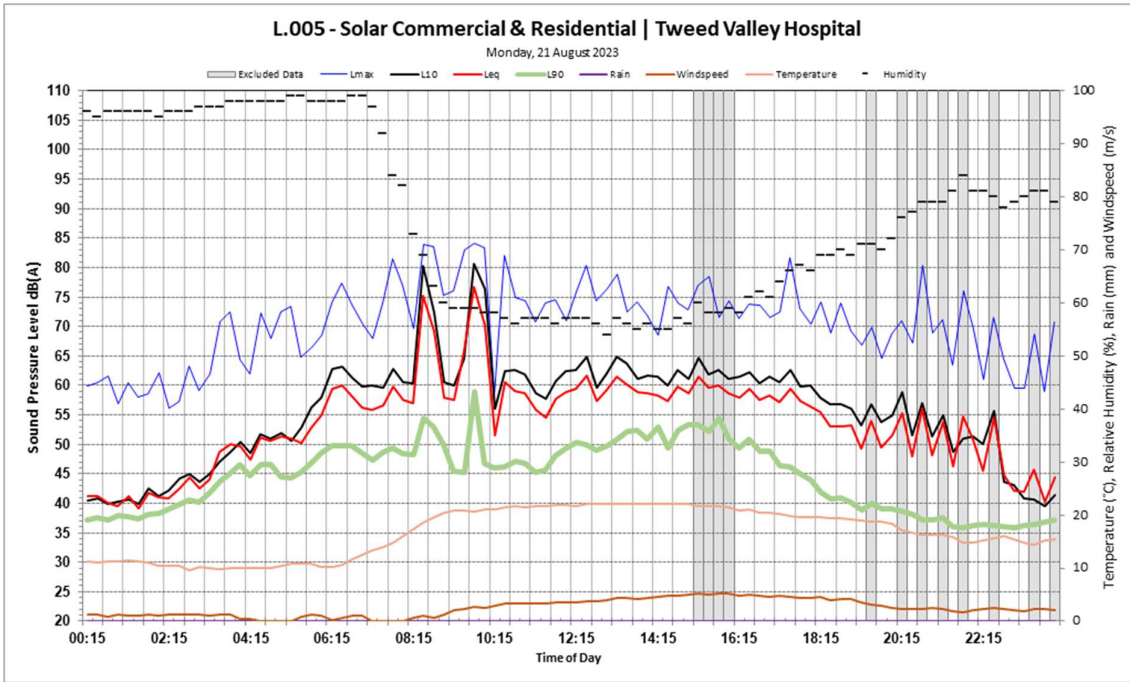
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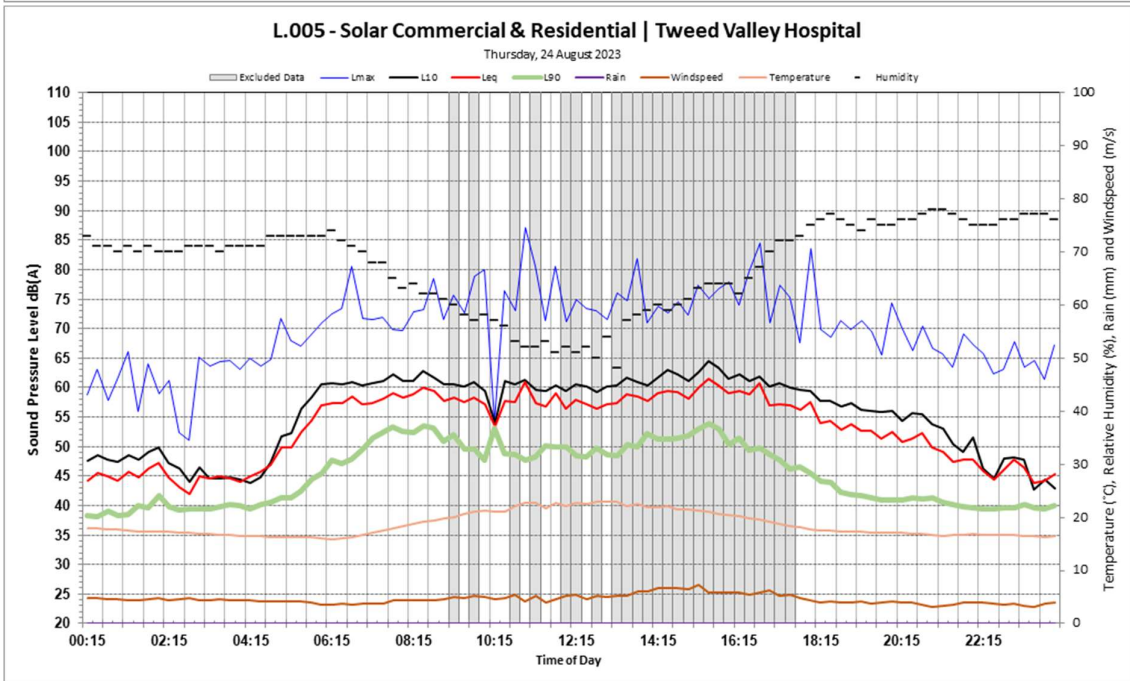
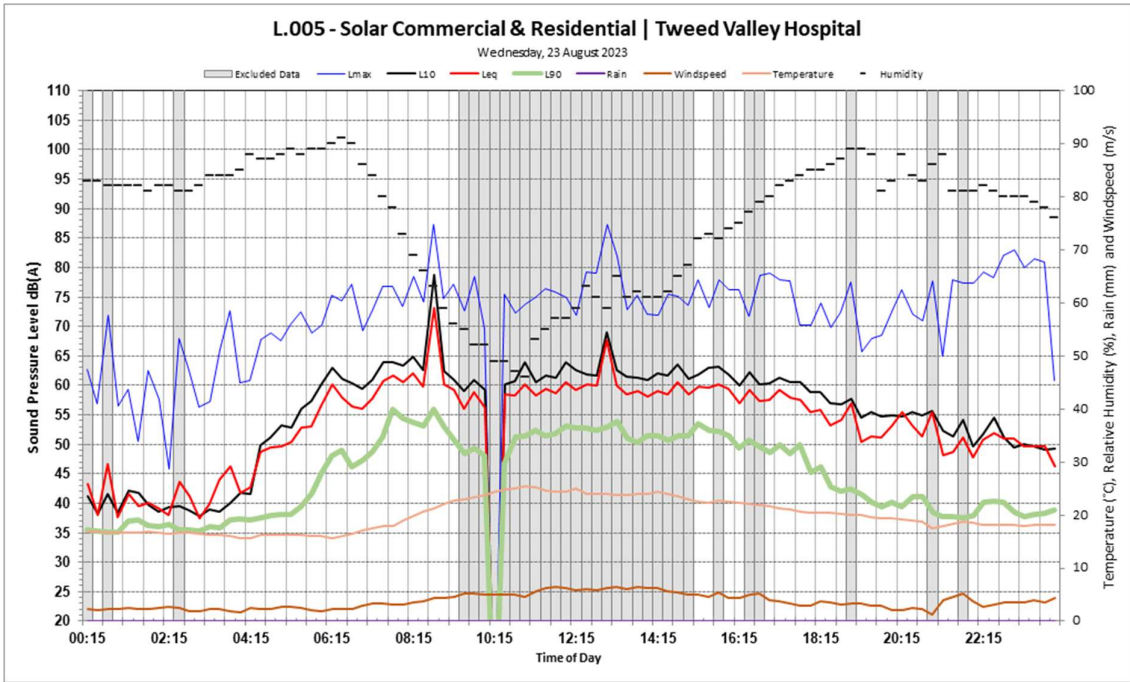


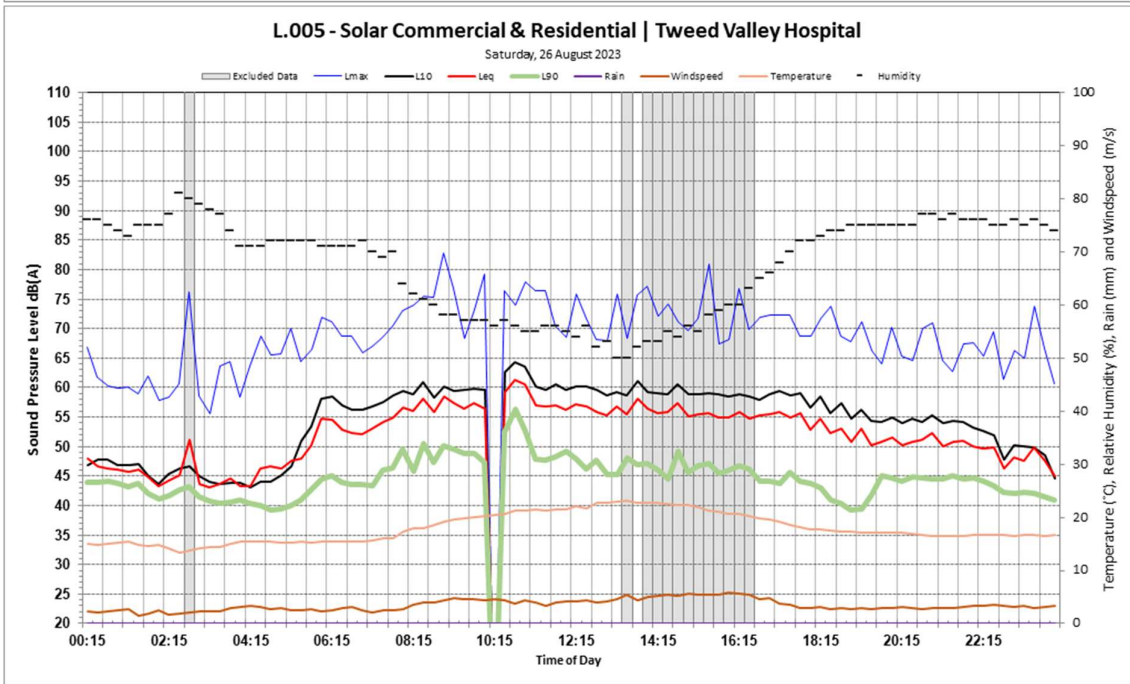
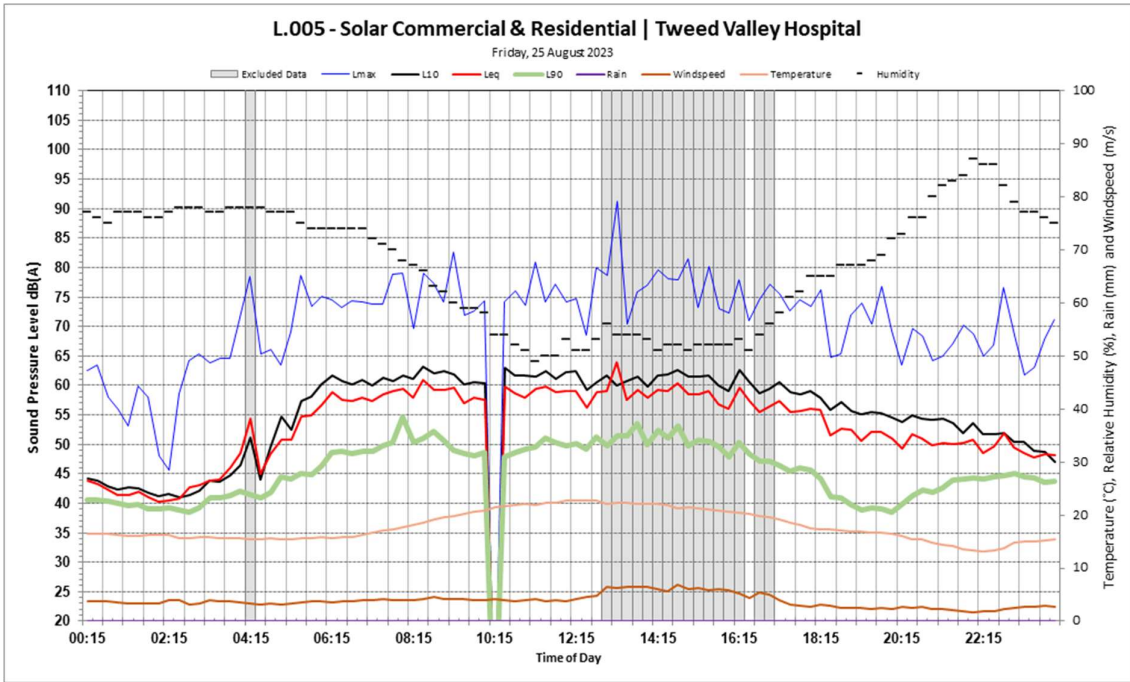


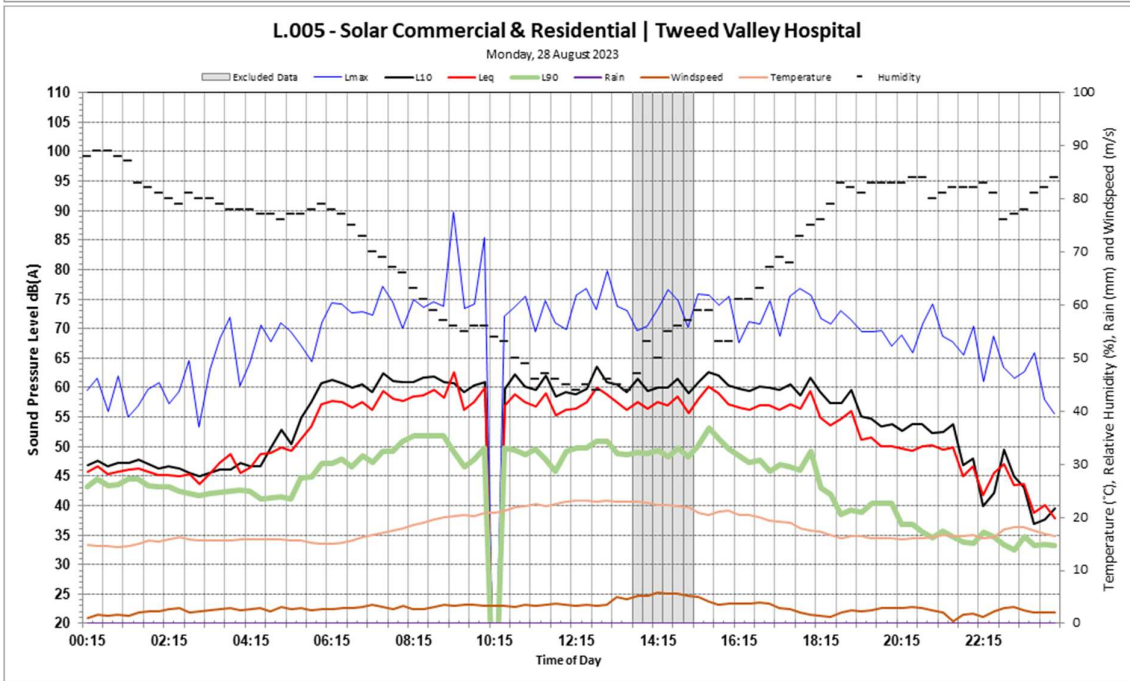
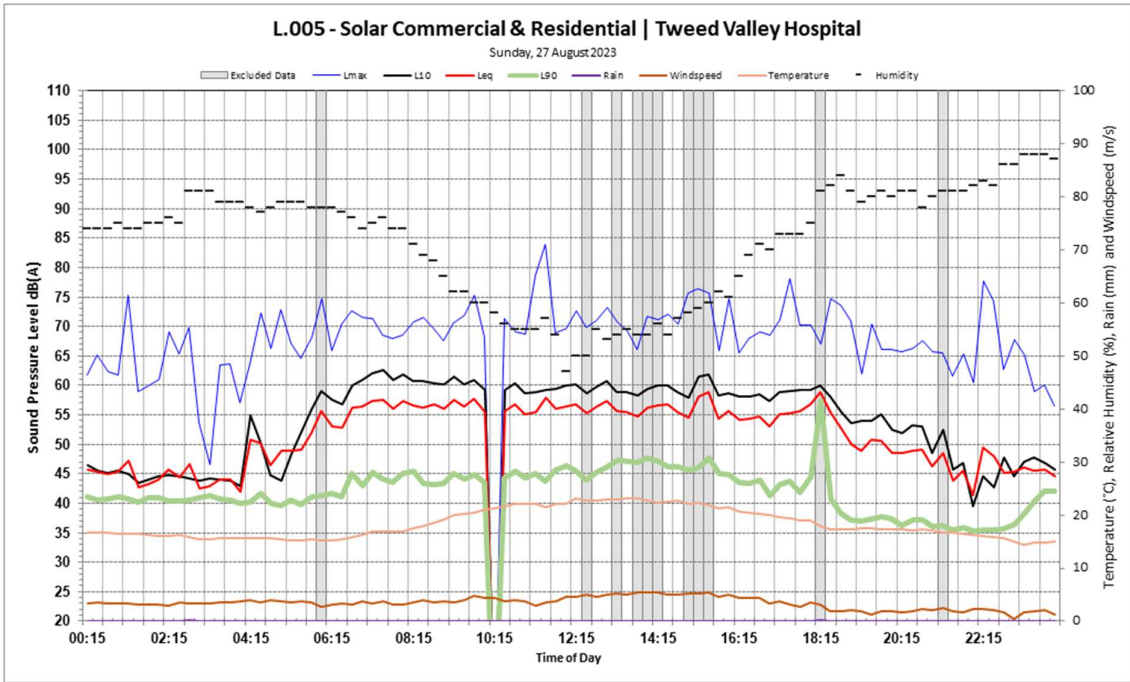


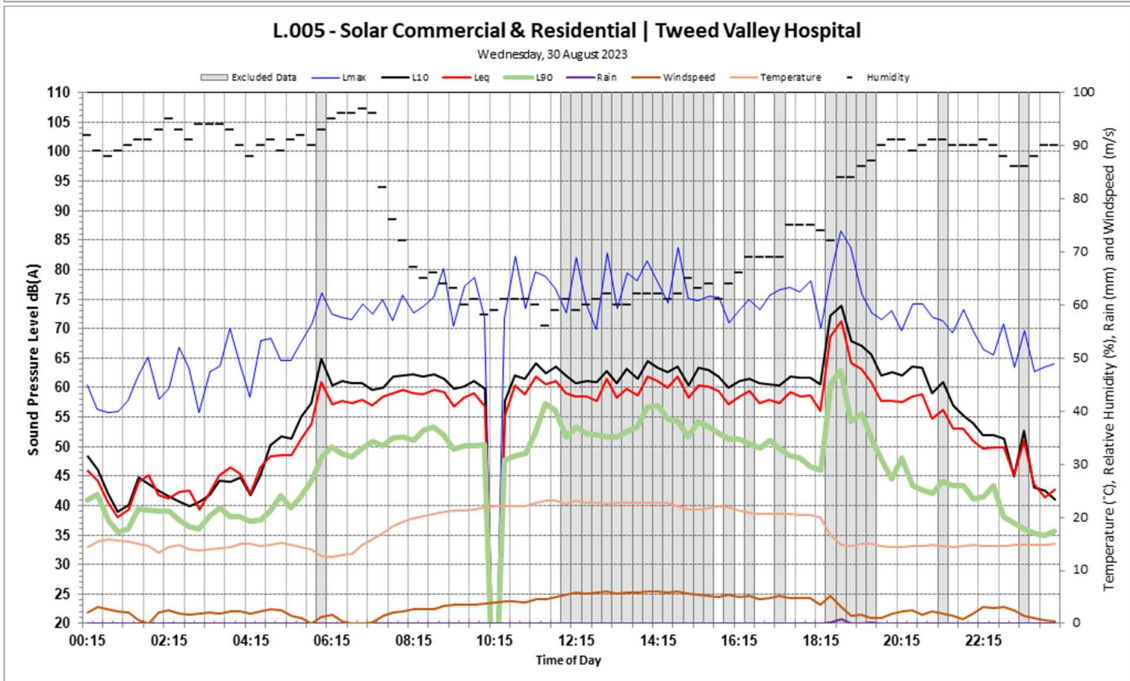
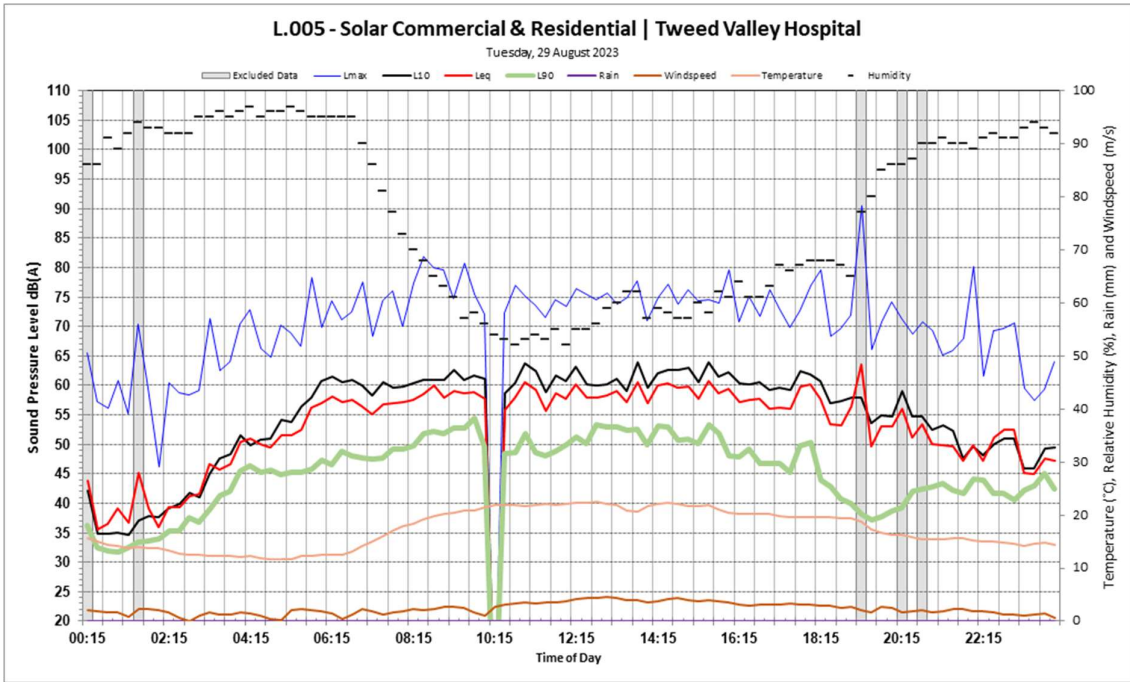






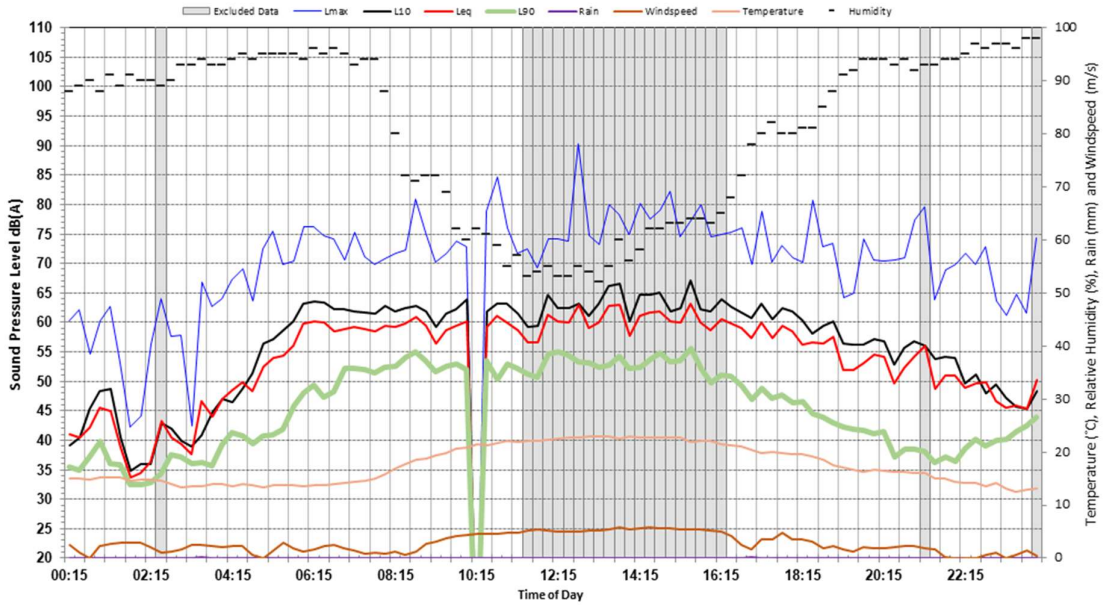




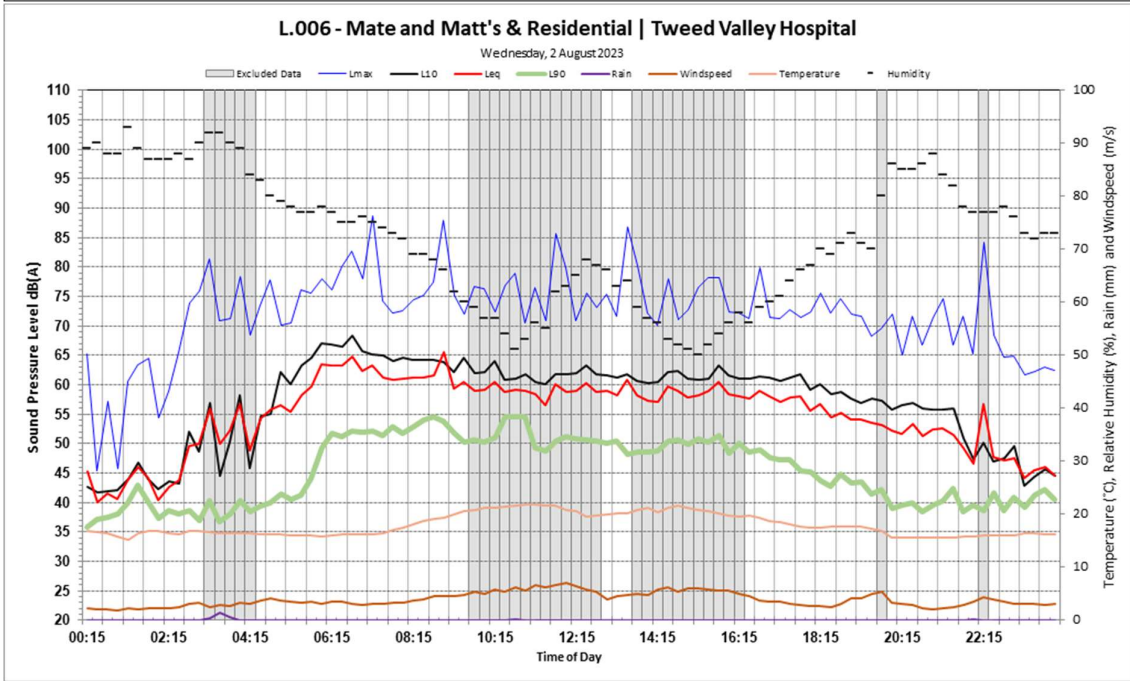
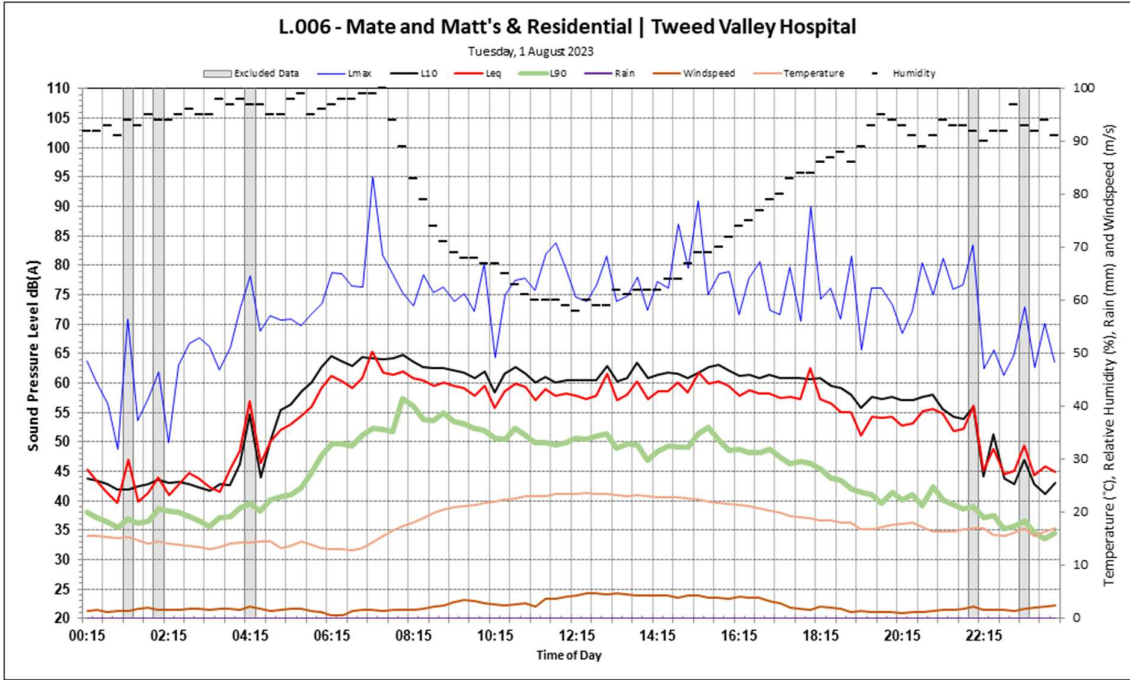


# L.005 - Solar Commercial & Residential | Tweed Valley Hospital

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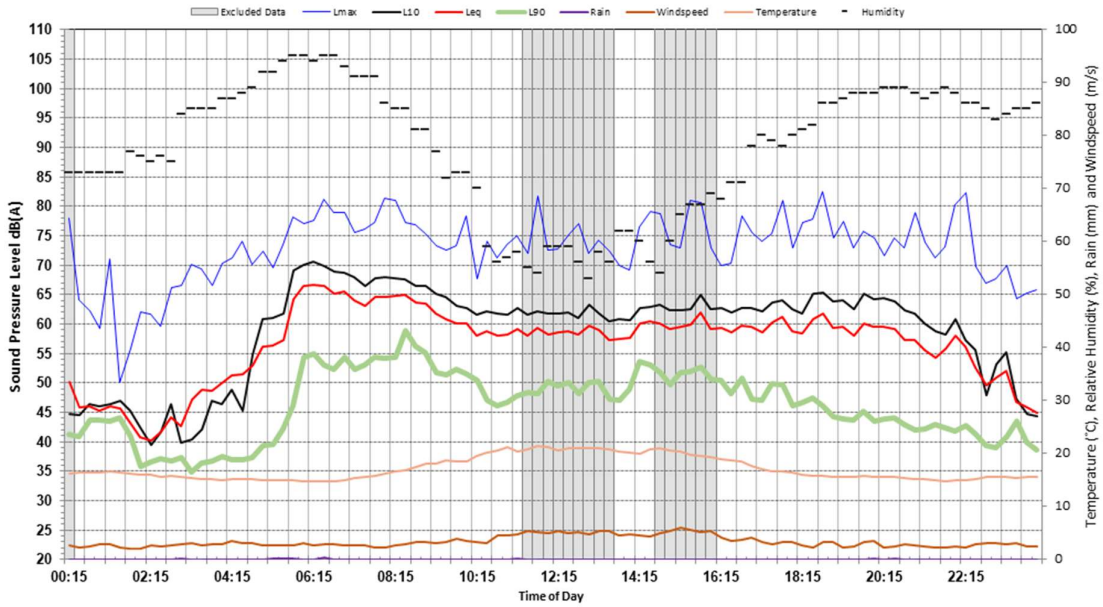






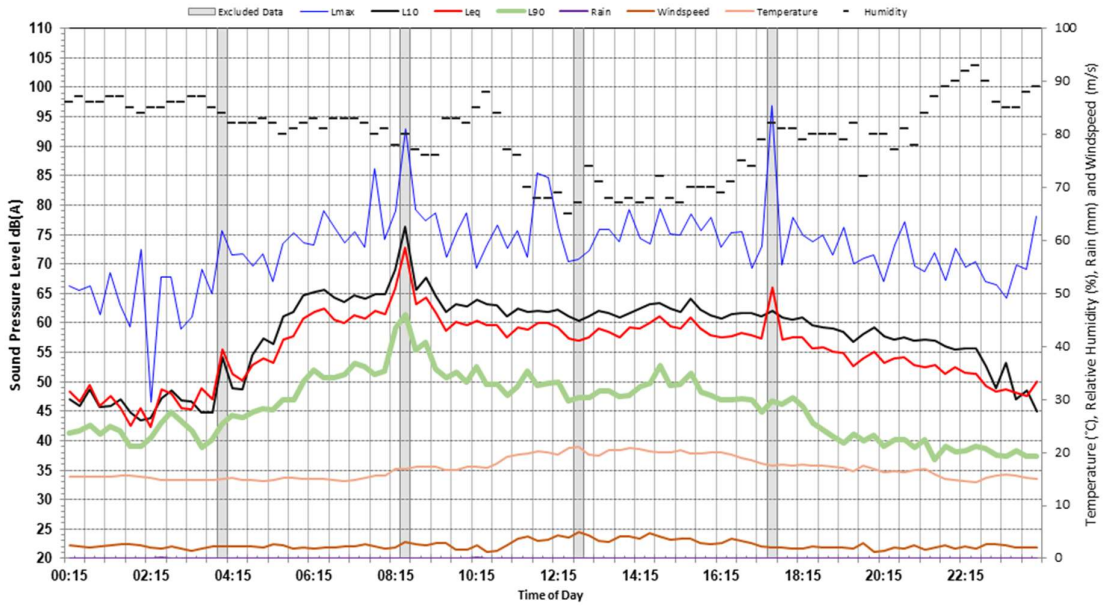
### L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

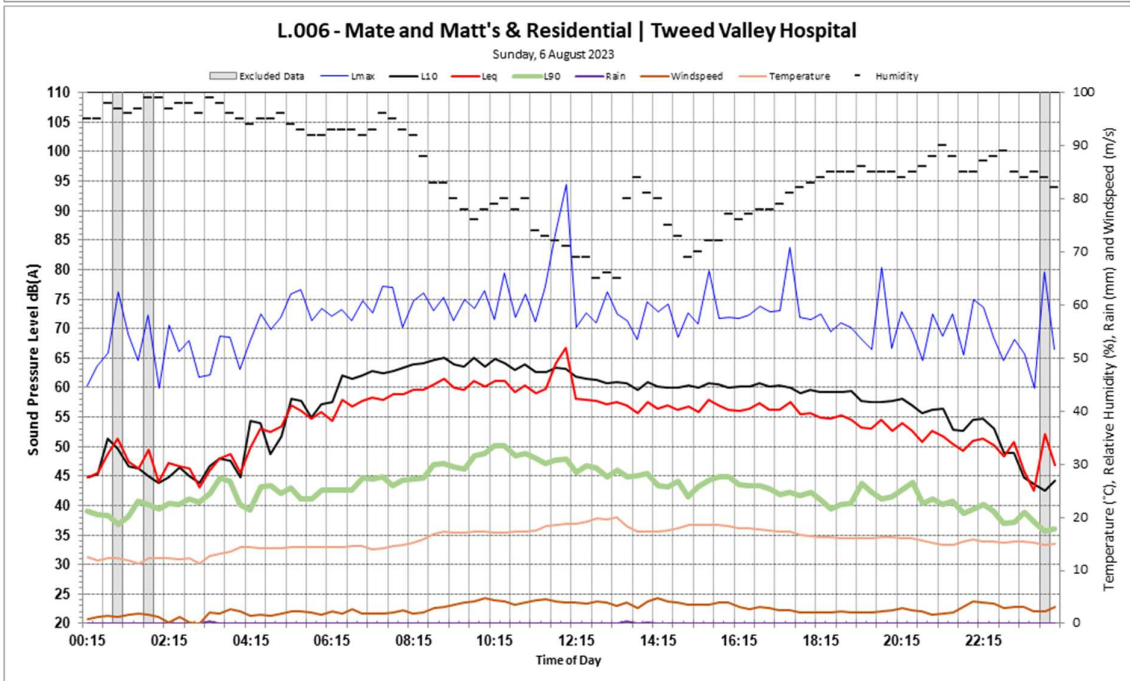
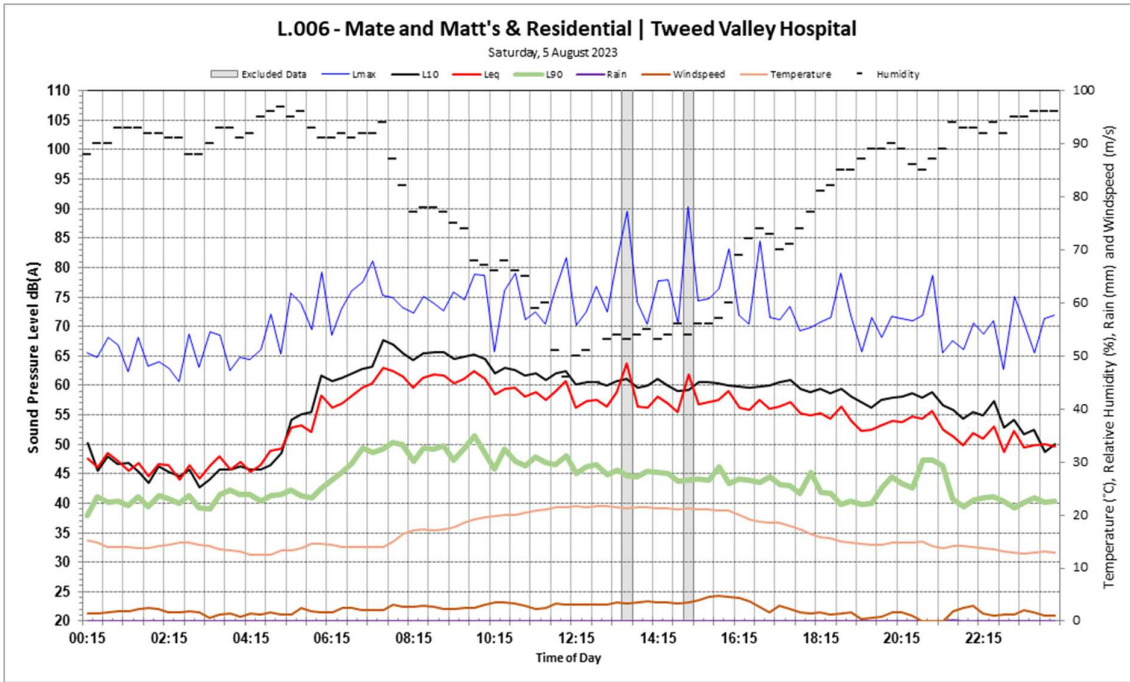
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### L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

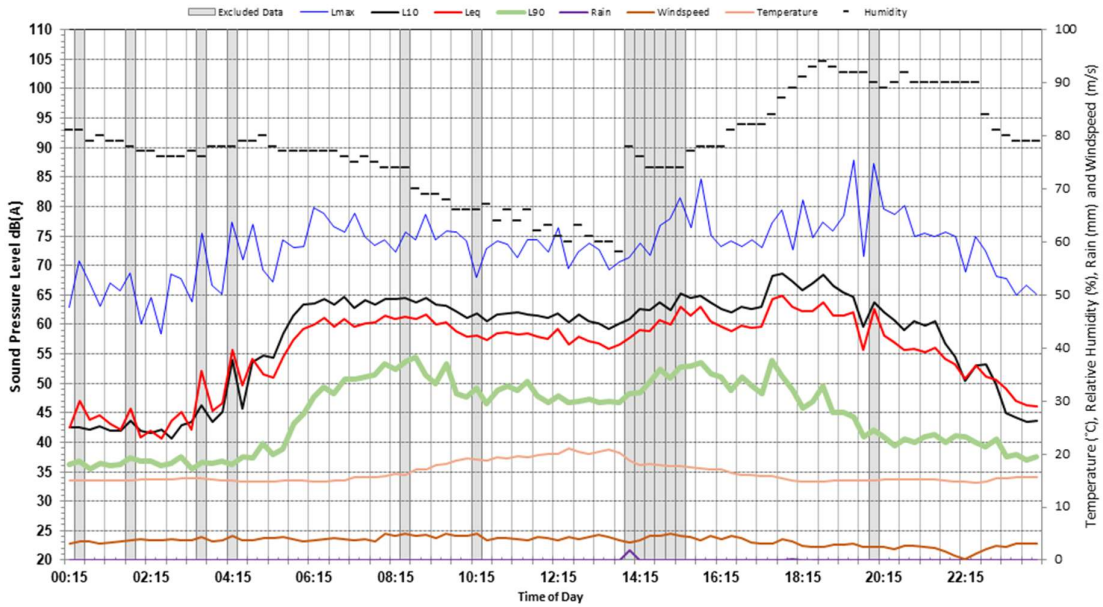
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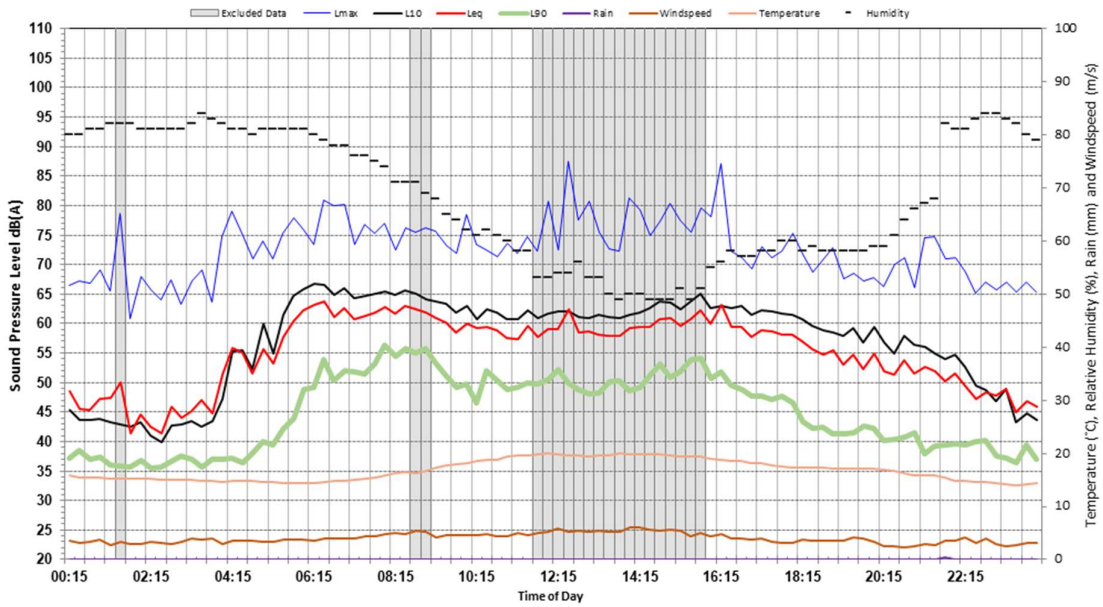
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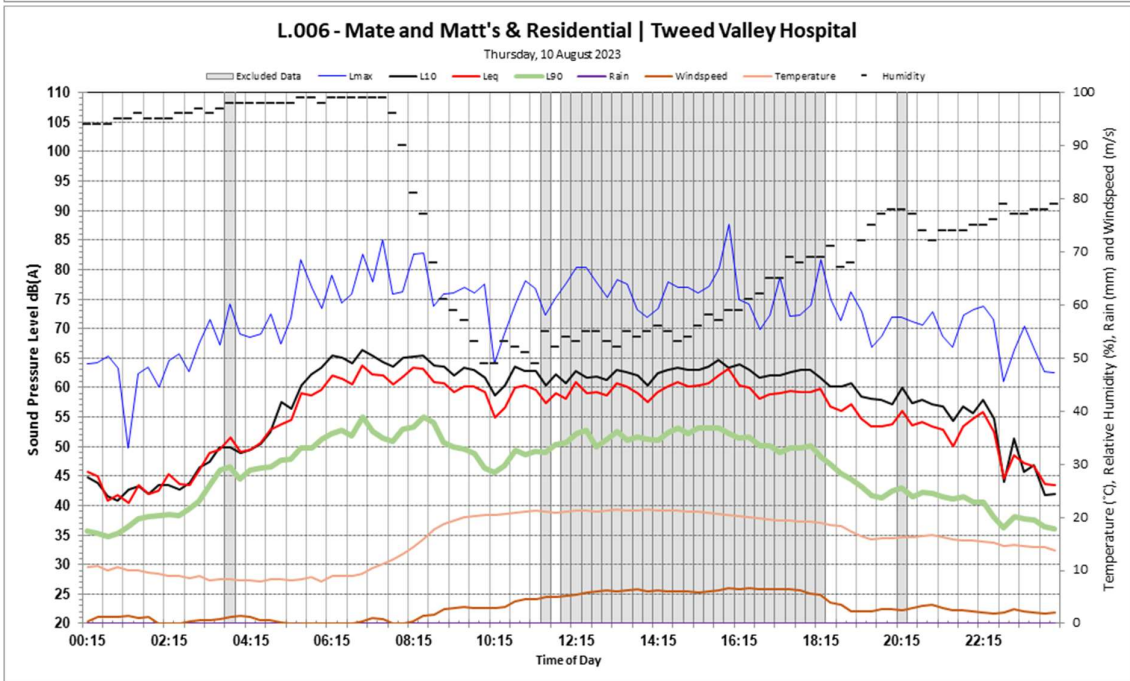
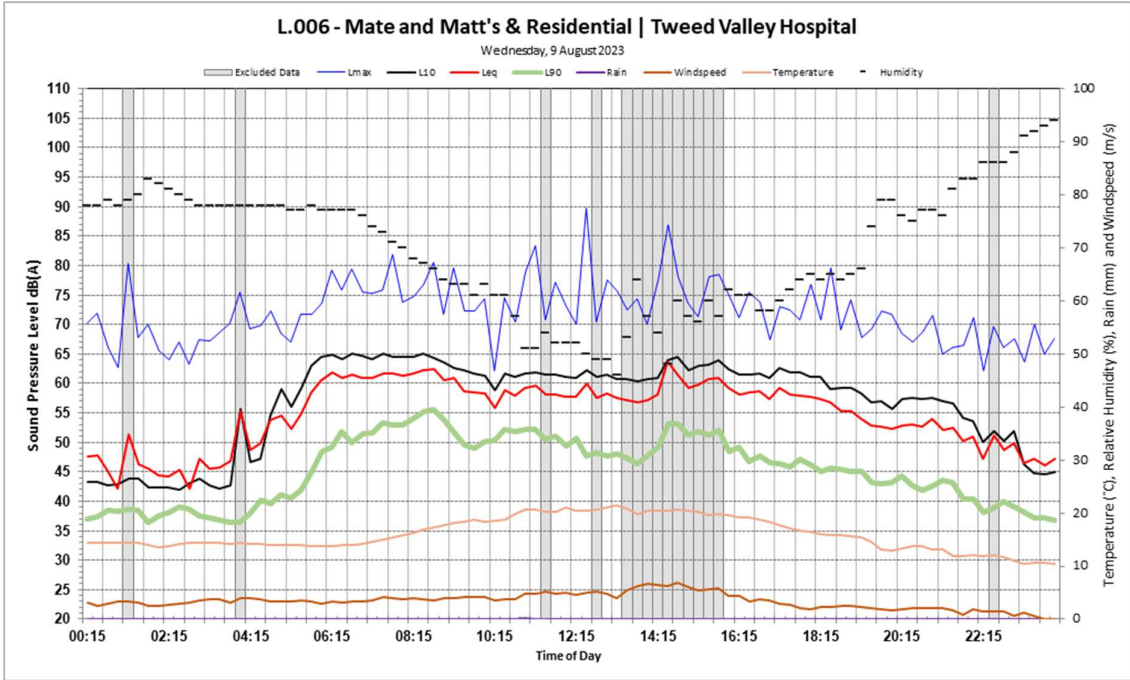
Monday, 7 August 2023



### L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

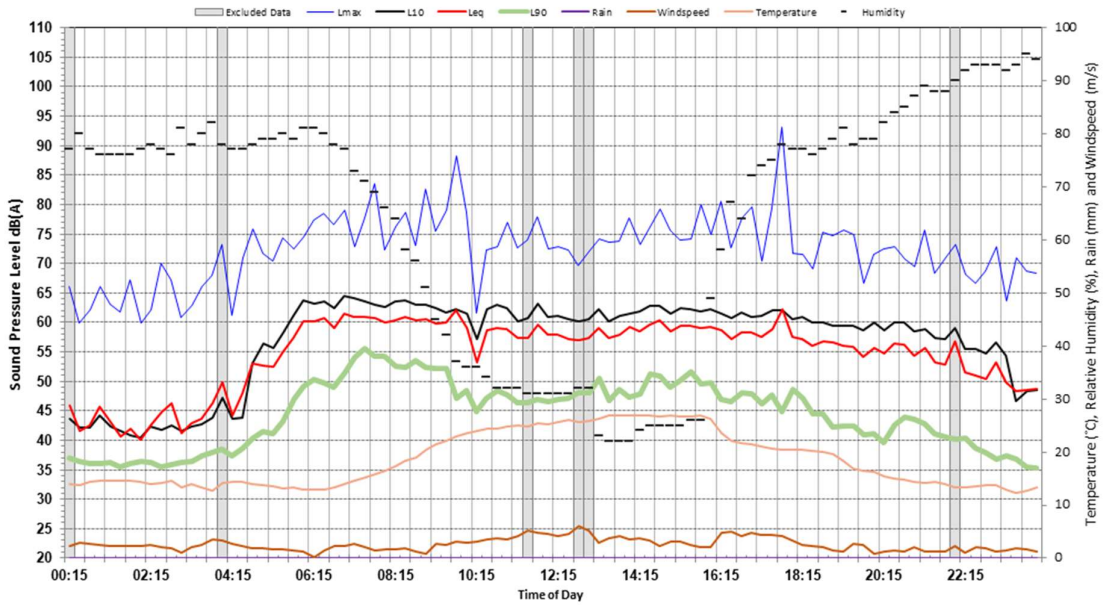
Tuesday, 8 August 2023





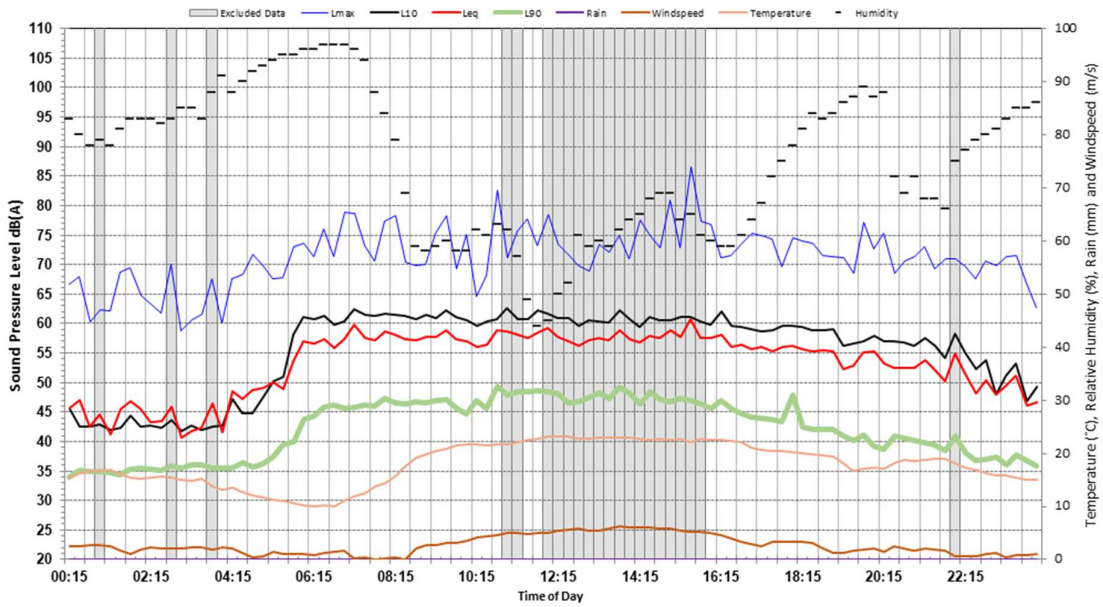
### L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

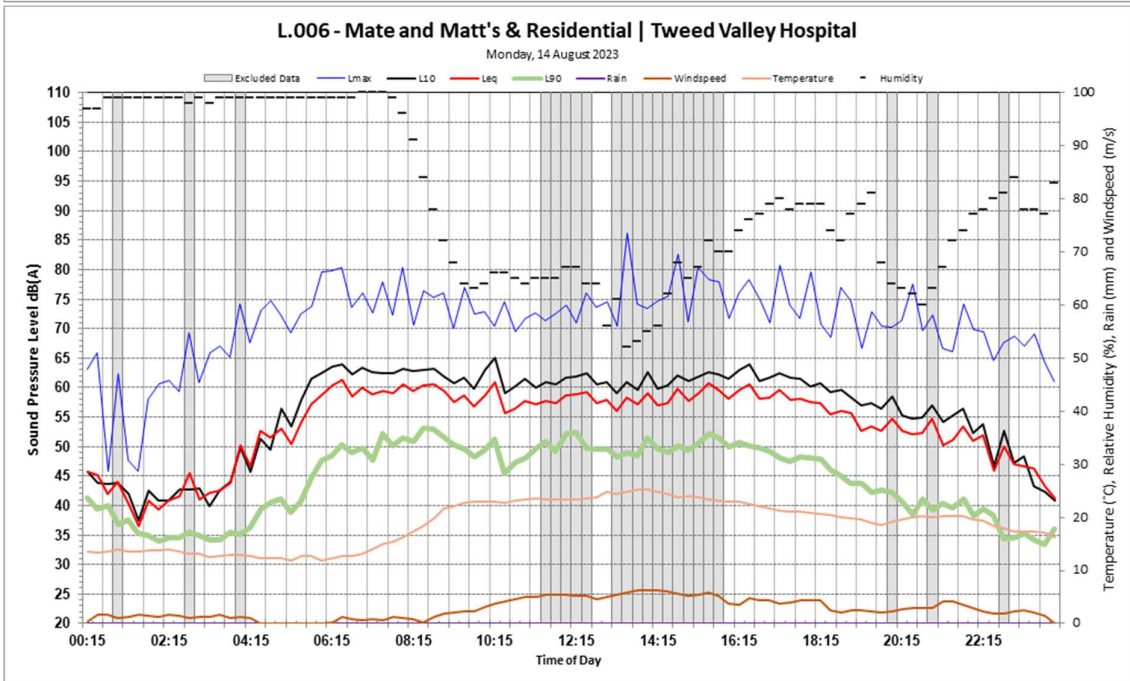
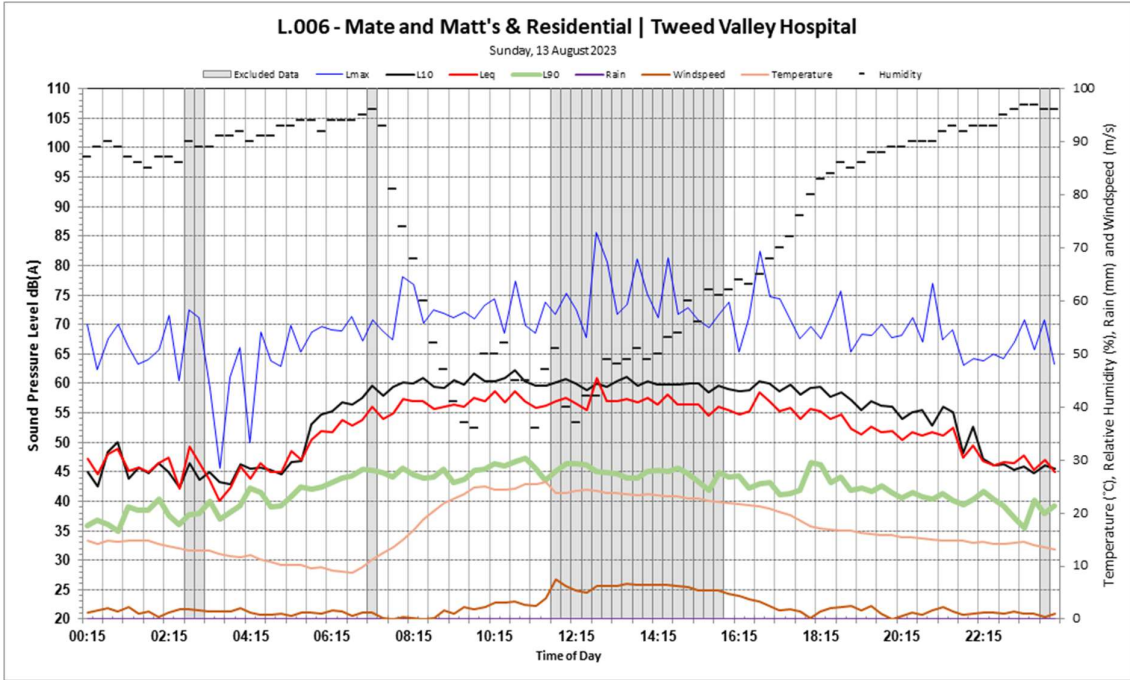
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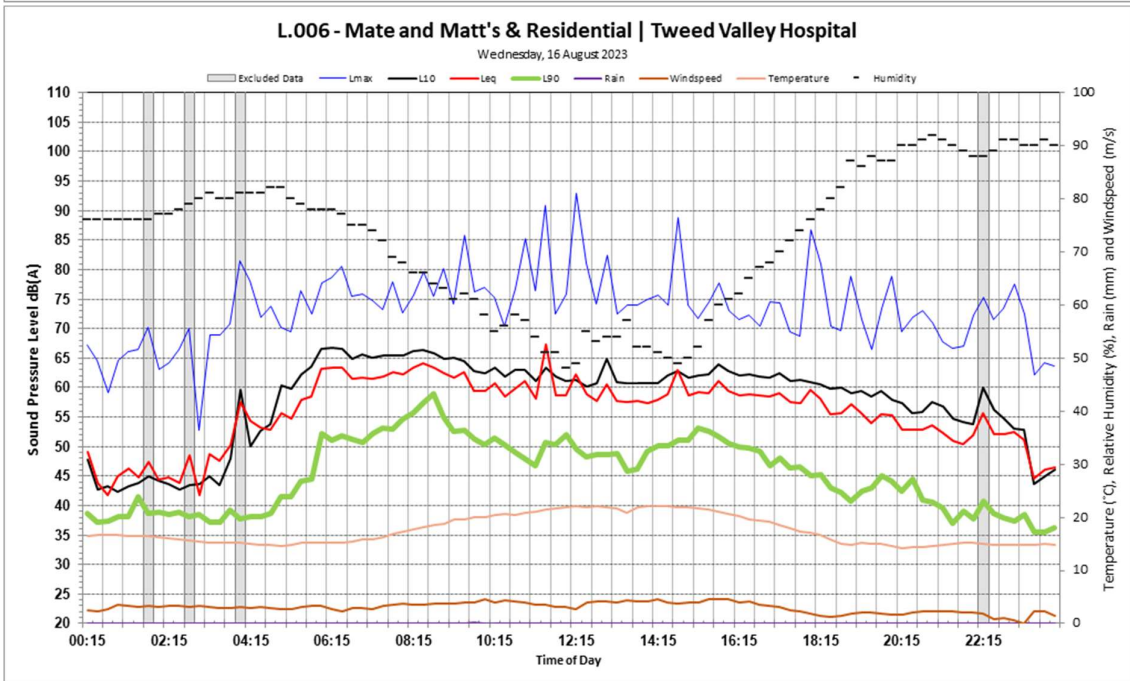
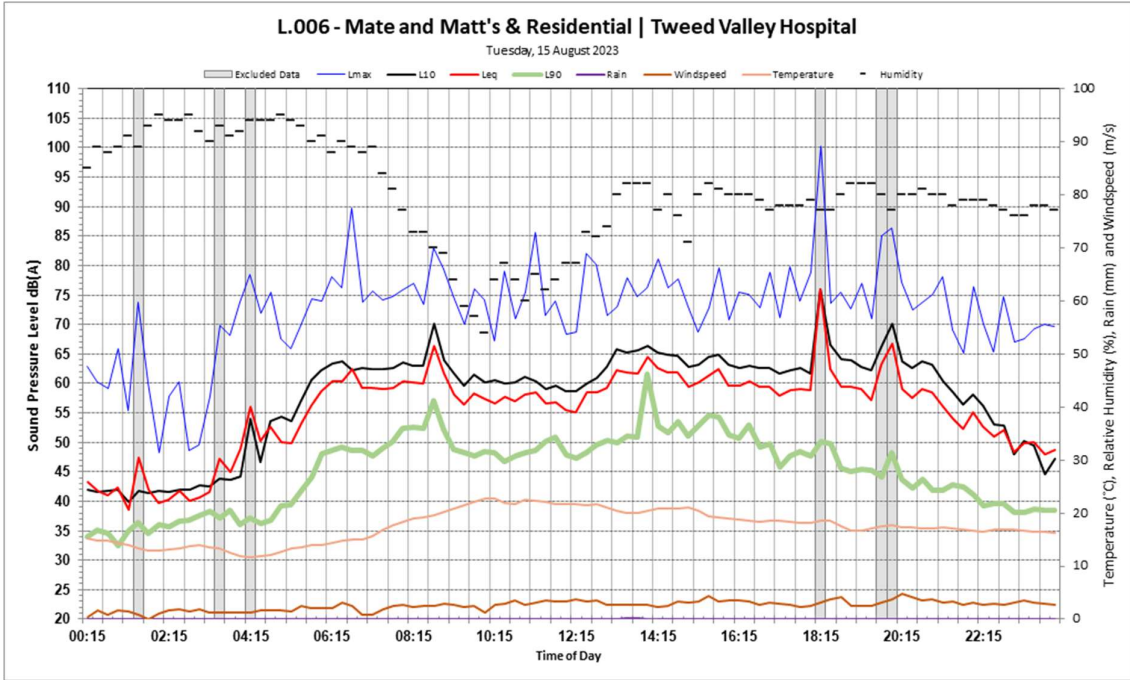


### L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

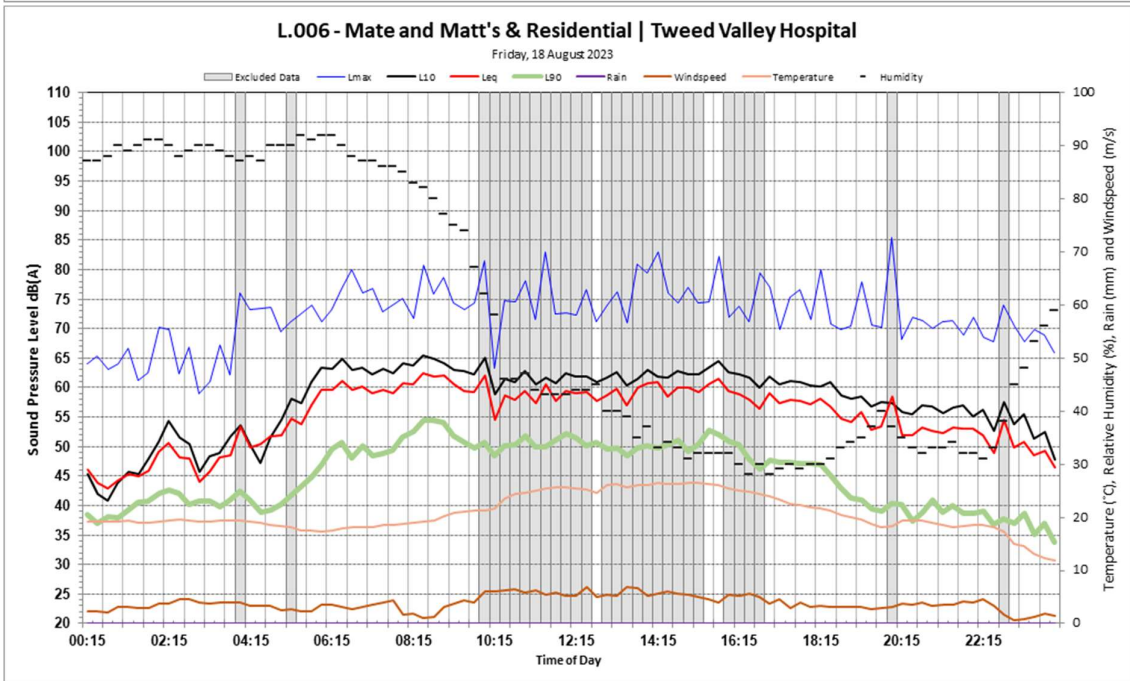
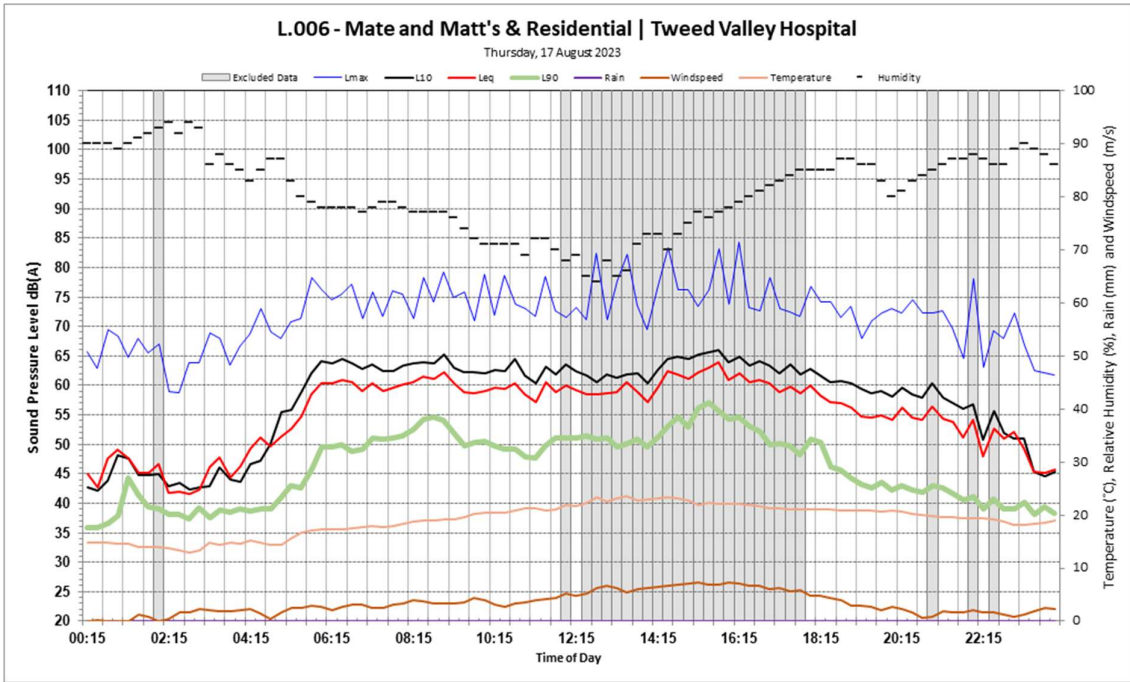
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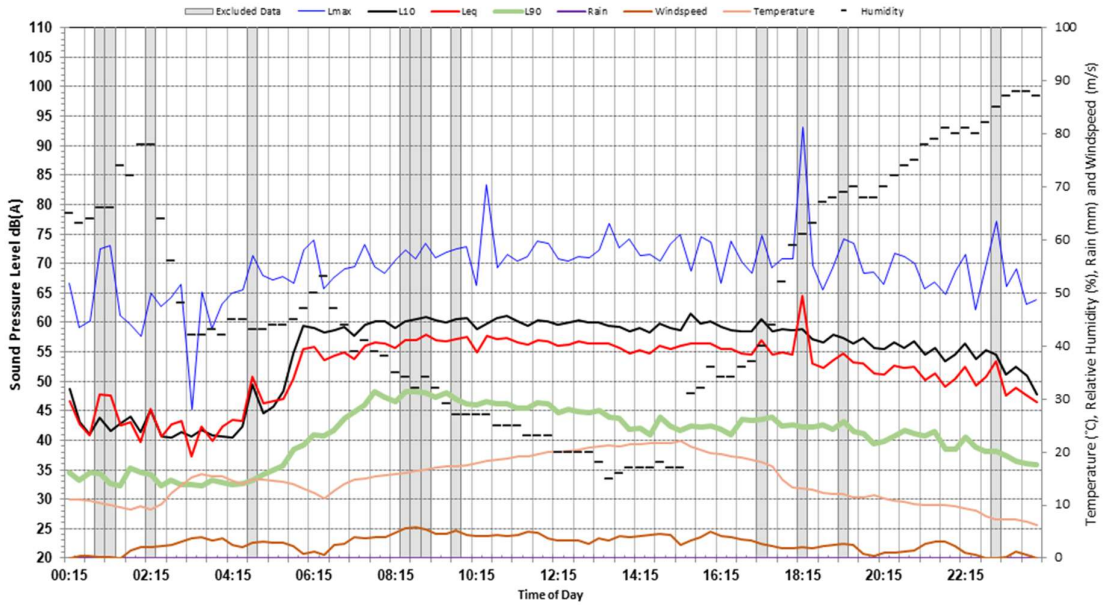






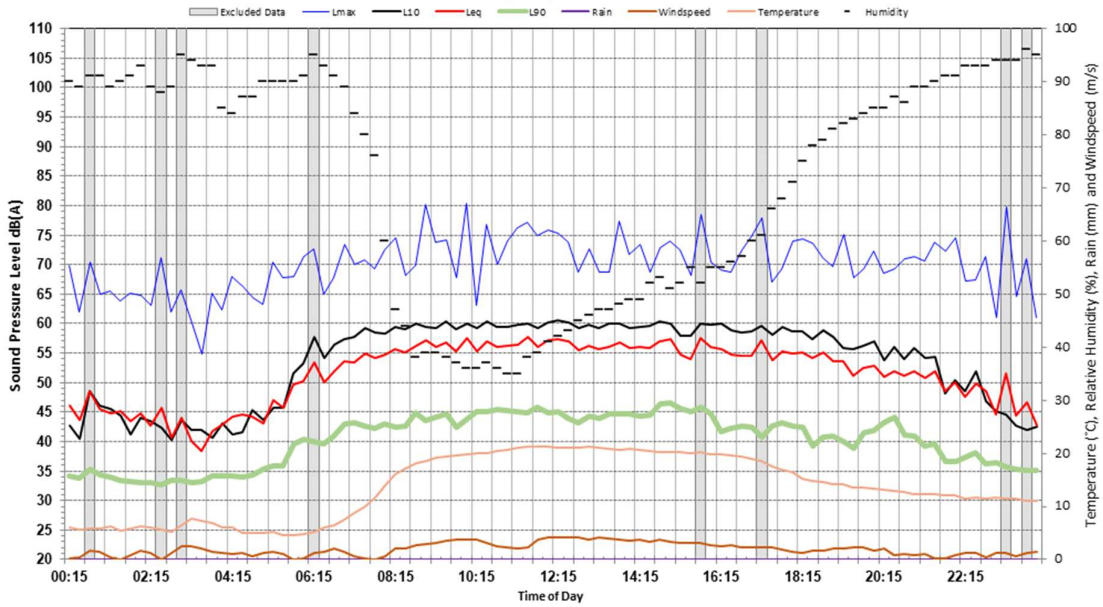
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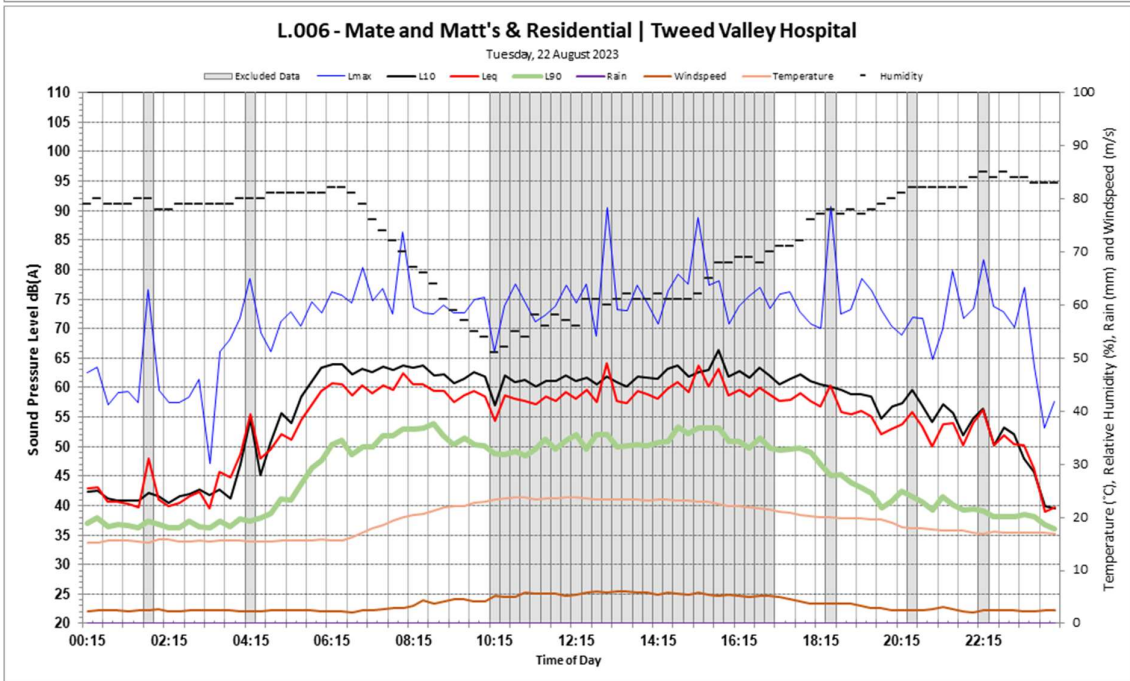
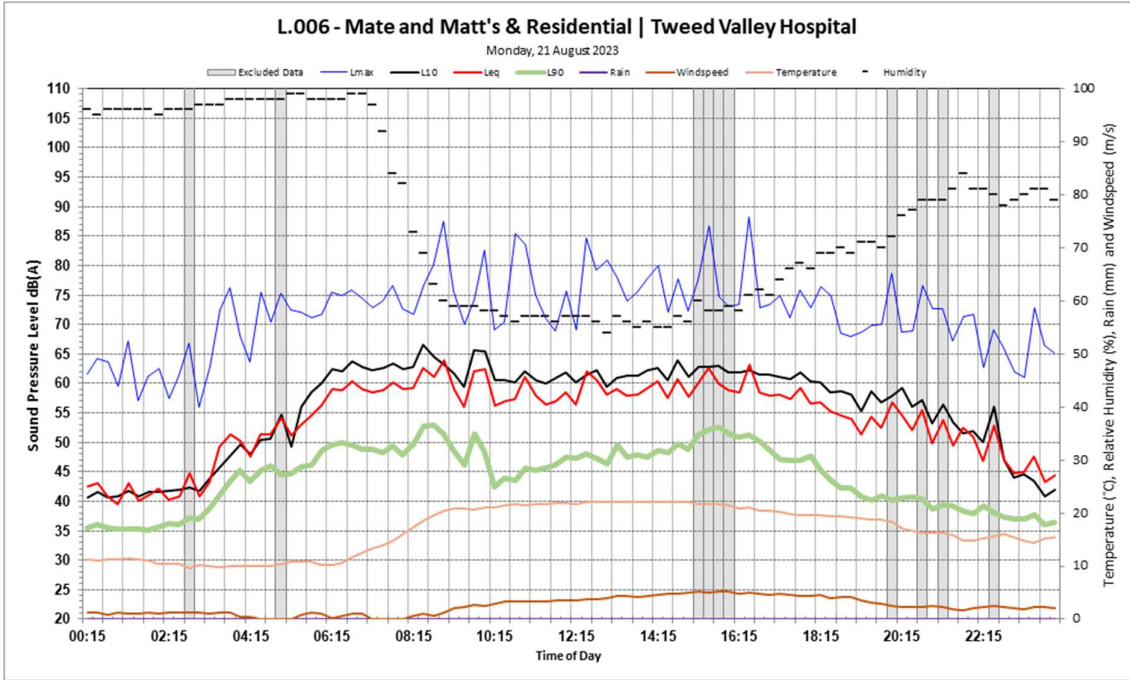
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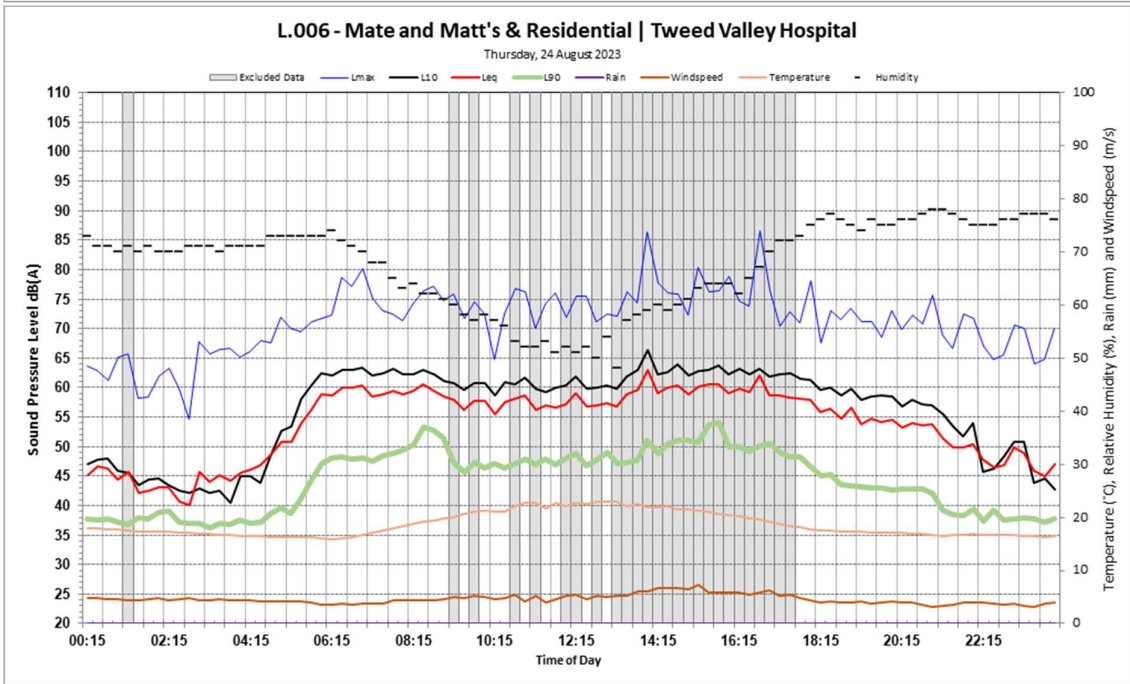
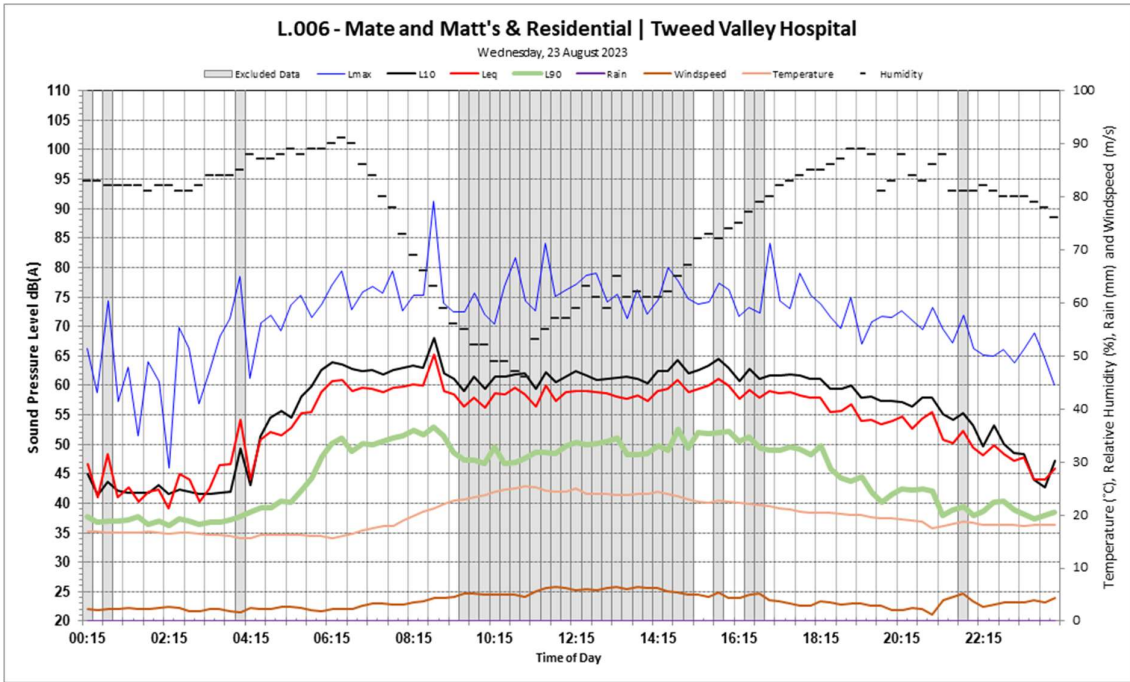


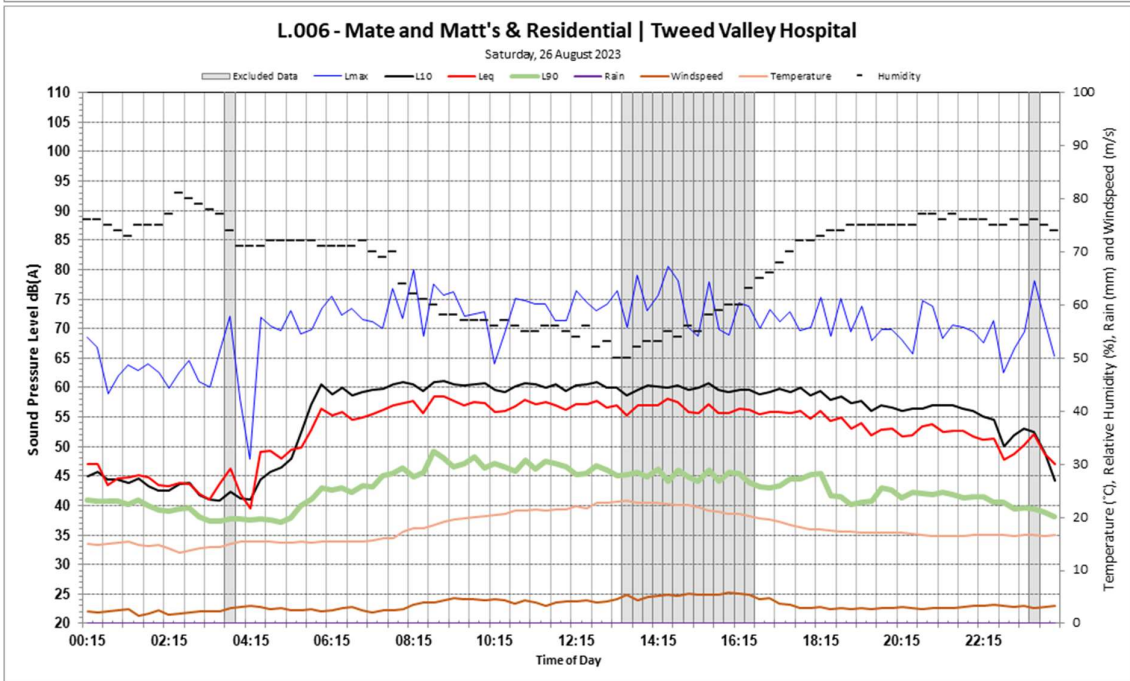
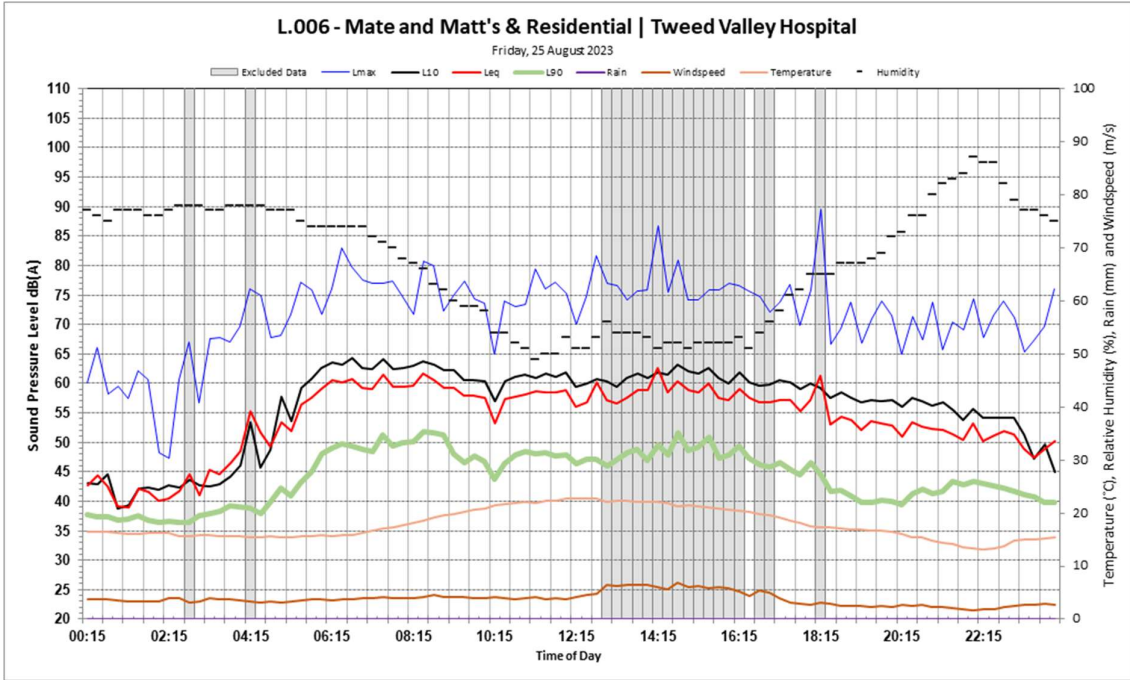
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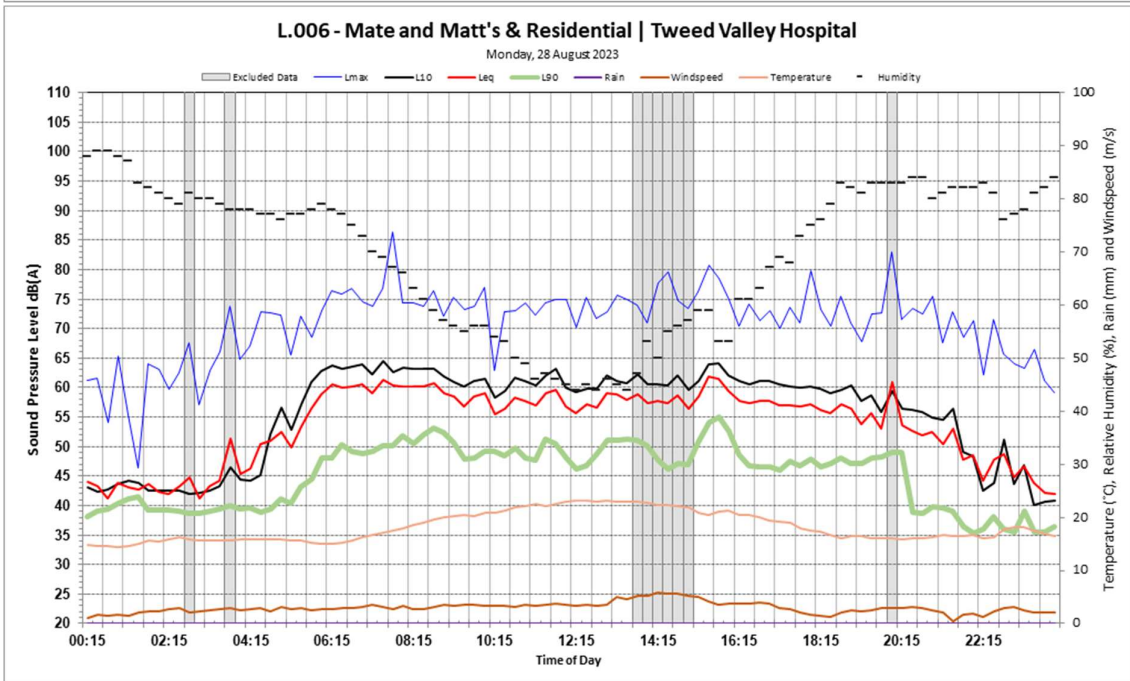
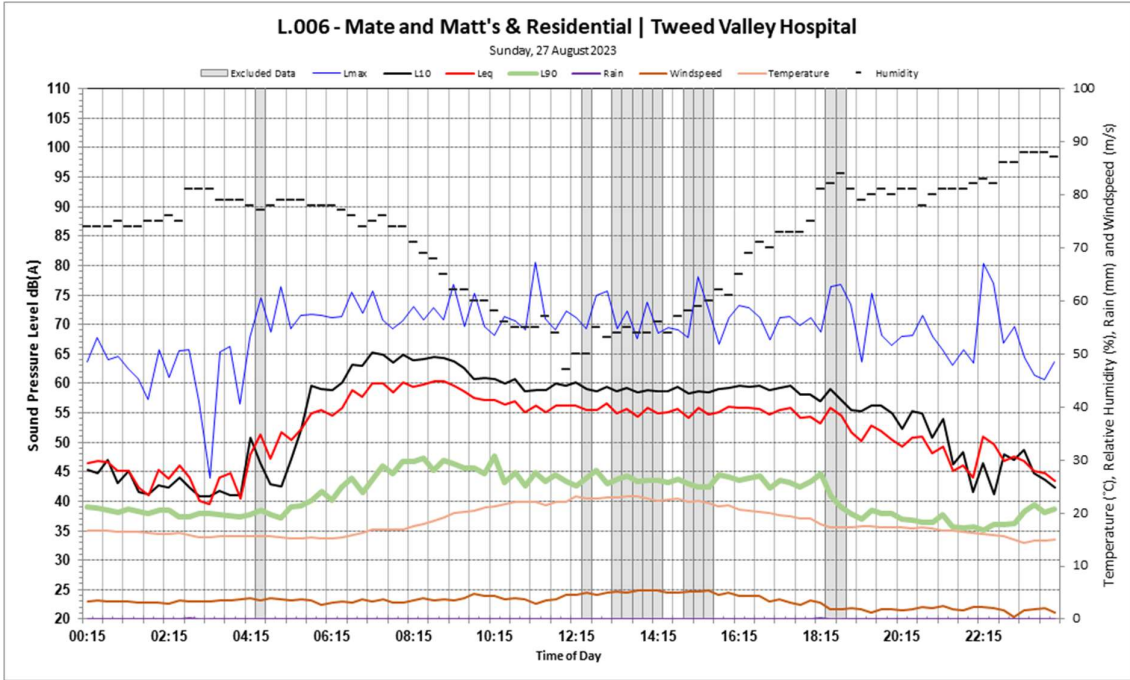
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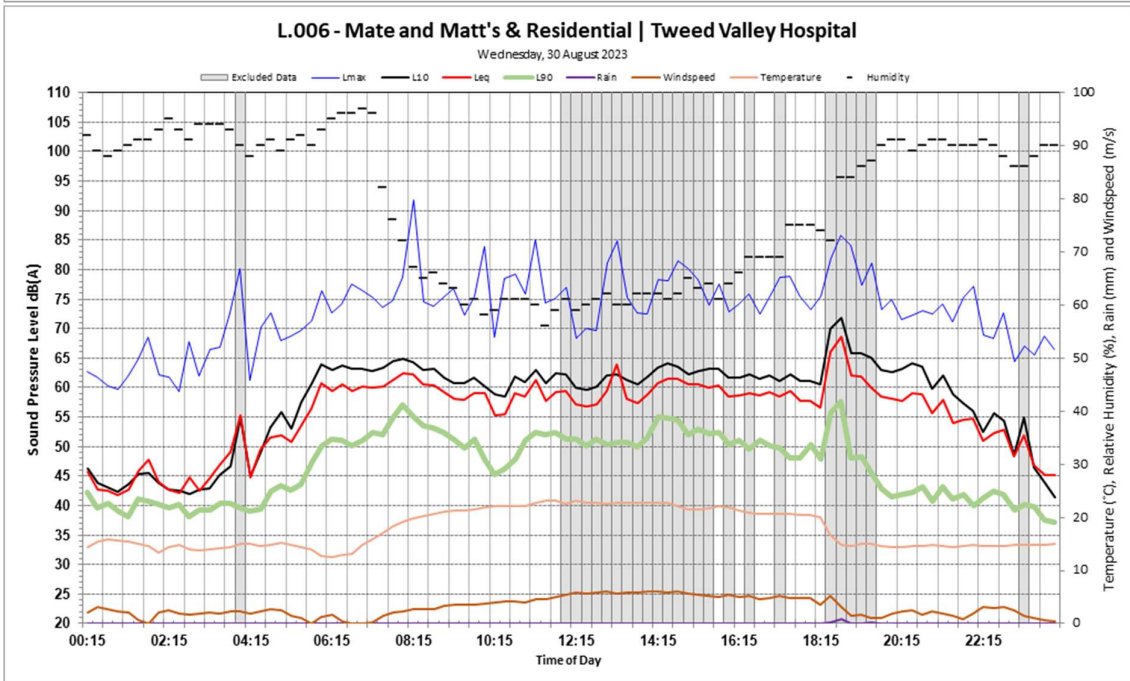
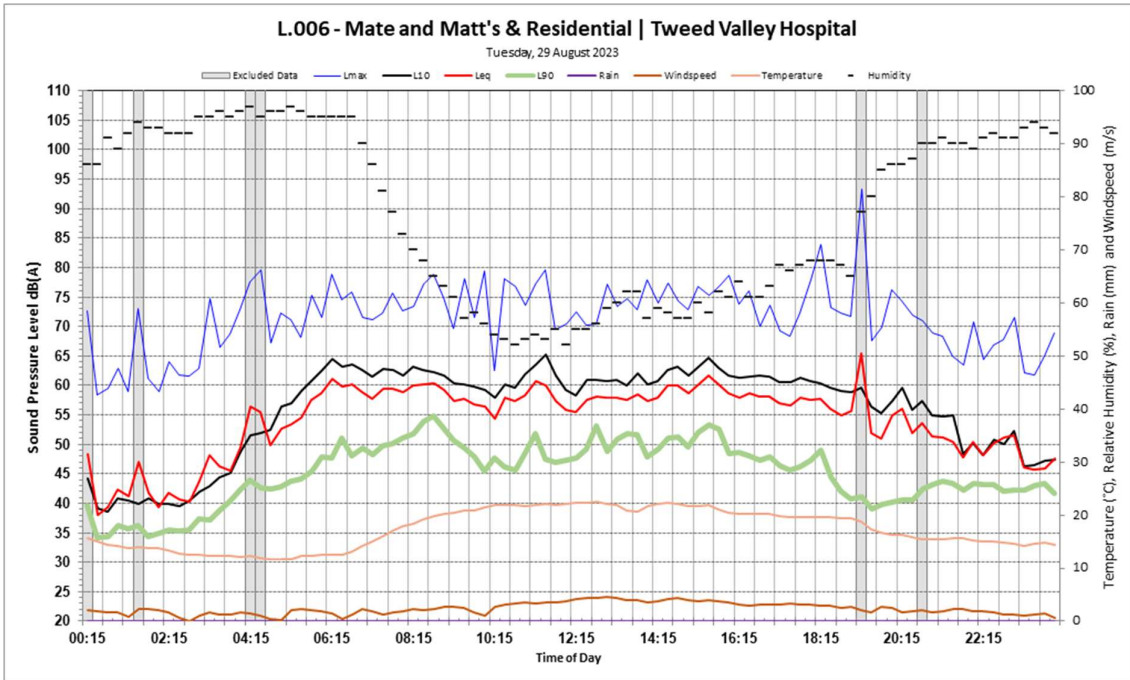






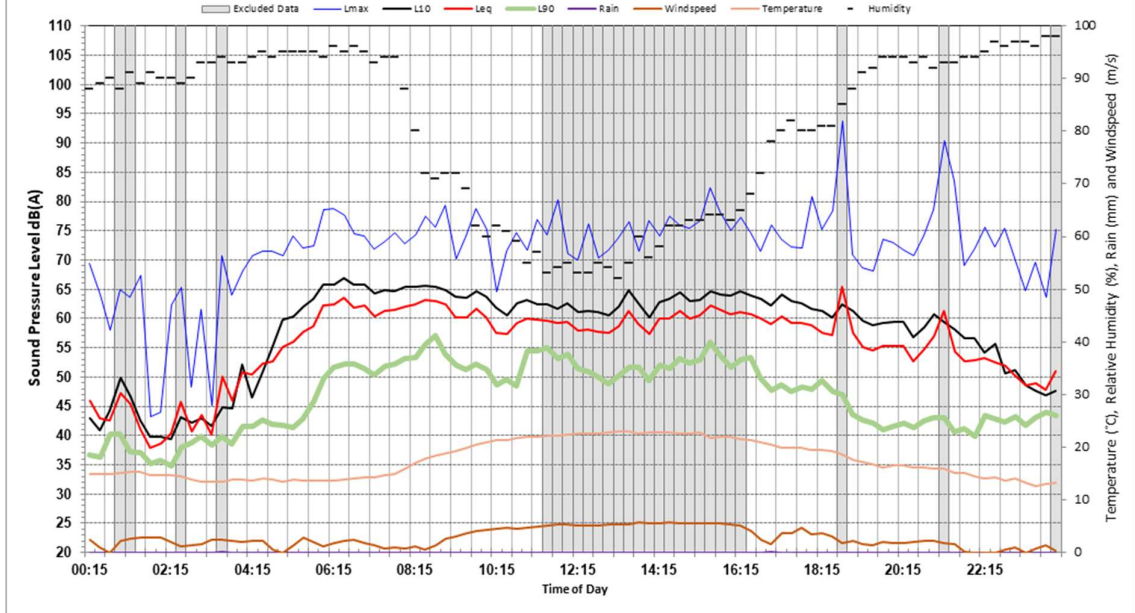




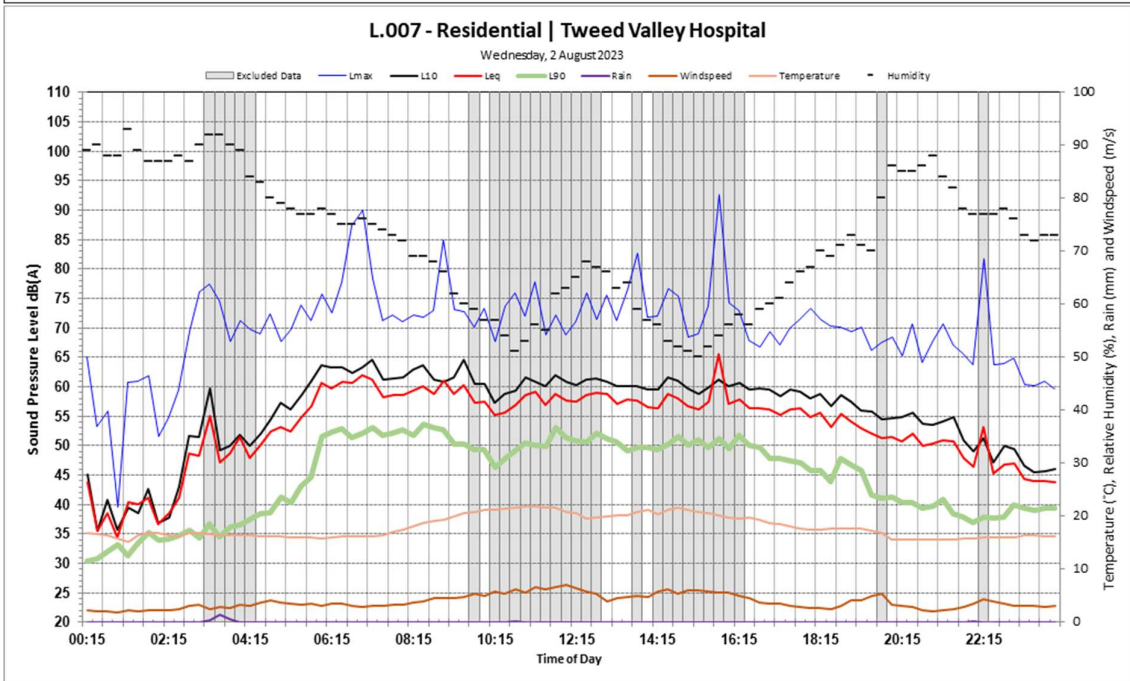
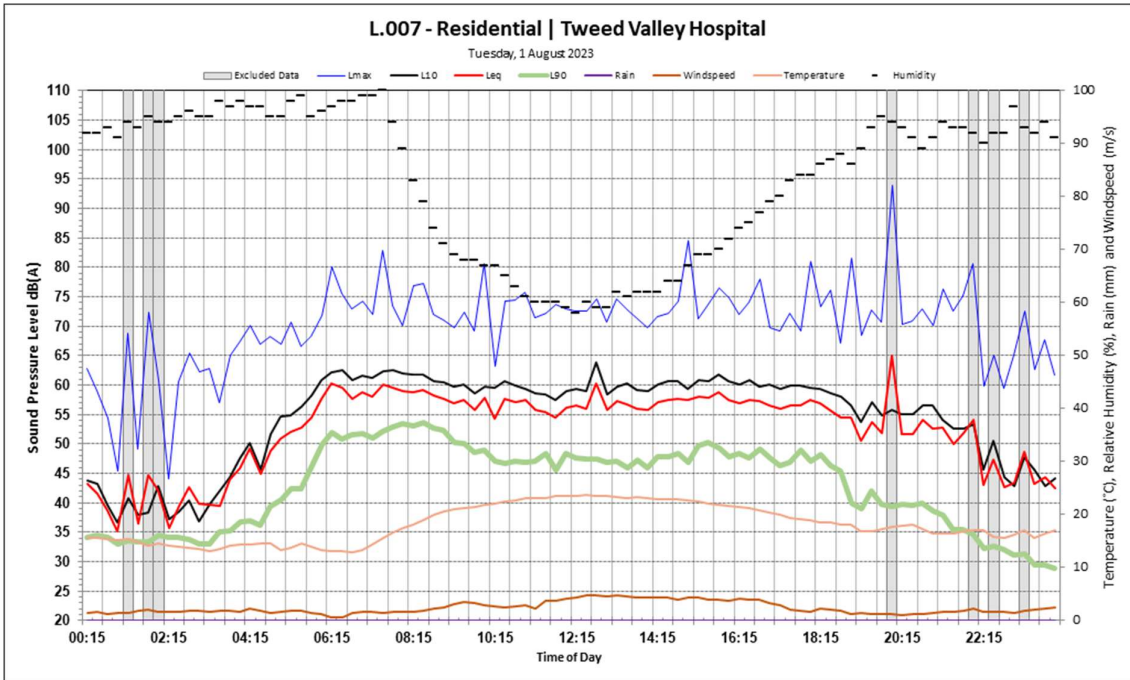


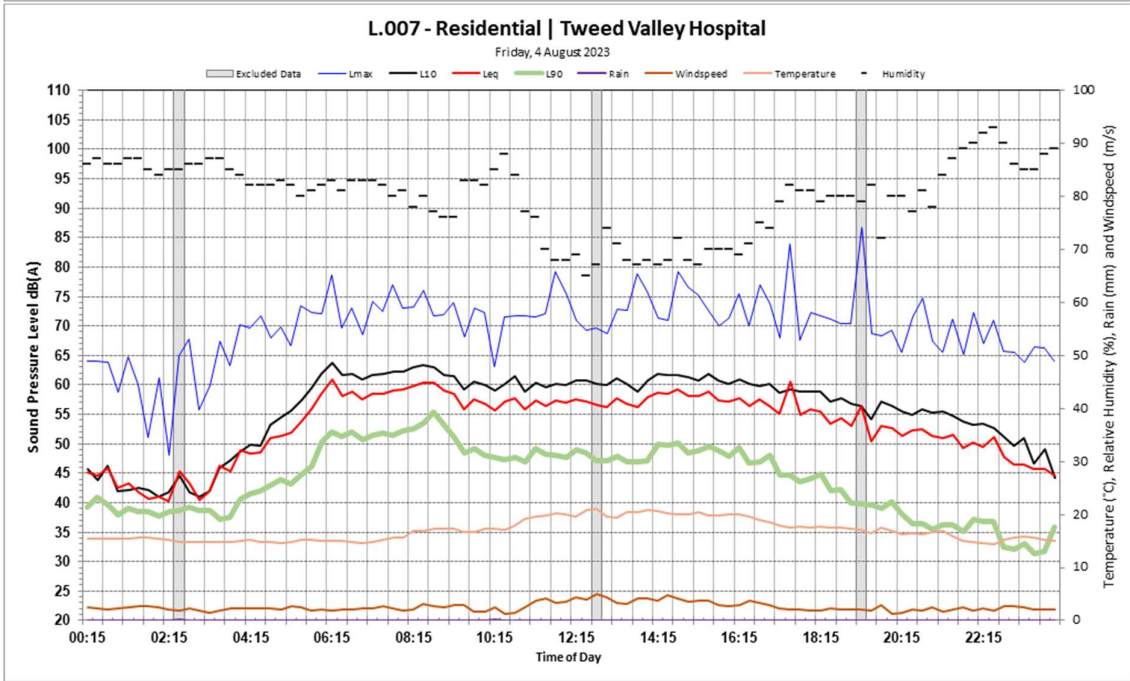
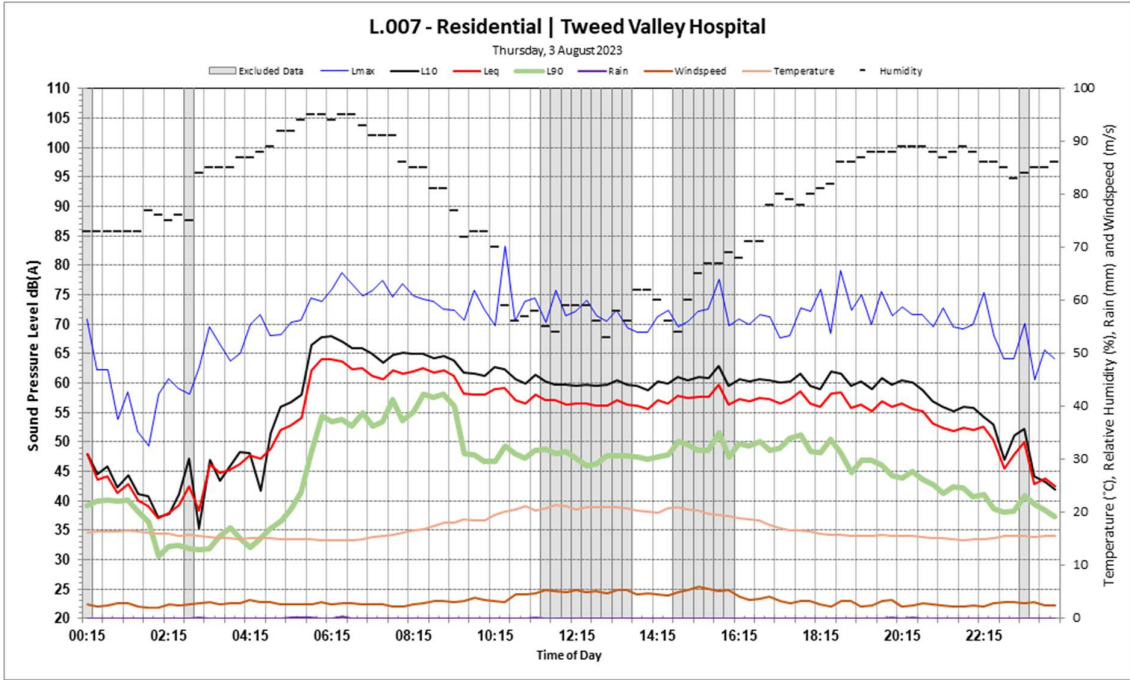
### L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

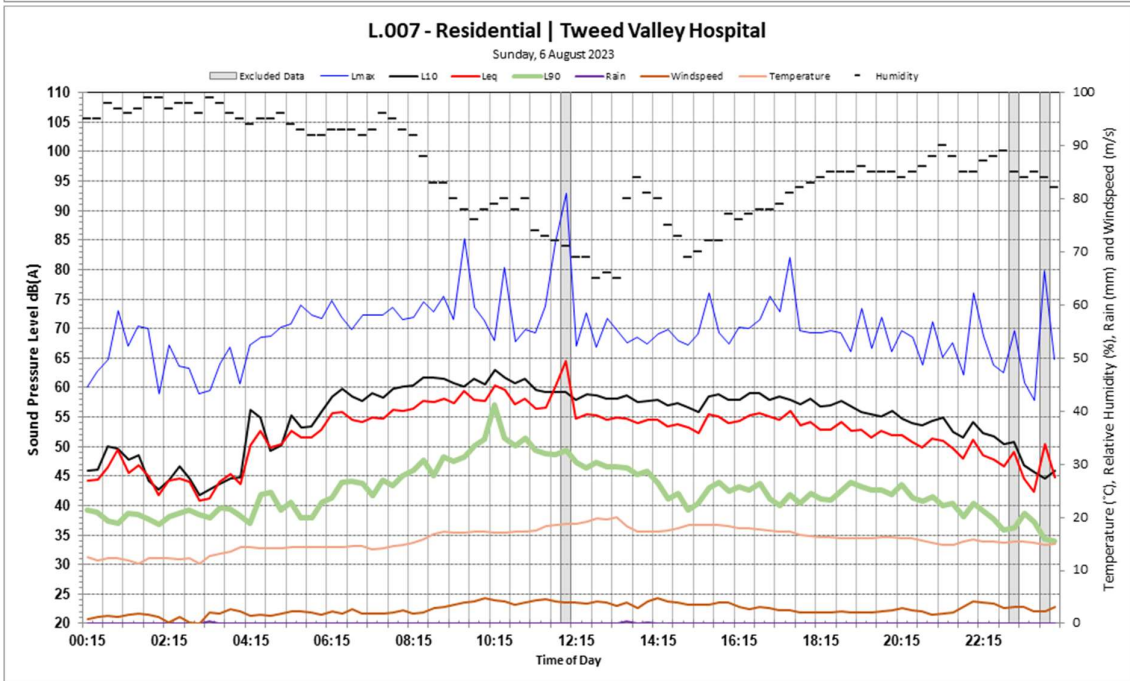
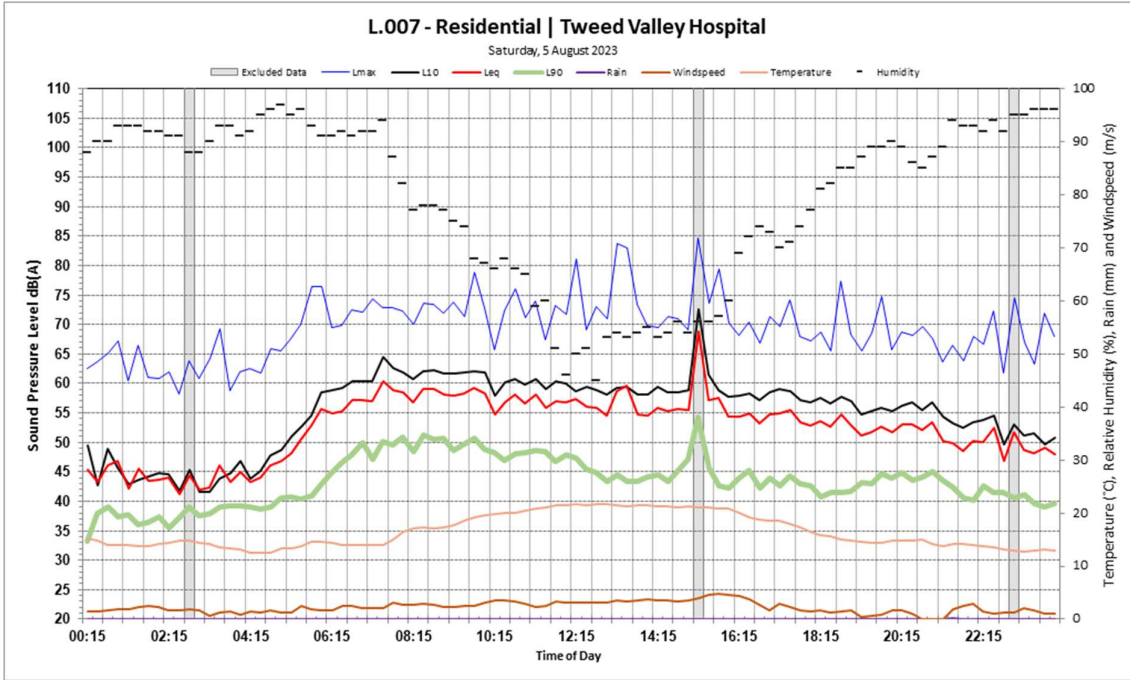
Thursday, 31 August 2023





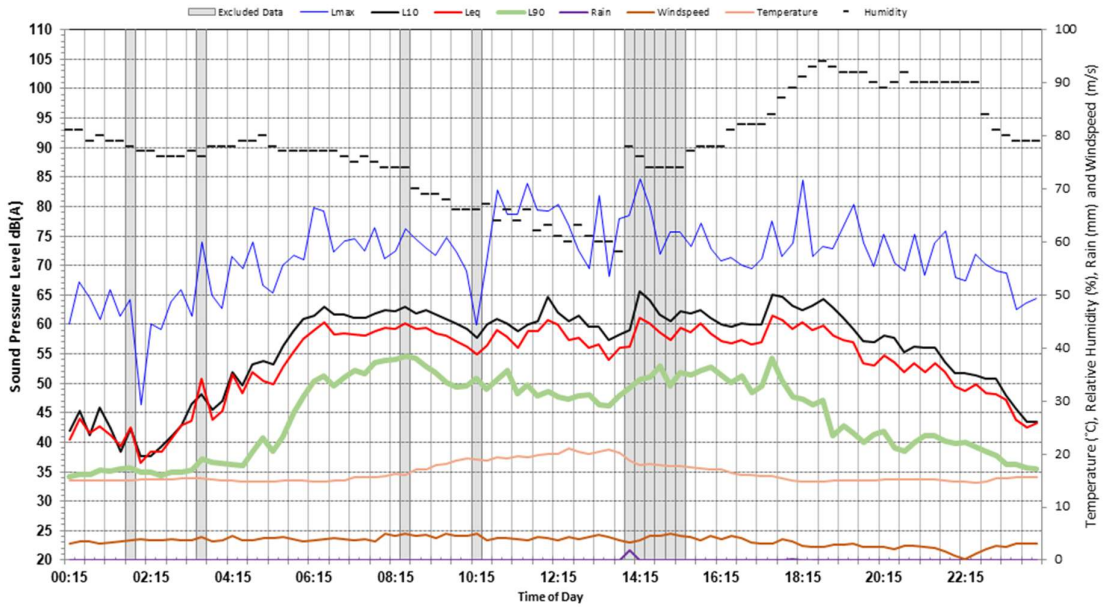






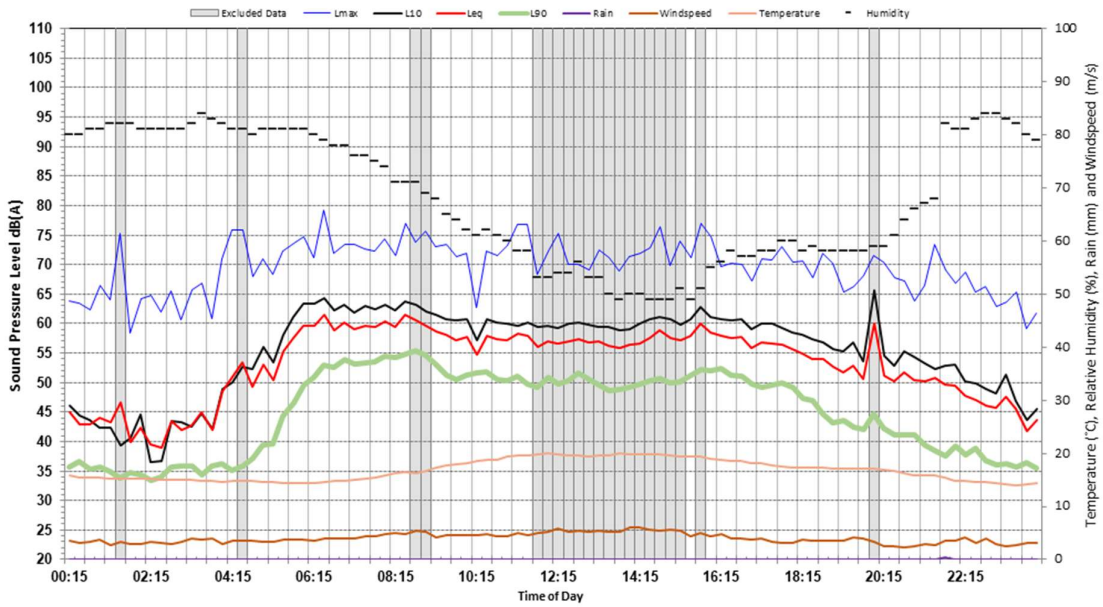
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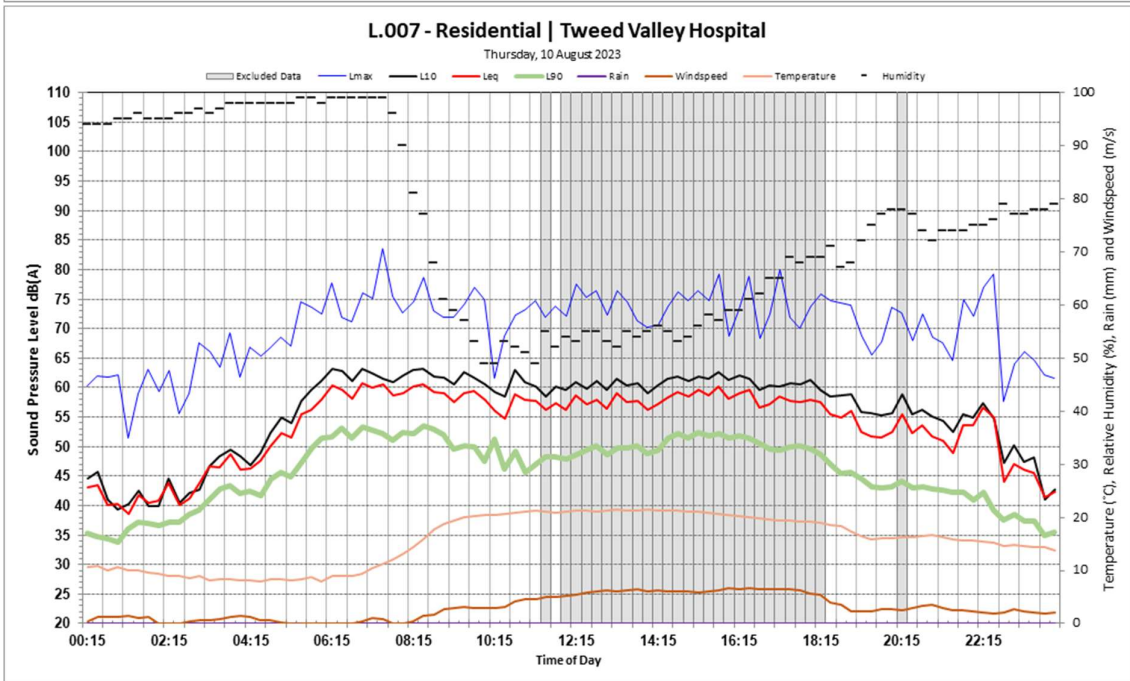
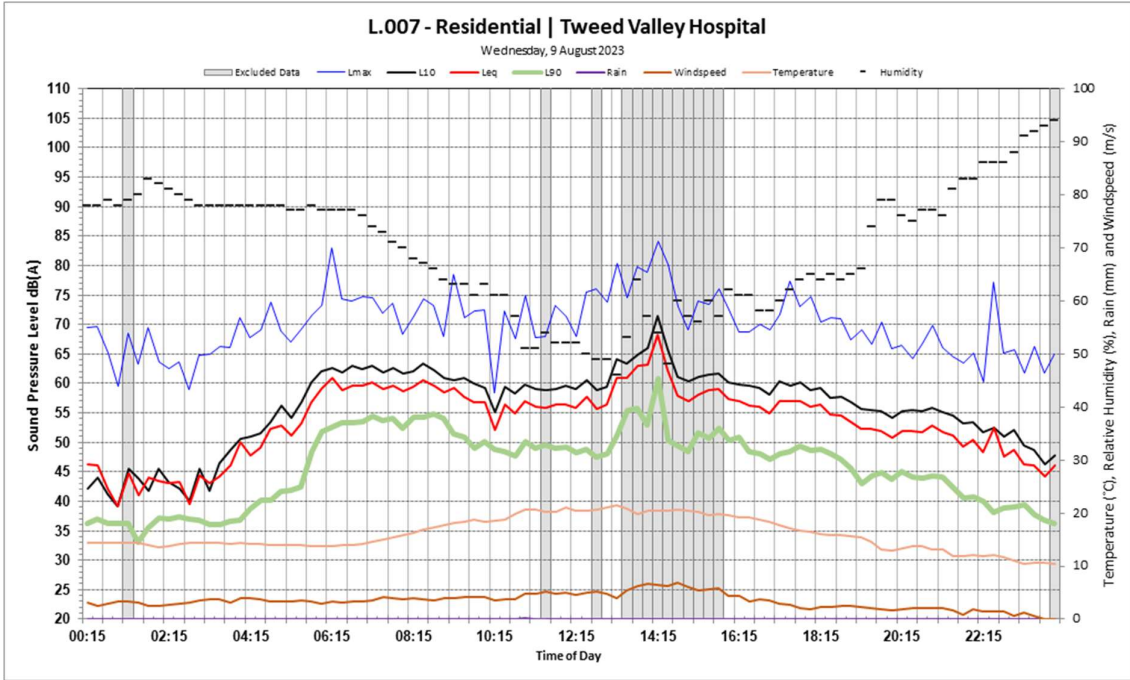
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### L.007 - Residential | Tweed Valley Hospital

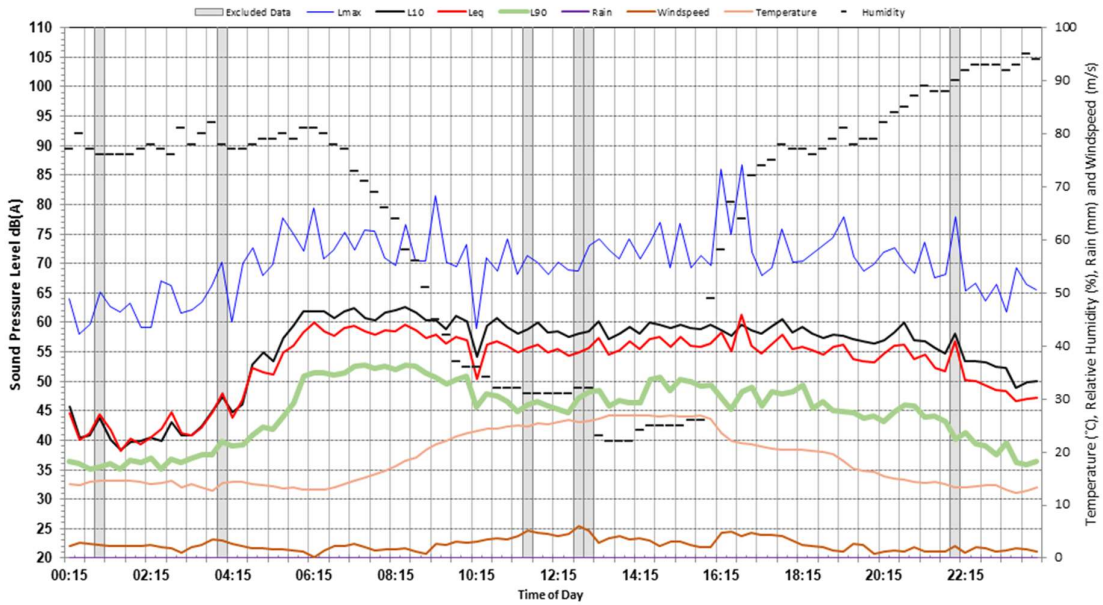
Tuesday, 8 August 2023





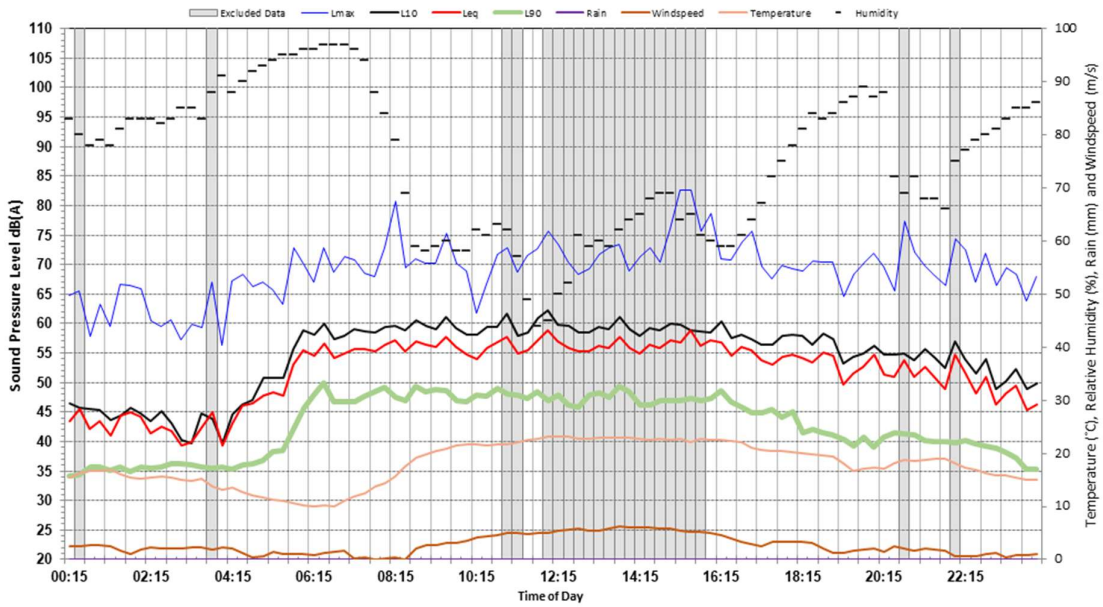
### L.007 - Residential | Tweed Valley Hospital

Friday, 11 August 2023



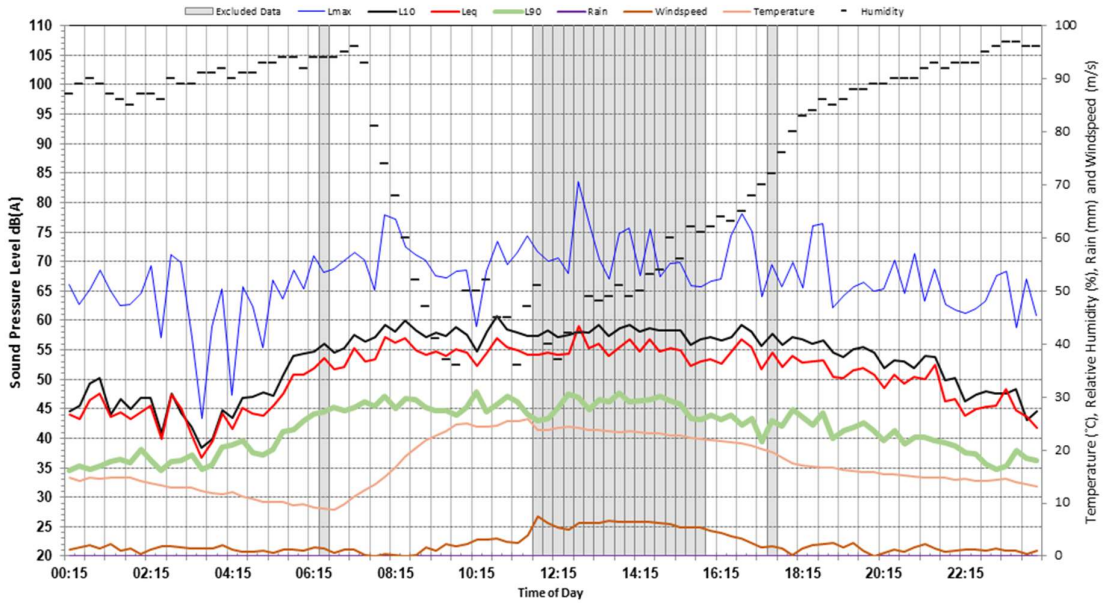
### L.007 - Residential | Tweed Valley Hospital

Saturday, 12 August 2023



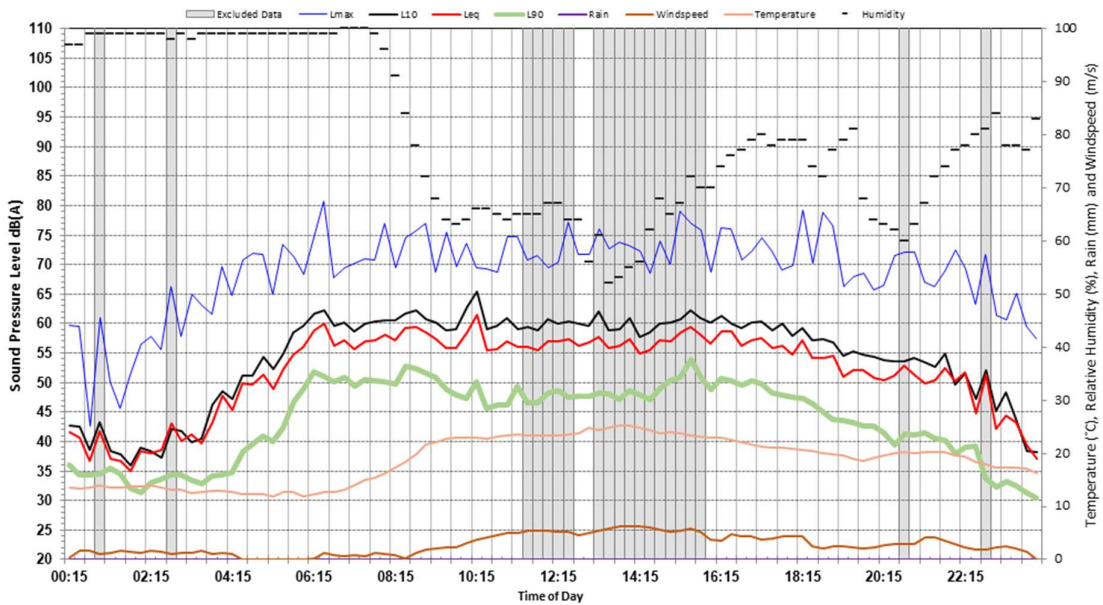
### L.007 - Residential | Tweed Valley Hospital

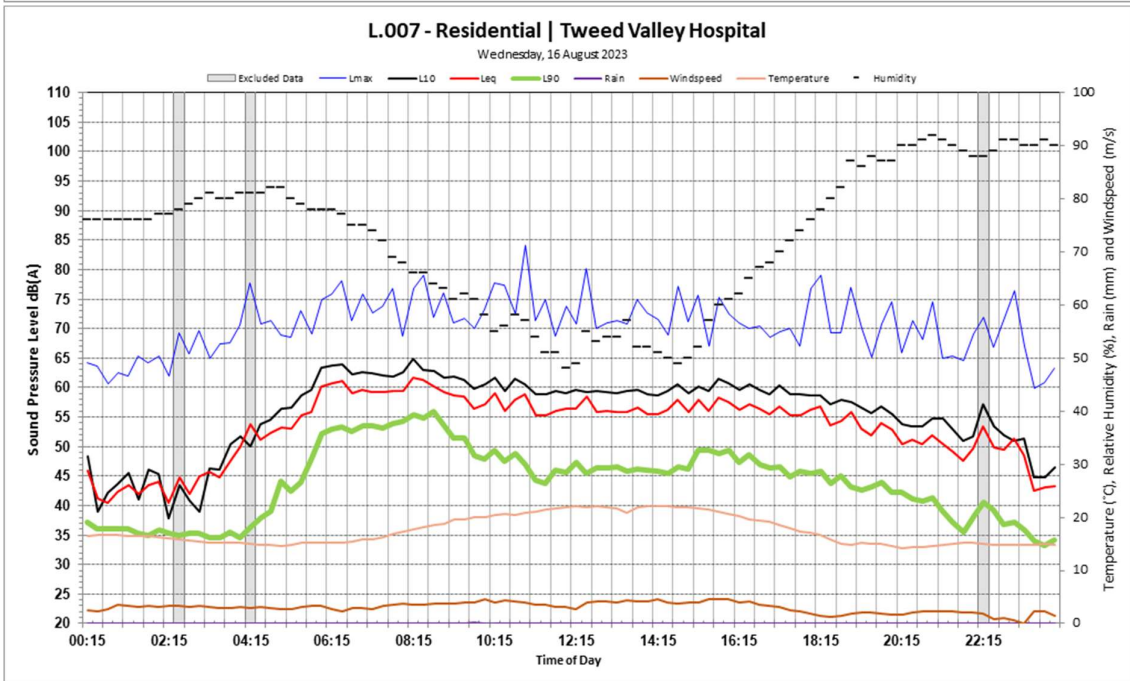
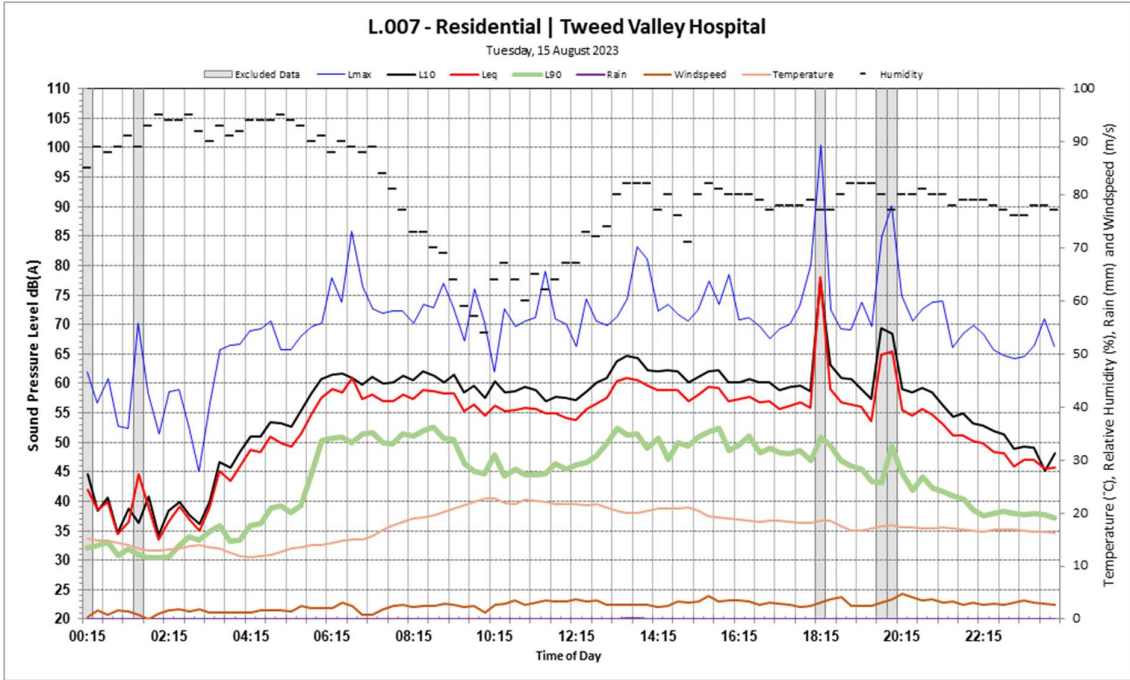
Sunday, 13 August 2023



### L.007 - Residential | Tweed Valley Hospital

Monday, 14 August 2023

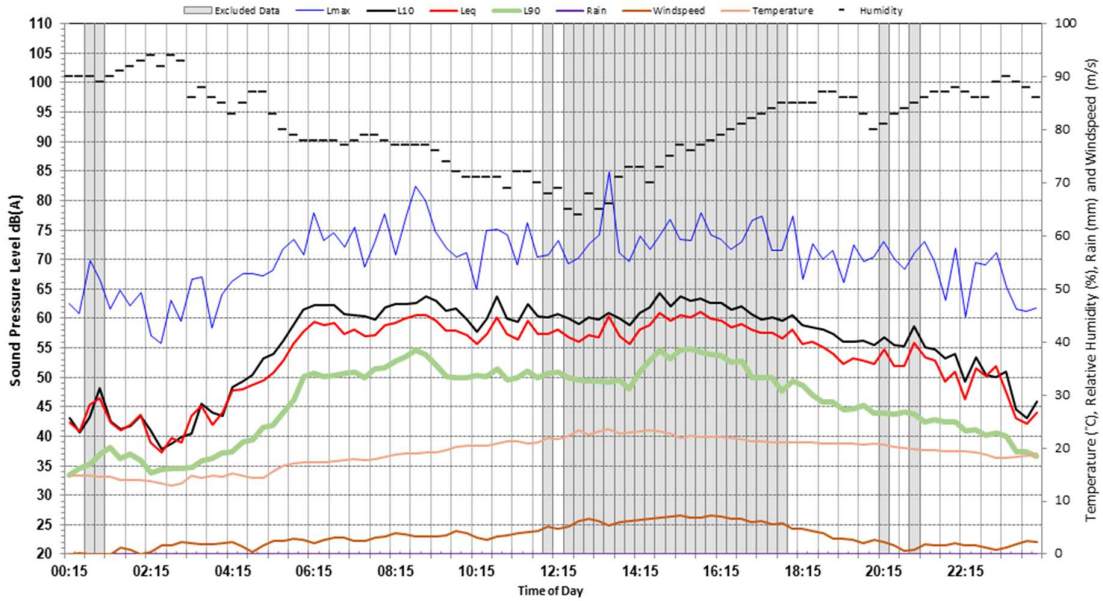






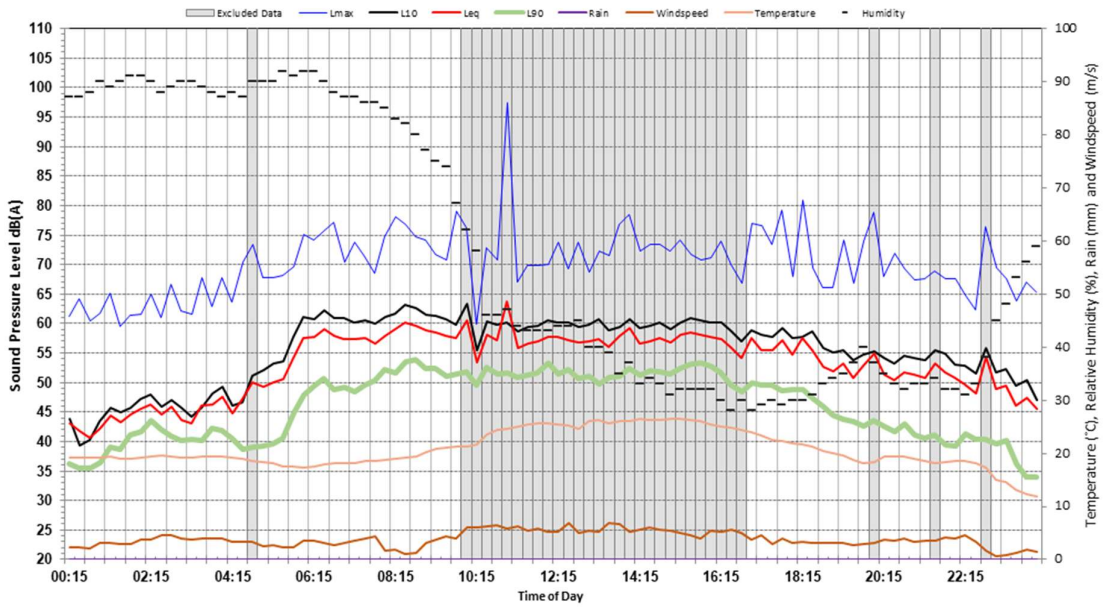
### L.007 - Residential | Tweed Valley Hospital

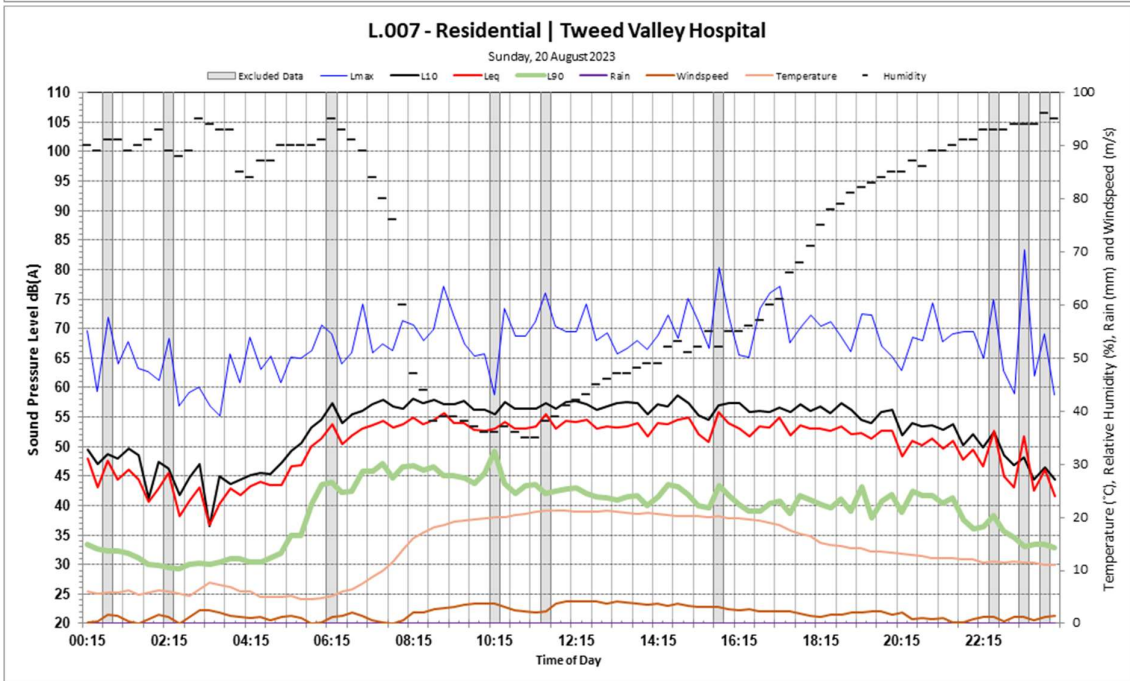
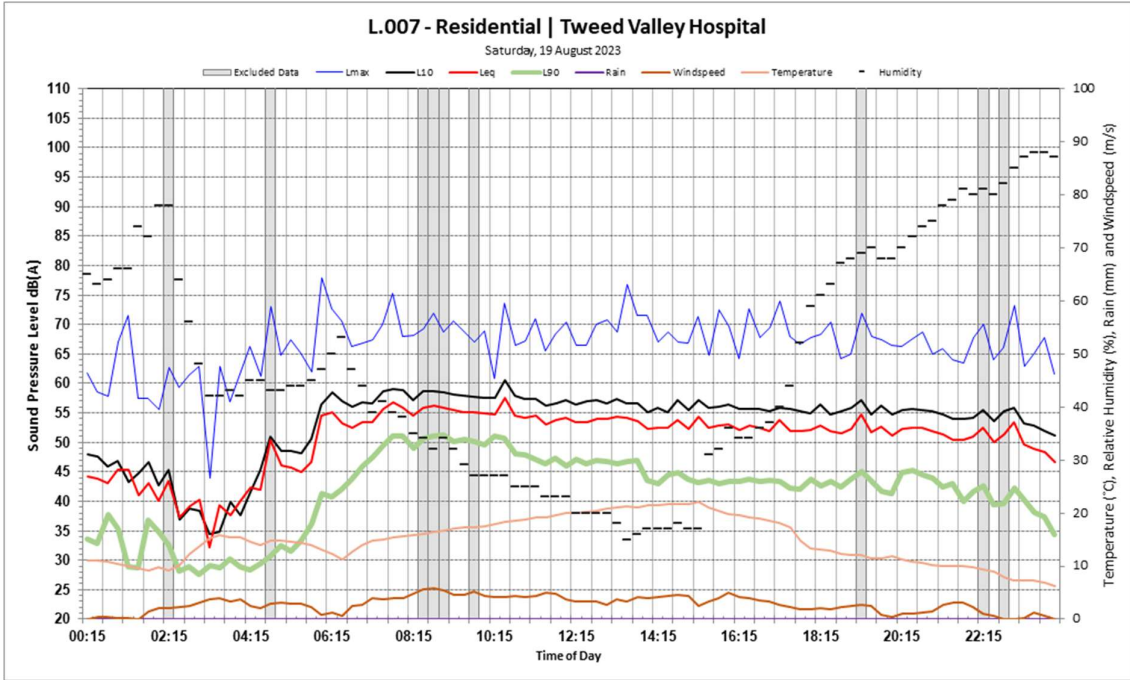
Thursday, 17 August 2023

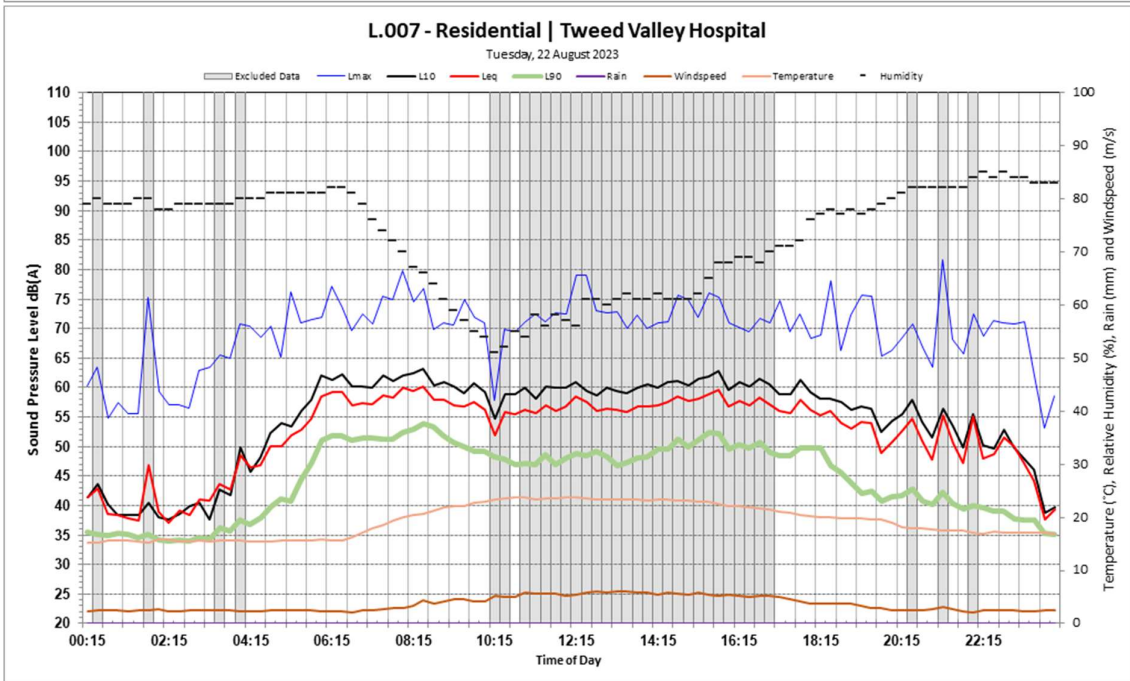
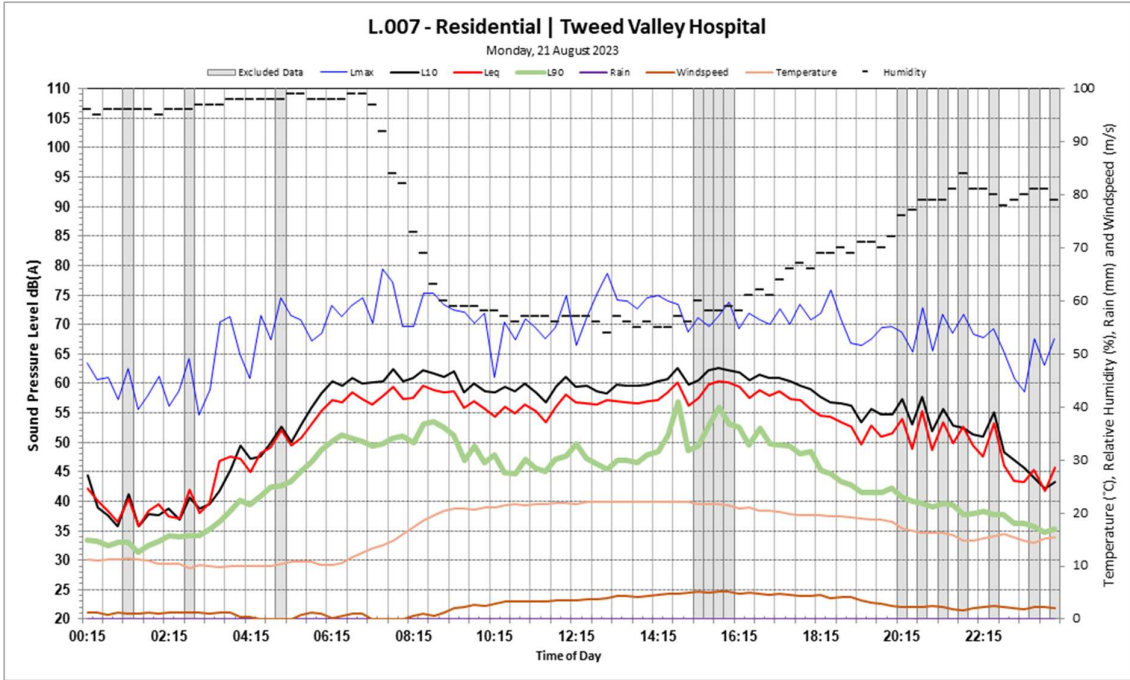


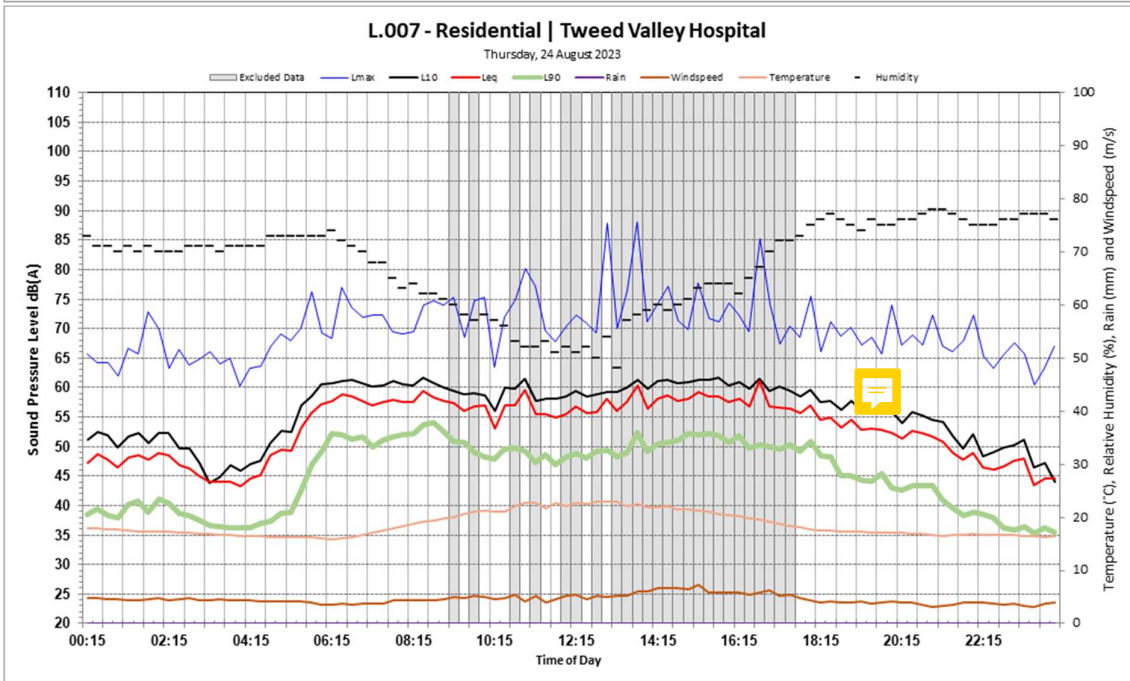
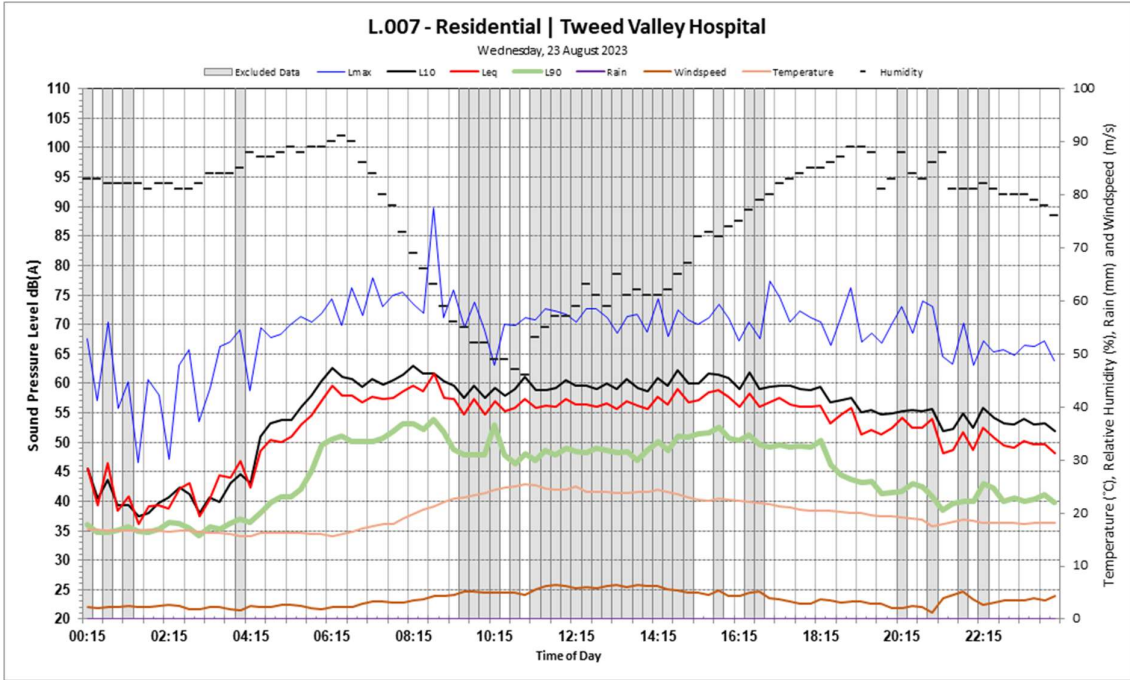
### L.007 - Residential | Tweed Valley Hospital

Friday, 18 August 2023



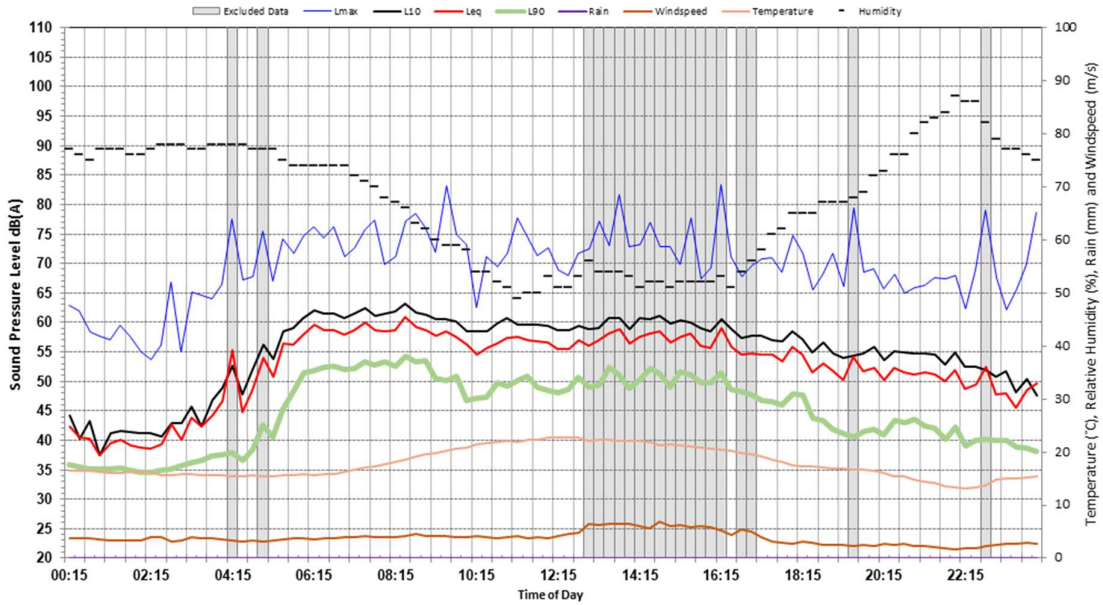






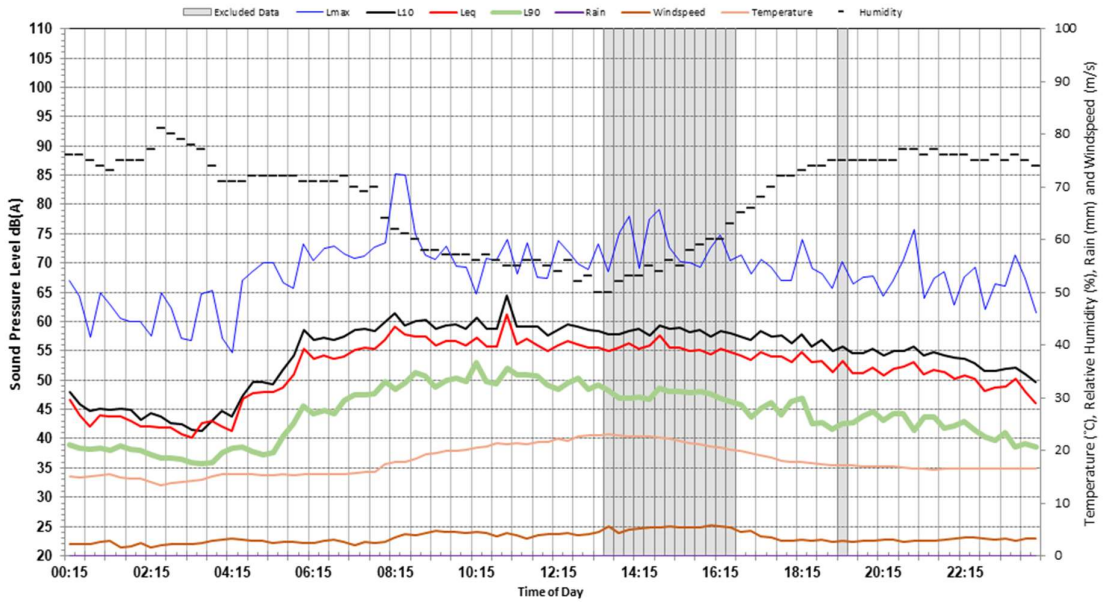
### L.007 - Residential | Tweed Valley Hospital

Friday, 25 August 2023



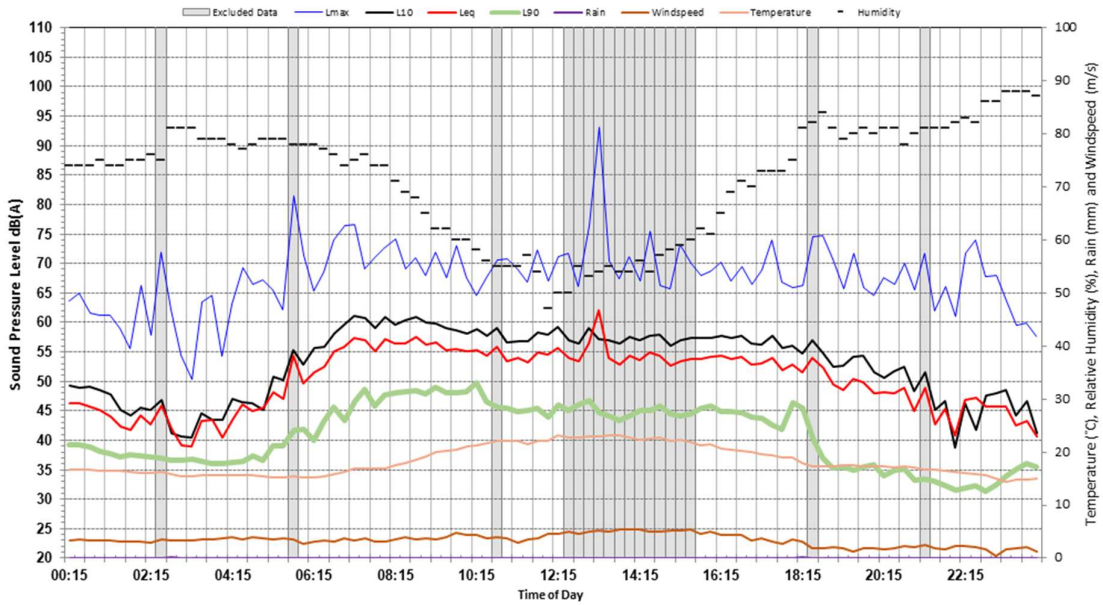
### L.007 - Residential | Tweed Valley Hospital

Saturday, 26 August 2023



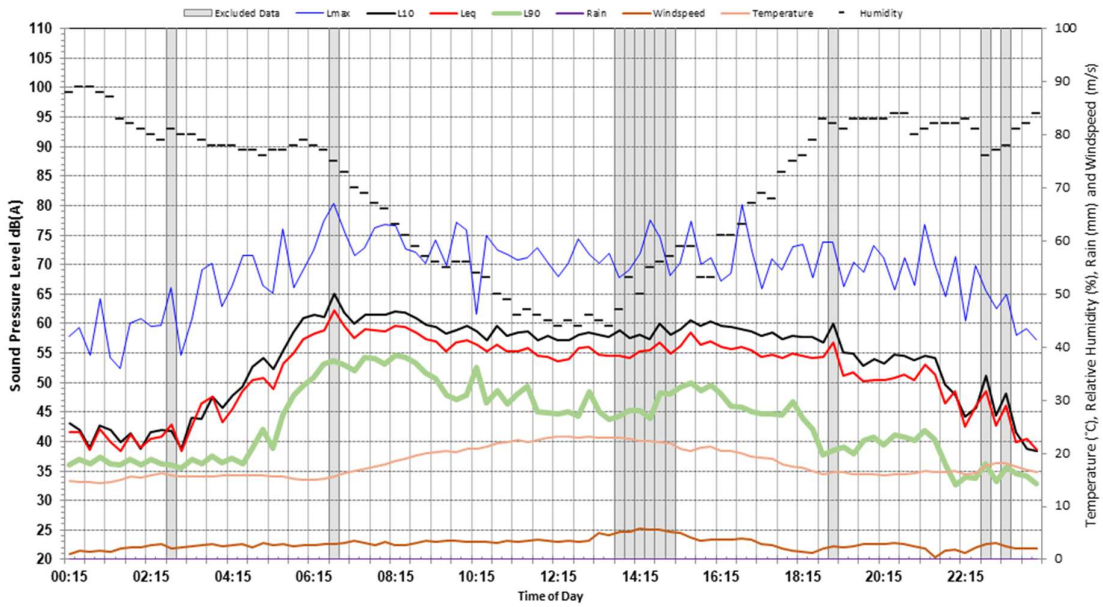
### L.007 - Residential | Tweed Valley Hospital

Sunday, 27 August 2023



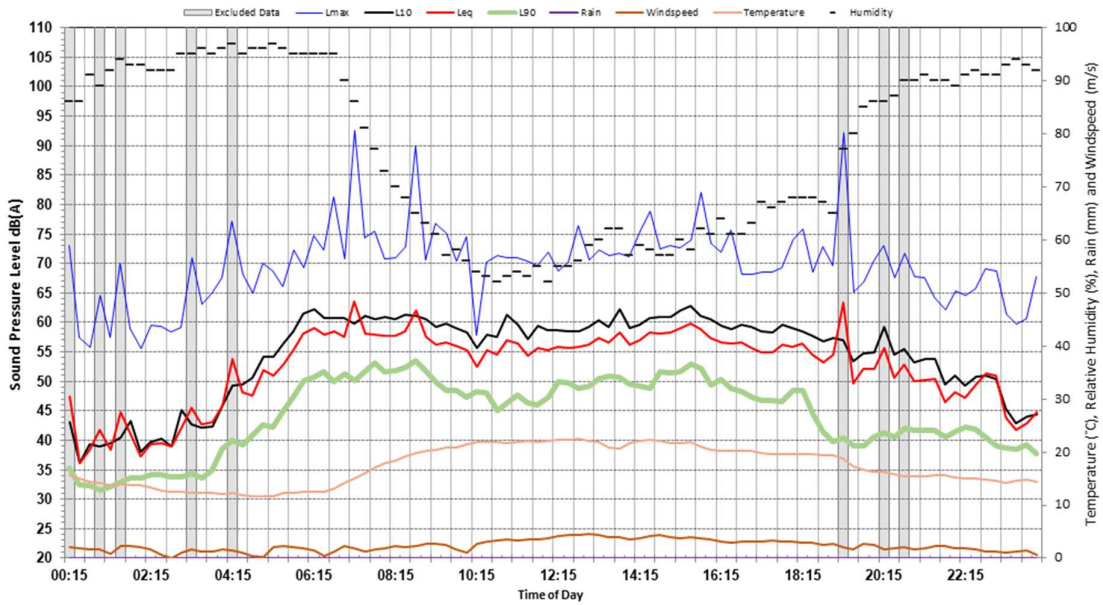
### L.007 - Residential | Tweed Valley Hospital

Monday, 28 August 2023



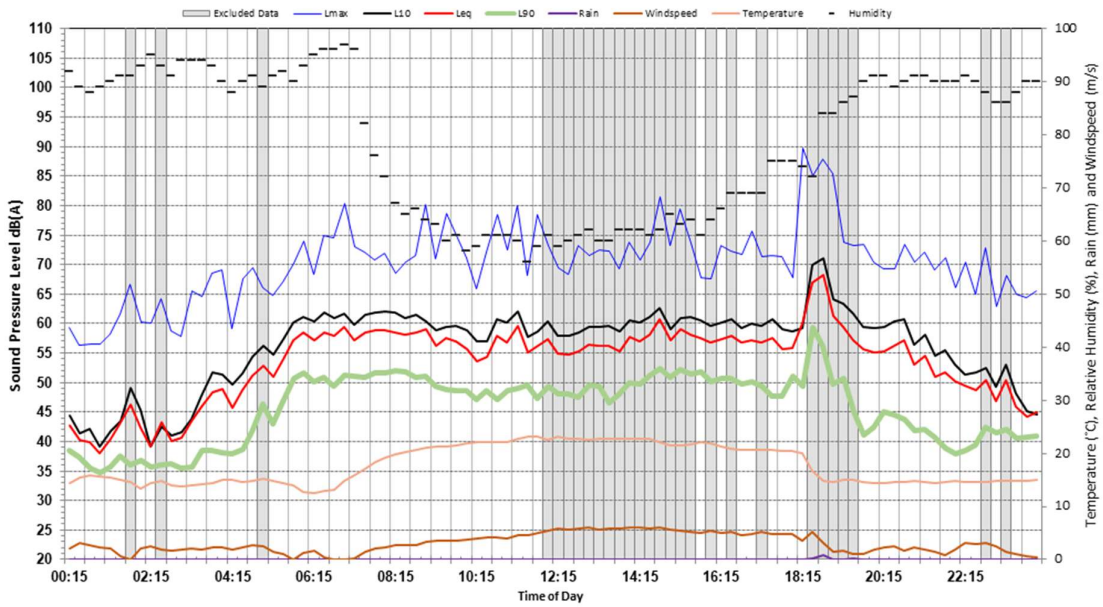
### L.007 - Residential | Tweed Valley Hospital

Tuesday, 29 August 2023



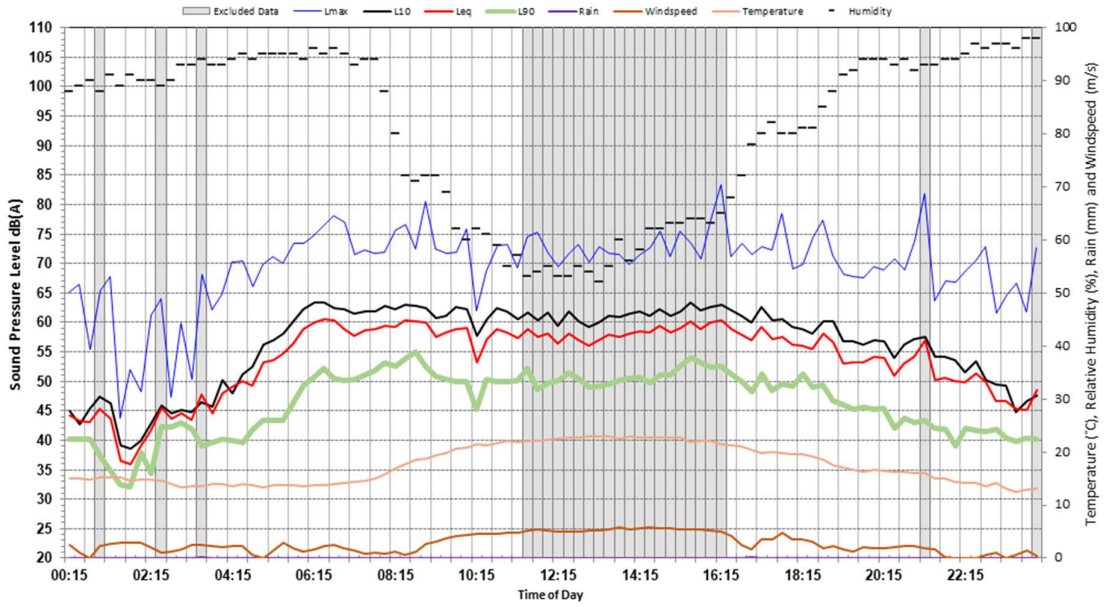
### L.007 - Residential | Tweed Valley Hospital

Wednesday, 30 August 2023



# L.007 - Residential | Tweed Valley Hospital

Thursday, 31 August 2023







*Further details regarding ADE's services are available via*

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