



Noise Monitoring Assessment Report | June 2023

Tweed Valley Hospital, 771 Cudgen Road, Cudgen NSW

Prepared for: Lendlease Building Pty Ltd

Job Number: A101021.0286.00 ENM47 v1.1f | Date: 31/07/2023



ADE
CONSULTING
GROUP

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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 June 2023, each device being positioned along the southern alignment of Cudgen Road and located close to, or adjacent to, sensitive receptors.

The road improvement and widening works on Cudgen Road currently being undertaken were observed to be in close proximity to the SVANTEK Noise and Vibration loggers located at each of the monitoring locations. The roadwork construction activities during the June survey period included activities such as compacting and asphalt works.

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

This report finds the following;

- Noise levels have shown an increase from previous monitoring periods due to night works
 - Alternative accommodation was offered to identified residential receivers, mitigating the immediate impacts of the works at those locations
 - Analysis of data shows that during night works maximum noise levels (L_{Amax}) of up to (and exceeding) 54 dBA may be experienced at noise sensitive residential receivers approximately 400 m distance from the works, indicating potential impacts to sleep disturbance
 - Noise level calculation is based on logger data. Where works progress closer to sensitive receivers this level would increase
 - Noise levels were not defined through operator attended noise monitoring per Health Infrastructures ('HI') requirements
- During standard hours, the Highly Noise Affected criterion is not exceeded (noise levels up to 75 dBA $L_{eq,15min}$ are noted)
- Noise levels presented which are comparable to the noise model output, indicating that noise management practices are ineffective or have not been satisfactorily implemented. Review of the management plan and mitigation measures feasible for implementation is necessary for compliance with CoA **C7**, and **C12**, refer to **Table 2**.

Compliance with the Out of Hours Protocol ('OOH') is yet to be achieved as the alternative accommodation offer benefitted the adjacent impacted receivers only. Noise level spread to the surrounding Kingscliff community were predicted to experience sleep disturbance events (outline in the Construction Noise and Vibration Impact Statement 'CNVIS' Addendum v1.1f). Noise levels are conservatively calculated at 54 dBA (L_{max}) based on measurement data collected and outlined in this report, indicating that noise management strategies are ineffective.

Operator attended noise monitoring is a requirement under the HI OOH Protocol to verify noise predictions. It is to verify the effectiveness of mitigation measures/noise management strategies and refine those strategies and management measures during sensitive time periods with the goal to mitigate impact to noise sensitive residential receivers during the evening/night-time period.

Noise sensitive receivers predicted to experience sleep disturbance during the night-time period would have benefited from implementation of noise management strategies pending the outcome of operator attended noise monitoring at the commencement of night works (per OOH Protocol/CNVIS requirements).

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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.

During the previous reporting period in May and continuing during this survey period, CD Civil are undertaking pavement and compaction works within the road corridor along Cudgen Road in close proximity to identified residential and commercial sensitive receivers.

Much of this work within the road corridor includes construction of permanent footpaths, stormwater drainage and placement of culverts, placement and trimming of road base layer as well as widening the road alignment. The type of plant used by CD Civil to conduct the forementioned works include 10T vibratory rollers, excavators (8 to 12 tonne), multi-tyre rollers, graders and asphalt machines.

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 1.2.1)** 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	
Client Name:	Lendlease
ADE Project Number:	A101021.0286.00
Site Address:	771 Cudgen Road, Cudgen NSW (Lot 11 DP 1246853)
Date of Report:	31/07/2023
Development Consent	SSD-10353, Health Administration Corporation. Authorised by the Minister for Planning and Public Spaces on 9 March 2020. Consent approved on 12 June 2020.
Objectives:	<ul style="list-style-type: none"> • comply with relevant guidelines and conditions C4 – C7, C12 – C14 and B16 of the SSD-10353 consent • 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) • establish and maintain good relationships with the neighbours and wider community.
Key Legislation:	<p>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:</p> <ul style="list-style-type: none"> • environmental protection licensing, as per schedule 1 • regulation of scheduled and non-scheduled activities • environmental protection offences and penalties • establishment of a general duty of care to notify environment harm.

1.2.1 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	C4	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.
	C5	Construction activities may be undertaken outside of the hours in condition C4 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.
	C6	Notification of such construction activities as referenced in condition C5 must be given to affected residents before undertaking the activities or as soon as is practical afterwards.
	C7	The construction hours must include respite periods and specific times for activities during the day (outside the sensitive times), as required by condition B16 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	C12	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 B16 .
	C13	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.
	C14	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 B16 and the Stage 1 works in SSD-9575.
	C15	The intra-day respite periods required to be provided in the CNVMSP in condition B16 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.
	C16	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 C4 .
	C17	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)

1.2.2 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** .

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"> • where the predicted (or measured LAeq(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 • the proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly Noise Affected >75 dBA	The highly noise affected level represents the point above which there may be a strong community reaction to noise <ul style="list-style-type: none"> • 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"> ■ times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences ■ If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> • 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 dBA above the noise affected level, the proponent should negotiate with the community

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 LAeq,15 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 Matts, 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 LAeq,15min	
	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 ¹	Standard hours (RBL +10)	Out of hours (RBL +5)			Sleep Disturbance (RBL +15) dB LA _{Max}
		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 June 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

Note: Monthly field calibrations per AS1055:2018 are carried out, no calibration drift exceeding ± 1 dB has been recorded at 114 dB at 1 kHz
 Note: Svan 92832 (L05) was replaced by Svan 98323 on 15 June. The location of the replacement device was not compliant with AS1055 ‘free field’ distance requirements and was relocated on 21 June to approximately 4 m from a Colorbond[®] fence. Data from prior to this date is not valid nor presented in this report.

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 once per month to ensure calibration drift does not exceed ± 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 fair conditions with some days of average wind conditions, and precipitation resulting in 6 partial days to be removed from analysis in line with acceptable analysis and reporting exclusion requirements set out in the NPfl and AS1055.

Monday 12 June was a public holiday in New South Wales, this day is removed from analysis.

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 – June 2023)

Logger ID	Measured noise levels, dBA												
	Average noise level (Leq)			L10,ave noise level			Background noise levels (RBL)			RNP defined noise level (Leq) ^B			
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day		Night	
										15 hr	1 hr	9 hr	1 hr
L.005 ^A	57	59	55	60	62	58	47	42	36	57	58	55	53
L.006	60	60	55	63	63	58	47	41	36	60	62	55	56
L.007	59	58	54	63	61	57	46	41	35	59	61	54	55

Note A: Dataset incomplete

Note B: 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

Note: Monday 12 June (The King’s Birthday) is removed from analysis

The results of the unattended monitoring in June show an increase in noise impacts recorded at the loggers’ locations primarily due to night-works pertaining to the road improvement works along Cudgen Road.

Following on from the previous months’ works, construction activity in June has recorded some correlated noise impacts arising from construction traffic and plant utilised on-site, as summarised below:

- Final asphaltting corrector and wearing course. Plant include profiler, paver, trucks, 9T drum roller, multi wheeled tyre roller. Proximity to monitors is approximately 10 m. **Note: these works were carried out during out of hours**
- Portable generators live throughout the day. Proximity to monitors is approximately 60 m
- Constant entrance/exit of trucks to site compound for spoil removal and material delivery through main entrance. Trucks involved are semi-trailers, 6-wheelers. Proximity to monitors is approximately 30 m
- Footpath and kerb preparation and pour. Plant include 8T Excavator, 9T Roller and Concrete Trucks.

The following graphs display measured Leq noise levels exceeding 57 dB(A) (to filter out low ambient noise below the nominated NML), and are inclusive of all road traffic noise along Cudgen Road, weather affected noise data has been removed.

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

Figure 1 below presents noise and vibration data processed from the relocated logger redeployed from 21 June onwards.

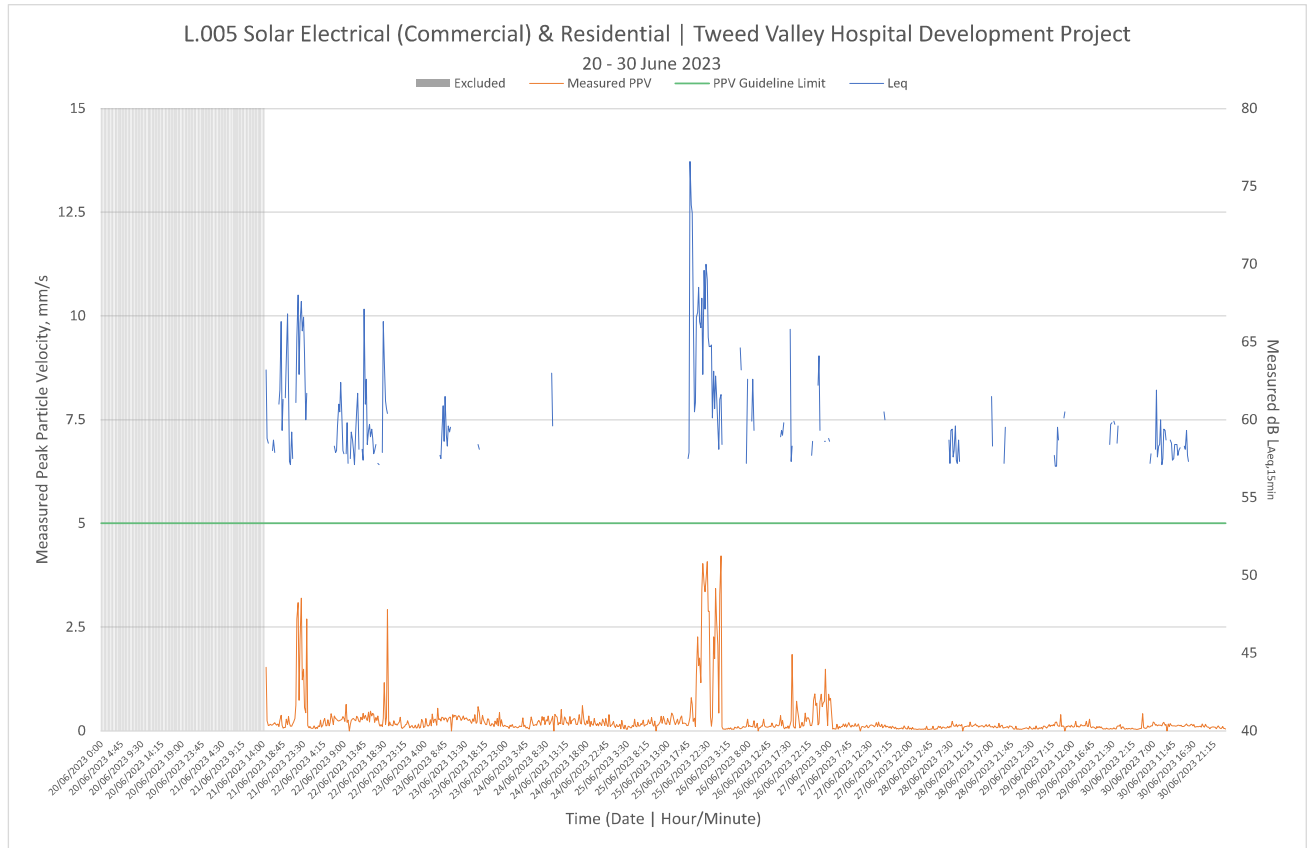


Figure 1 Measured PPV Vibration and Leq noise levels – Location 005 – 21 – 30 June

Some intermittent impact is noted between 20:00 hrs from the 25 June to 02:00 hrs on the 26 June indicating night works were undertaken during this period.

Figure 2 below presents correlation data at Monitoring Location L.006.

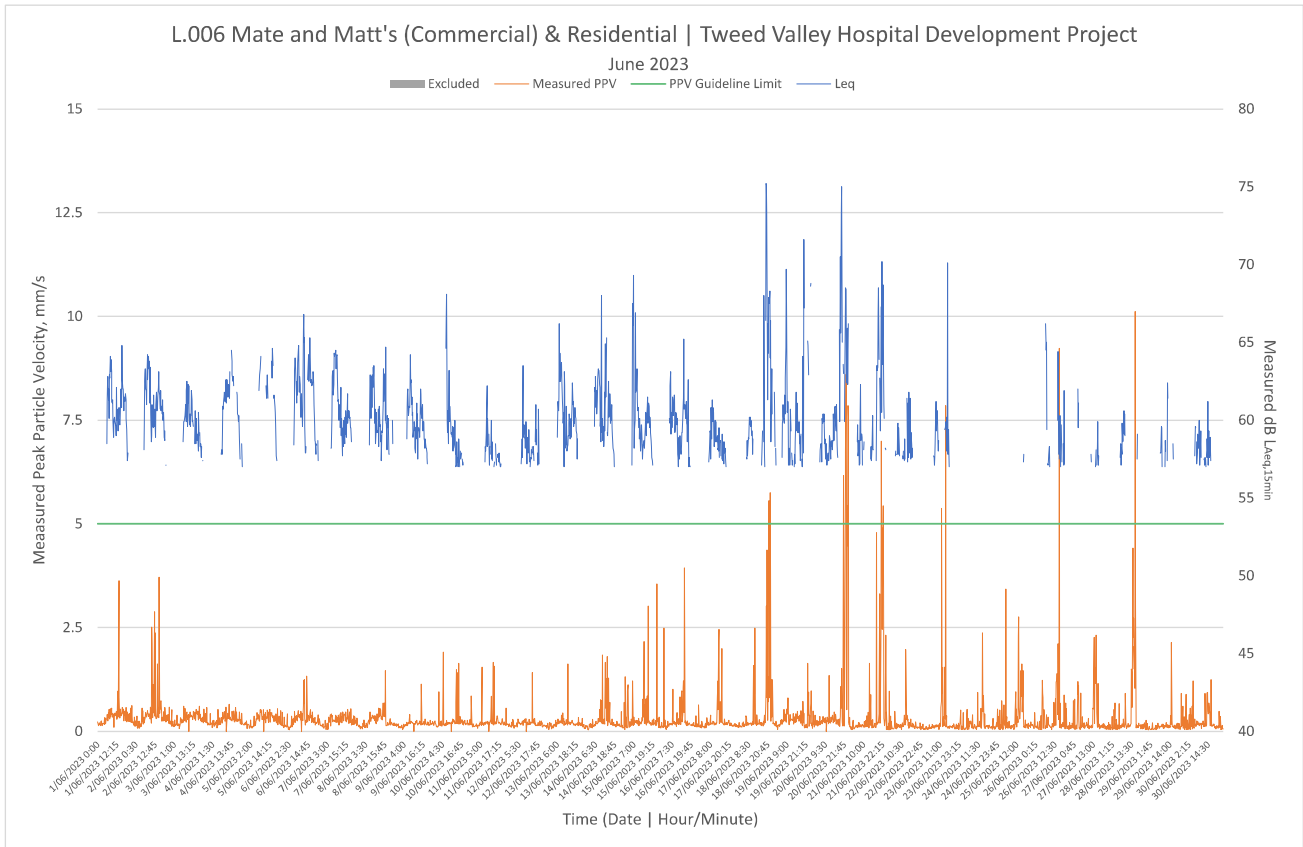


Figure 2 Measured PPV Vibration and Leq noise levels – Location 006

Cumulative noise and vibration at L.006 is also attributed to the use of the nearby field, and the business in operation throughout the typical trade day.

Noise and Vibration impacts are noted during the evening and night-time period where noise levels reached 75 dBA Leq (18 June 19:30 to 22:00 hrs), and on 20 June at 22:00 hrs. Other NML exceedances and impacts from the site are noted on 19, 21 to 23, 27, and 29 June.

Note that the Highly Noise Affected noise level (>75 dBA Leq) only applied to the day-time period during standard working hours (refer to the ICNG and **Table 3**). Noise levels presented are comparable and consistent with the Impact Statement findings at the Addendum, showing that ineffective noise mitigation measures were employed, or adequate mitigation not implemented at site.

Figure 3 which follows presents correlation noise and vibration data at Monitoring Location L.007.

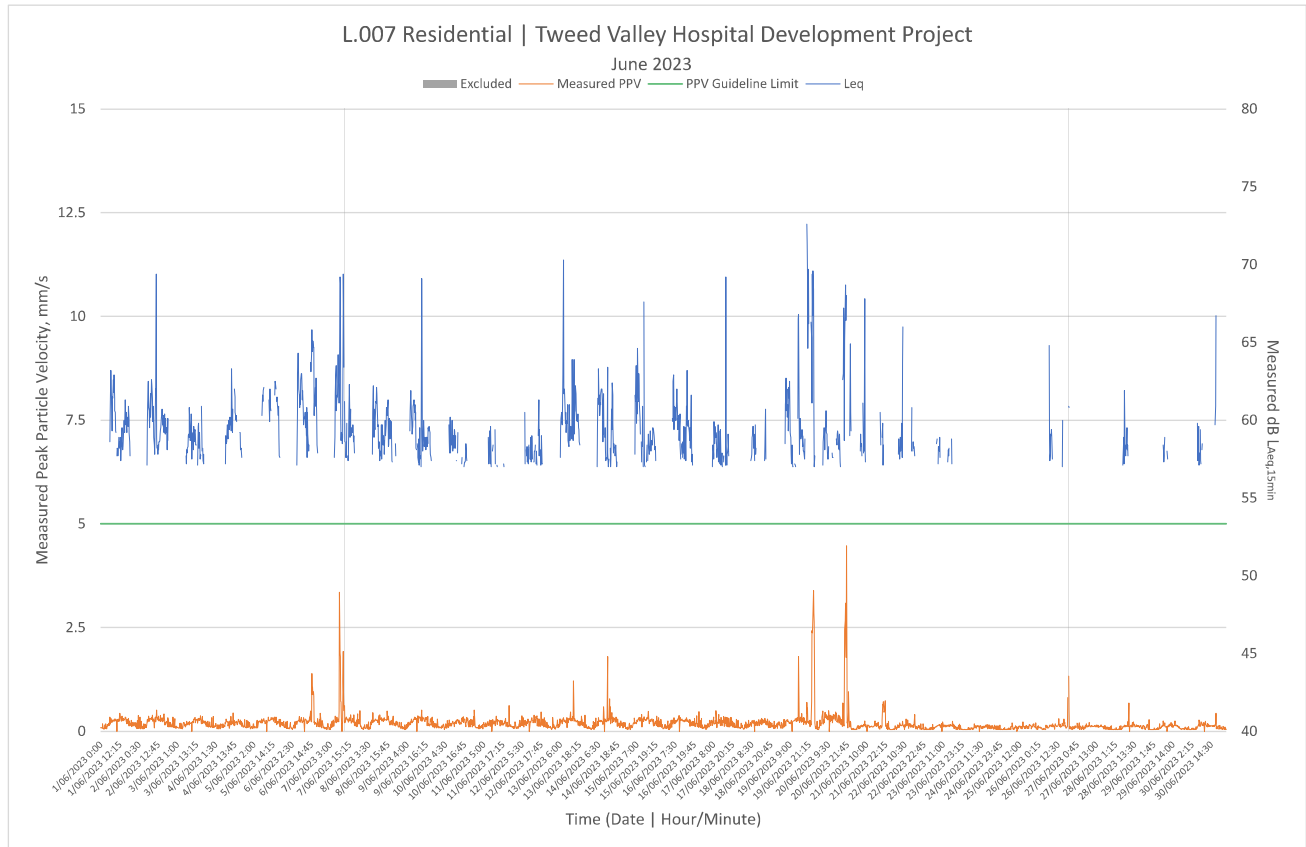


Figure 3 Measured PPV Vibration and Leq noise levels – Location 007

Evening and night works occurring on Monday 19 June measure noise impacts up to 73 dBA Leq (19:45 hrs) during the evening period, and 70 dBA Leq (23:45 hrs) during the night-time period. The works impact had returned to nominal noise levels approximately 01:15 hrs.

3.3 Discussion

Night works were carried out along the road carriageway between approximately 19 and 26 June. The immediate noise impacts were mitigated through Alternative Accommodation ('AA') offers to the residences predicted to be impacted by the works outlined in the CNVIS Addendum version 1.1f presented to the client in April of 2023.

Other findings of the Addendum assessment also include the necessity for operator attended noise monitoring at other identified premises, and, other community notification methods such as specific notification, individual briefing and phone calls.

The AA offers, where accepted by impacted residences, would mitigate noise during the worst-case scenario for those receivers, noting that noise levels measured are consistent with the noise levels predicted in the CNVIS (76 dBA Leq).

ADE understands that this phase of the asphalt works required to be undertaken during night works is complete. Operator attended noise monitoring has not undertaken at other premises to verify the impact on other sensitive receivers or to confirm the Addendum's L_{max} noise assessment (ie sleep disturbance/awakening).

The noise management practices outlined in both the Management Sub-Plan, and the CNVIS and its subsequent addendum prepared for CD Civil were required to be employed at all times. The purpose of undertaking operator attended noise surveys, is to:

- Verify the the noise model data, as additional mitigation measures (defined by HI's Out of Hours Protocol) where identified for management of noise impacts are assigned on a per-receiver basis, where, or as necessary, per the CoA and other approvals under the project
- Define and categorise the impact with consideration to the existing ambient environment and confirm the implemented mitigation measures sufficient to control the spread of noise or manage impact to sensitive receivers, and that no additional mitigations are necessary, or would be necessary. The noise survey findings which exceed the noise model may:
 - Indicate that the noise model parameters are insufficient to inform the client of their mitigation requirements
 - Present findings which are inconsistent with information provided to ADE at the time of the assessment, including the area which is under assessment or survey investigation
 - Inform the client that a review of the management sub-plan is required, necessitating the need for additional mitigation management or other impact control measures, where feasible and reasonable.

Alternative accommodation alone would be insufficient per the requirements outlined in the Out of Hours Protocol and, on that basis, compliance with the protocol is not achieved. However, no complaint or concern has been lodged to our knowledge.

ADE reached out to the client for more information pertaining to the night works and noise/vibration findings during out of hours, outlined in this report. A response is pending as at the preparation of this report (ENM47 v1.1f).

3.3.1 NML exceedances

Onsite observations confirmed that construction activities and roadworks were occurring in close proximity to the noise logging devices at each monitoring location. Recorded noise levels were exceeding the noise management levels at each device's location. Note that the existing road traffic noise is the dominant noise source responsible for a steady noise level which also exceeds the NML at the loggers' locations.

The NML exceedances and measured noise levels recorded during the June monitoring period are consistent with the predicted noise results of the CNVIS (**Section 5.2.4**). That the noise levels are consistent with, and not lower than the predicted worst-case scenario out lined in the Addendum (for night works) is indicative that noise management strategies are ineffective, and, that residential land uses predicted to experience sleep disturbance events during the night-time period may have been impacted greater than what is being reported in this report.

Analysis of the collected L_{max} noise data shows maximum noise levels up to 86 dBA (L_{max}) during known night-time activities at L.006. Basic propagation calculation shows that, at a known distance of approximately (and conservatively) 10 m to predicted sleep disturbance affected residences approximately 400 m from the site, a noise level of up to 54 dBA L_{max} may have been experienced by other noise sensitive residential receivers along Yale Street in Kingscliff. T

The L_{max} prediction is based on data collected at one site during night works. Where the works are closer to the residential receivers along the alignment, the noise level would be higher, hence the impact would likely be greater than that which is reported here. This necessarily concludes that noise management strategies were ineffective.

3.3.2 Management of Noise

ADE prepared a Construction Noise and Vibration Impact Statement in October 2022 which assessed the road works as a whole activity separate from the hospital main works. An addendum was prepared in April 2023 which addressed construction activities proposed to be undertaken during out of hours.

The two technical reports outline the following information:

- Overview of noise intensive works
- Predicted impact per receiver
- General mitigation and standard management practices to minimise and control/manage impact
- Per-receiver based Additional Mitigation Measures ('AMM') to accord with Health Infrastructure's Out of Hours Protocol; the controlling document for works under HI in which additional mitigations are considered mandatory, on the outcome of the noise assessment, and, subsequent operator attended noise monitoring
 - Noise surveys define and categorise site impact to refine, modify, or amend management plans, practices, and management measures.

In accordance with the mandatory AAM outlined by Health Infrastructure's Out of Hours Protocol (which includes standard hours mitigation), Letterbox Drops and Attended Noise Monitoring is required to assess noise impacts at the boundary of the most impacted sensitive receivers during the evening and night-time period where receivers are predicted to experience high noise levels which may cause sleep disturbance.

Review of the analysed data, communications to ADE with respect to the Monitoring Plan outlined in the CNVIS, the CNVMP prepared by LendLease, and with further consideration of the works schedule including night works during the months of May and June, the following mandatory management practices are summarised:

- Operator Attended Noise Monitoring per the NPfl and Australian Standard AS1055:2018
 - Where noise measurement exceeds 75 dBA $Leq,15min$, the contractor is to hold works until reasonable and feasible mitigation measures are implemented and confirmed. In adherence to the current site-specific noise and vibration plan management measures, the following actions are also recommended to demonstrate the effectiveness of the applied strategies
 - All extraneous data such as adverse weather will be removed from analysis where applicable. If external noise sources (ie farming or commercial activities) have been identified to contribute to measured noise levels, the Leq contribution would be estimated to calculate the impact of the construction works at the boundary locations or other monitoring locations
- Additional mitigation measures, where operator attended noise monitoring demonstrates noise levels consistent with worst-case noise modelling, ineffective mitigation measures, no implementation of mitigations measures, or any combination of the aforementioned components, may inform updated management practices and strategies to manage noise impacts on the surrounding community during sensitive time periods.

ADE is made aware of Lendlease letter box drops and offers for alternate accommodation to adjacent impacted sensitive receivers, and at the time of writing await advice on the additional mitigation measures mandated by the Out of Hours Protocol inclusive of attended monitoring, respite periods (during night time works) and individual receiver briefings/phone calls to the wider community impacted by the works, as identified in the CNVIS Addendum (v1.1f) issued April 2023.

The noise impacts from the site were not yet defined or categorised per the OOH protocol requirements set by HI as attended monitoring is yet to be undertaken to ascertain the noise impact during night works. Mitigation measures and management of site impact per the CNVIS/Addendum is designed to be under review pending the outcome of the noise survey.

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 June 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 are on-site undertaking approved road work activities within the Cudgen Road corridor, with night works underway between approximately 19 to 26 June.

Noise Management Level exceedances (exclusive of existing traffic noise) have been identified with works and plant associated with construction activity for the Cudgen Road and intersection upgrade. In summary:

- ADE Noise and Vibration Logger L.005 was replaced and data prior to 21 June is not available
- Noise levels have shown an increase from previous monitoring due to night works
 - Alternative accommodation was offered to identified residential receivers, mitigating the immediate impacts of the works at those locations
 - Analysis of data shows that during night works, maximum noise levels (L_{max}) of up to 54 dBA may be experienced at noise sensitive residential receivers approximately 400 m away from the works, indicating potential impacts to sleep disturbance
 - Noise levels captured at the logging location L.006 have been used to calculate the potential L_{max} at noise sensitive receivers predicted to experience sleep disturbance. Where works are closer to these receivers along the alignment during night works, the L_{max} noise levels would be higher, and therefore the impact would be greater than that which is described in this report
 - Noise levels were not defined through operator attended noise monitoring per HI requirements
- During standard hours, the Highly Noise Affected criterion is not exceeded (noise levels ≤ 75 dBA $L_{eq,15min}$ are noted)
- Noise levels presented which are comparable to the noise model output, indicating that additional noise management practices are necessary. Review of the management plan and mitigation measures feasible for implementation are both necessary for compliance with CoA **C7** and **C12**, refer to **Table 2**.

The CNVIS presents mitigations and management practices and strategies, where implemented (where feasible and reasonable) would be anticipated to lower the impact of the works. Noise monitoring would be required where any implementation is undertaken to confirm the effectiveness of noise/vibration management practices, or, ensure that the implemented management plan would still be effective in the management of the noise generated from the site, as described in this report and other monitoring periods during roadwork construction activities.

The recommendations and requirements outlined below are strongly encouraged for future works within the road corridor:

- As part of continued community consultation, particularly leading into works with potential high noise output or leading into nightworks, community consultation via Letterbox drops to all surrounding sensitive land uses (including the TAFE), is recommended
- Operator Attended Noise Monitoring at the boundary of the most impacted residential receiver during all night works, and for all noise intensive works identified in the CNVIS, is required
- Detail relating to these and other previously mentioned recommendations has been provided in **Section 3.3**.

The Site has not yet achieved compliance with the CNVIS, CNVMP, and the Out of Hours Protocol (which includes daytime management, outlined in the CNVIS), and by extension the Conditions of Approval instrument SSD-10353 described in **Section 1.2.1**.

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 (2×10^{-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.

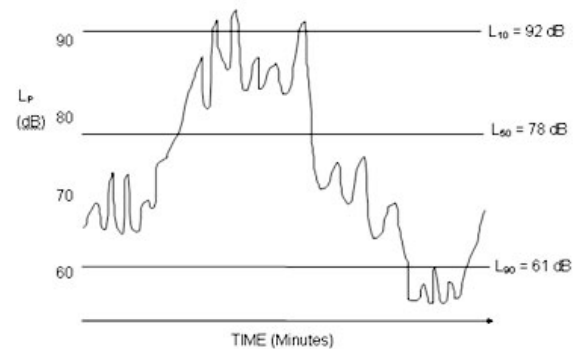
A change of 1 to 2 dB(A) is difficult to detect, whilst a change of 3 to 5 dB(A) corresponds to a small but noticeable change. A 10 dB(A) change corresponds to a doubling or halving in apparent loudness.

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

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



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



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

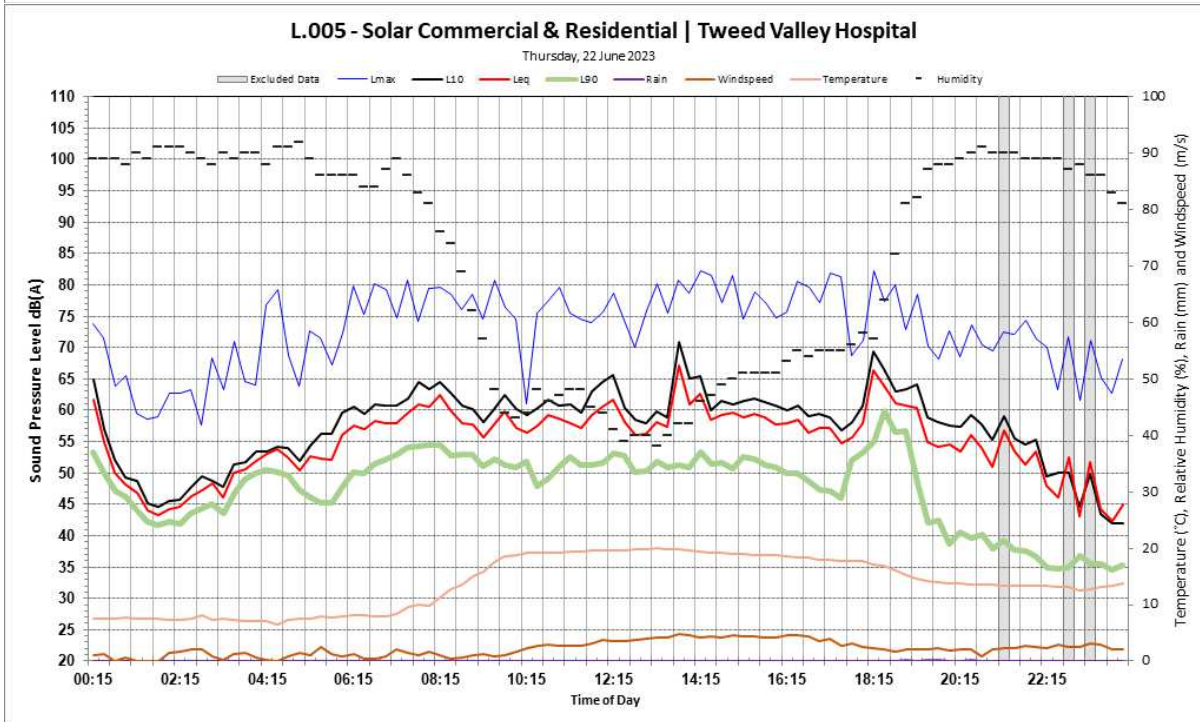
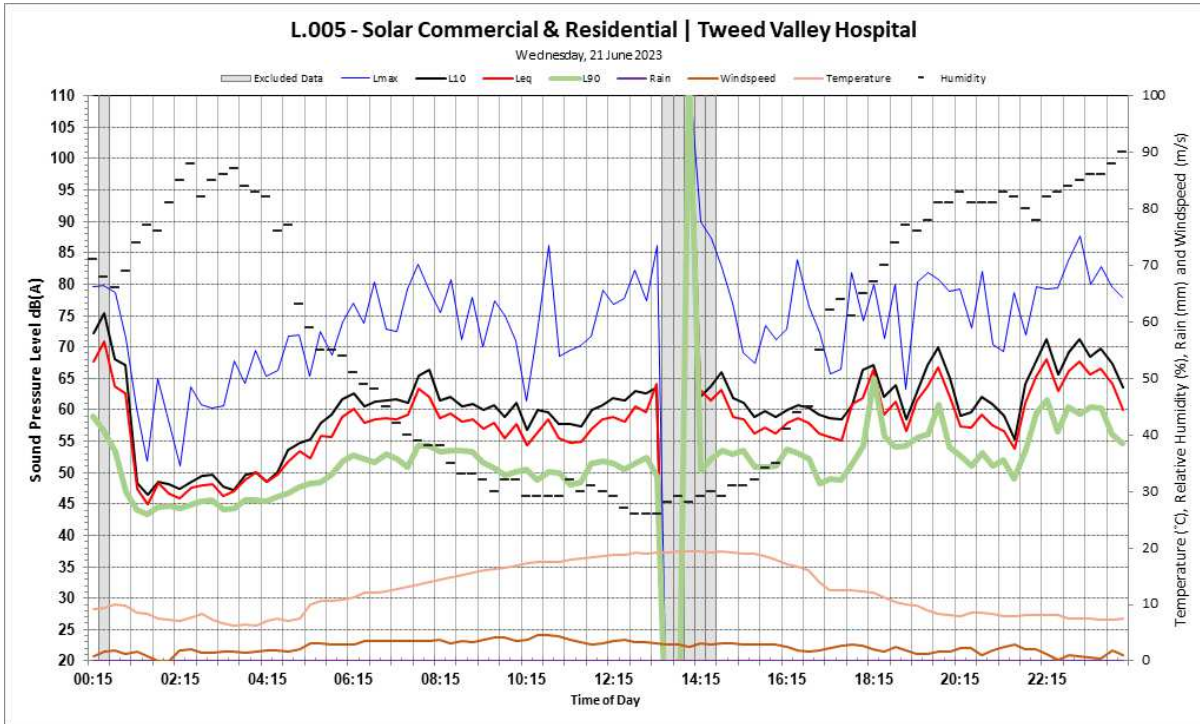


Photograph 2 Representative photograph of monitoring location 005 – Solar Industry, as observed 17/04/2023



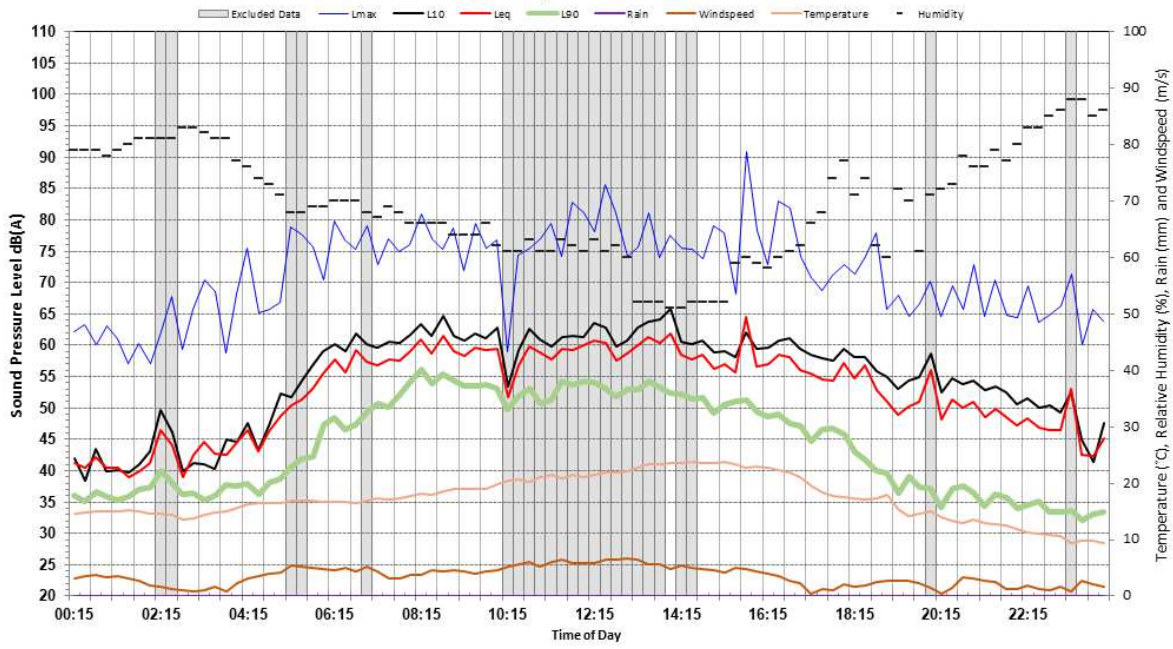
Photograph 3 Representative photograph of monitoring location 006 – Mate and Matts, as observed 17/04/2023

Appendix V – Noise Graphs



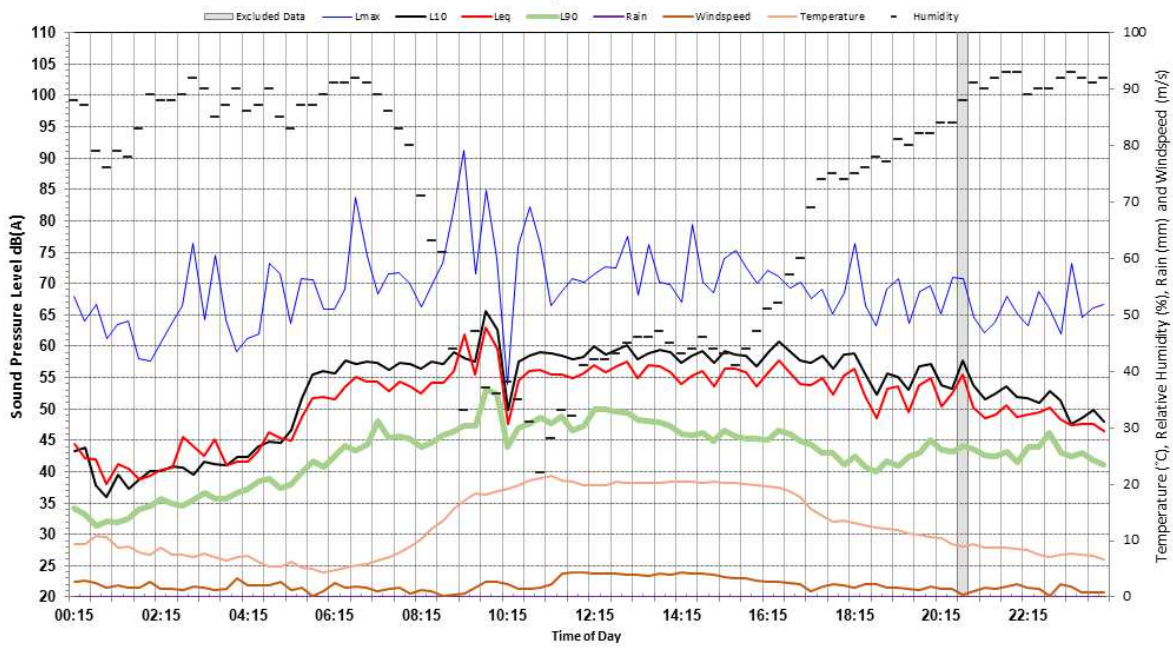
L.005 - Solar Commercial & Residential | Tweed Valley Hospital

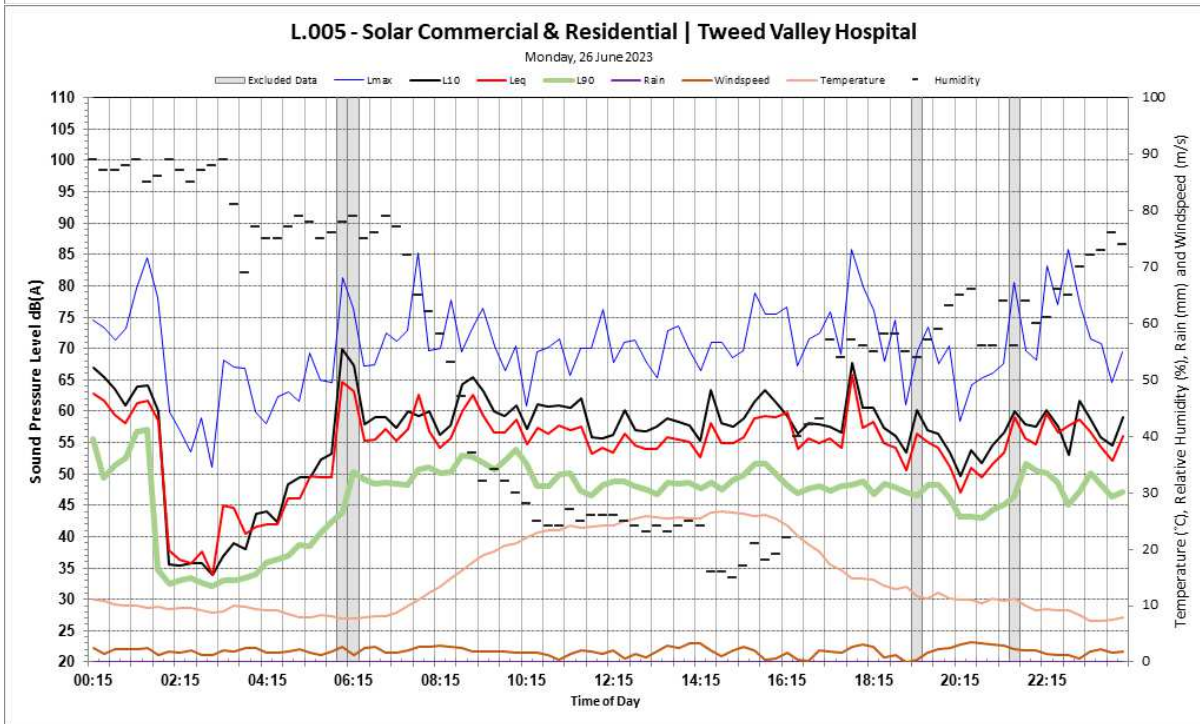
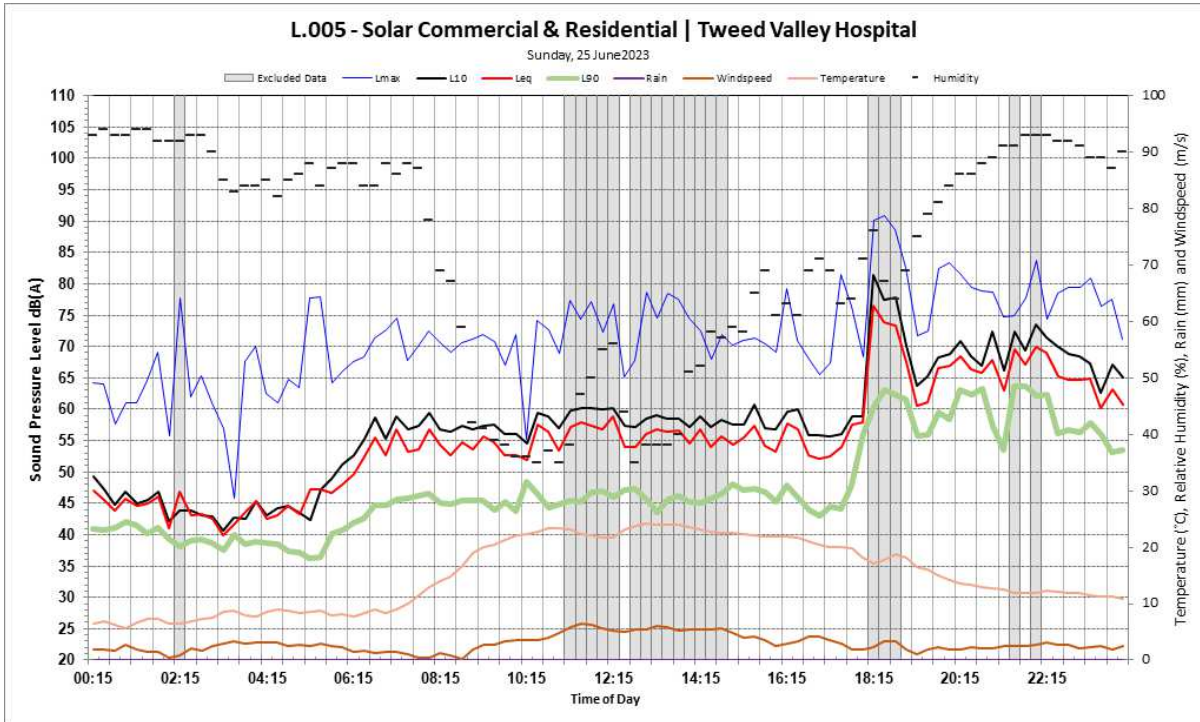
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L.005 - Solar Commercial & Residential | Tweed Valley Hospital

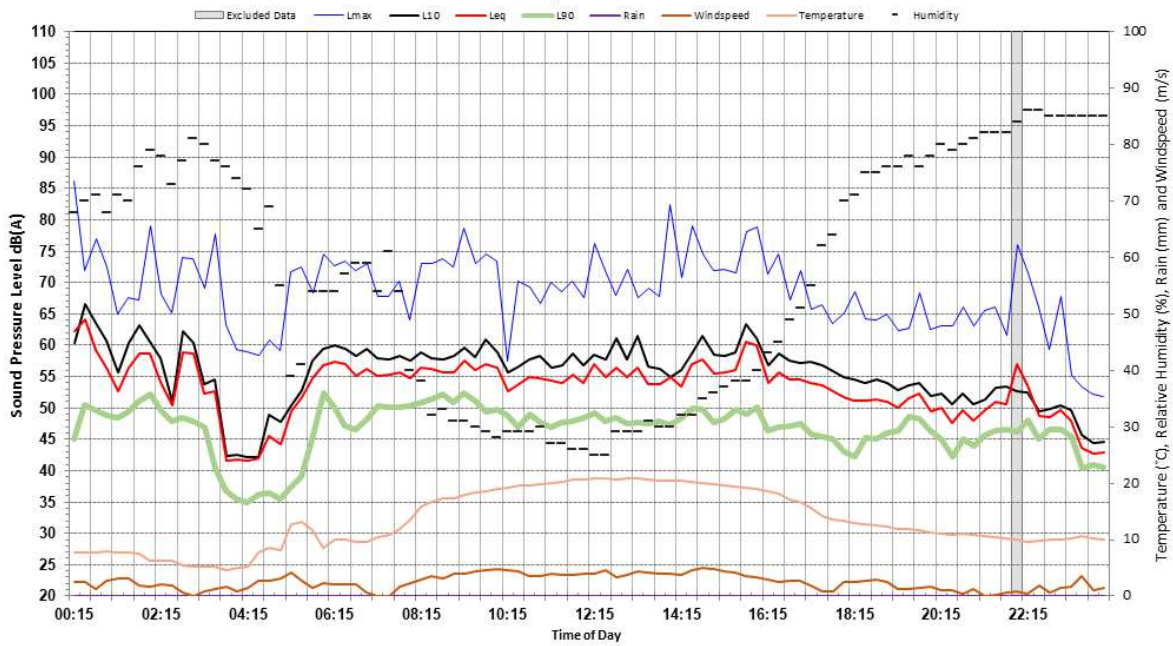
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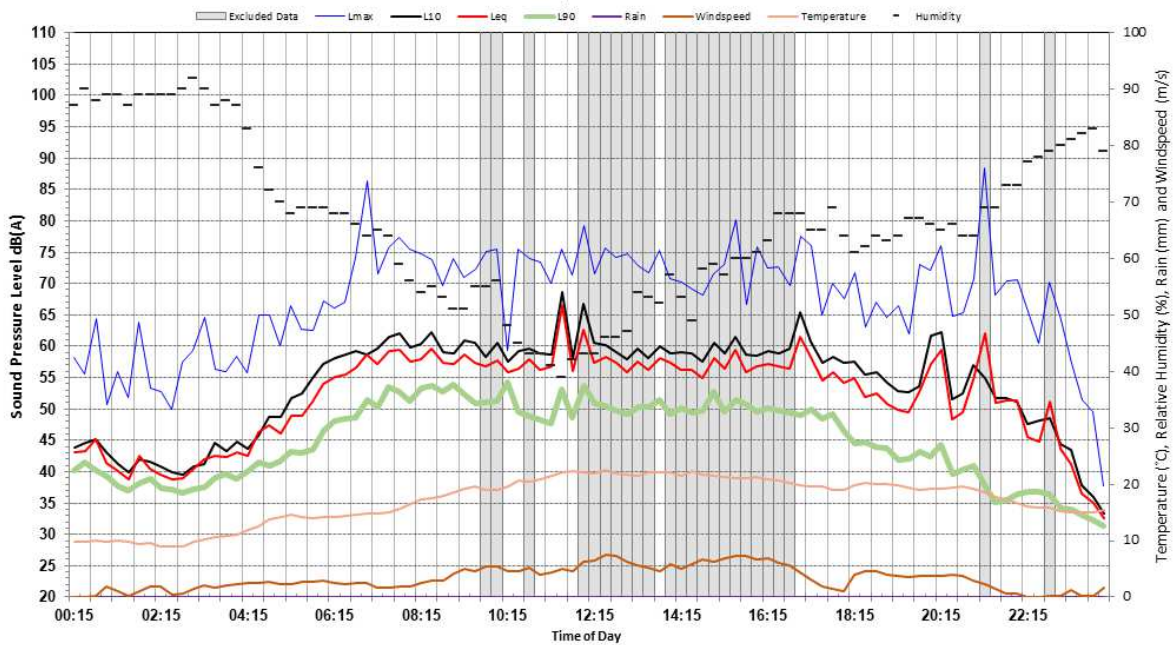
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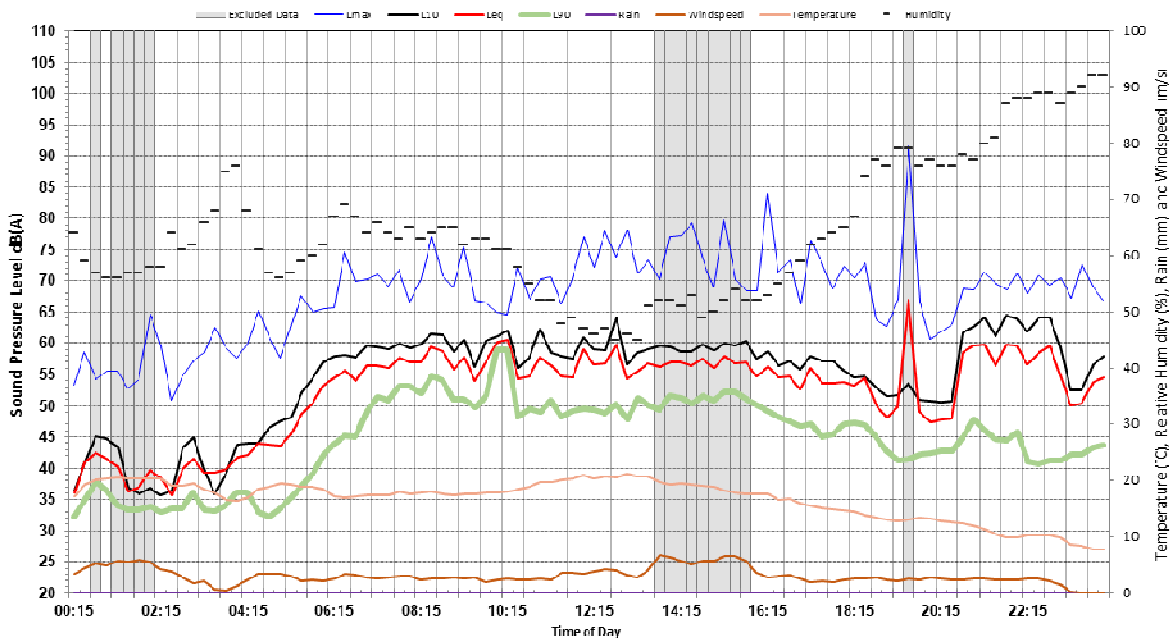
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Wednesday, 28 June 2023



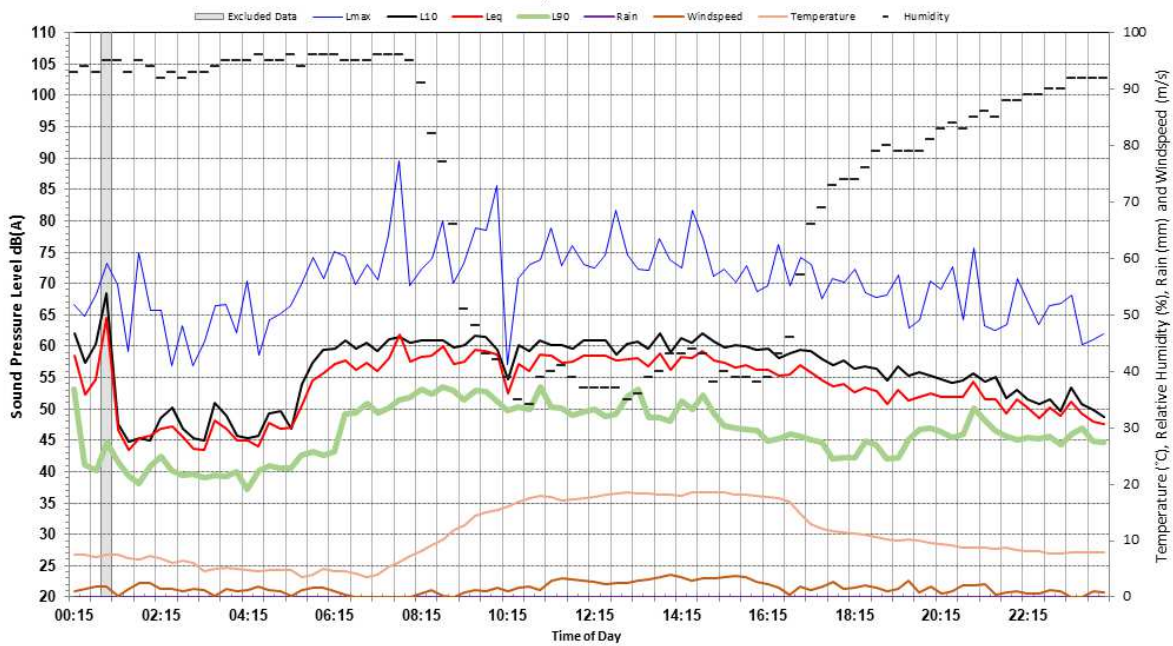
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Thursday, 29 June 2023



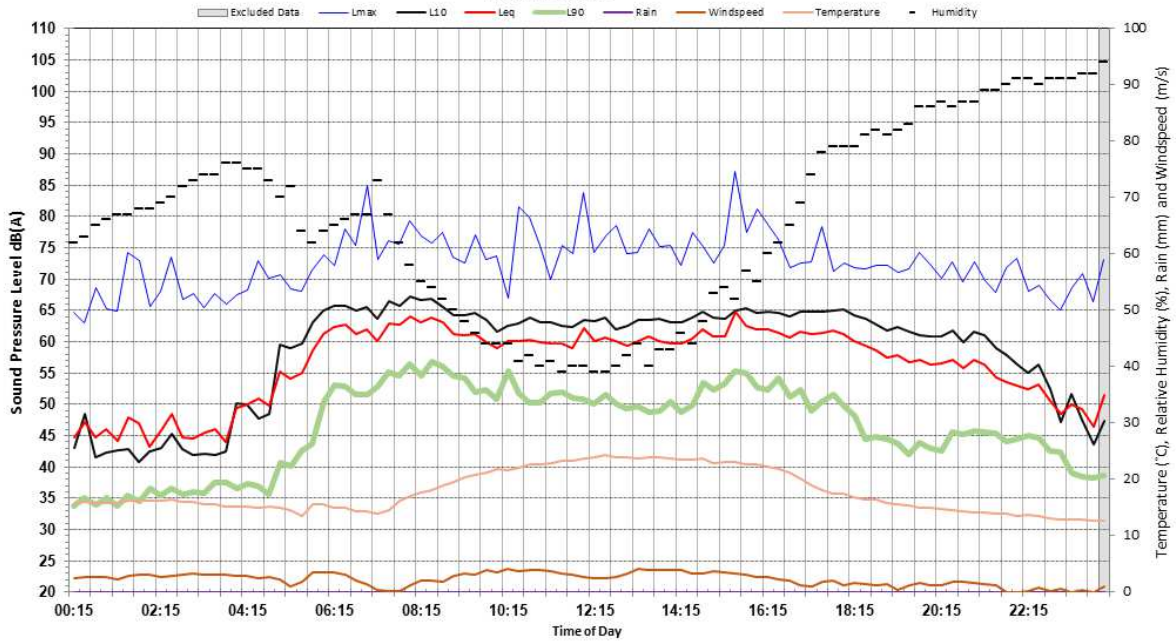
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Friday, 30 June 2023



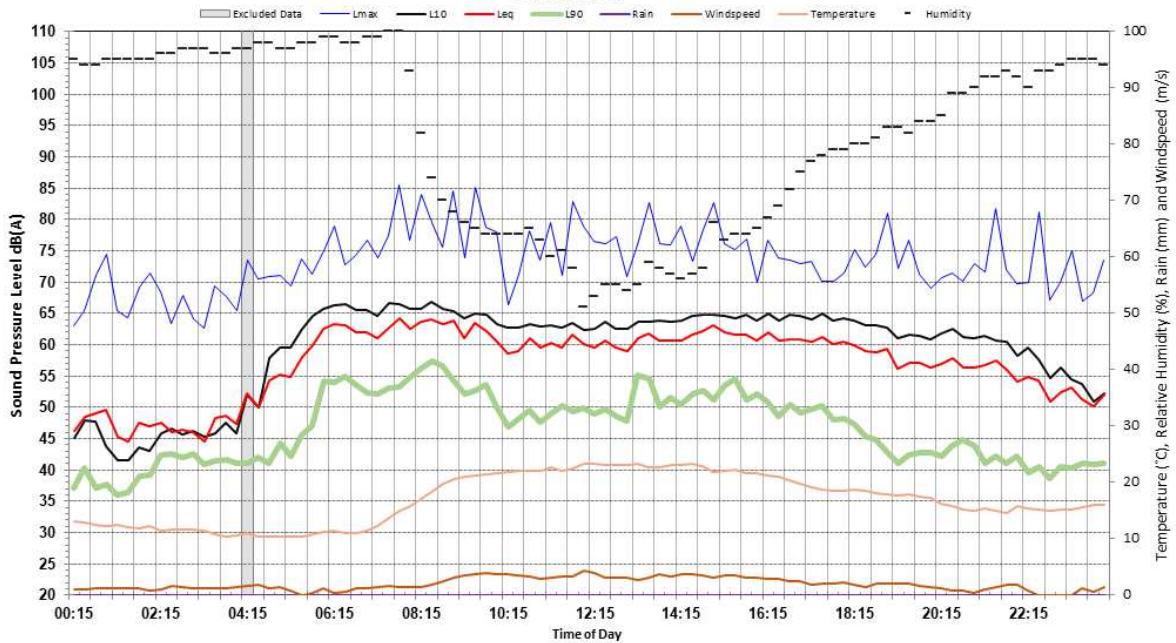
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Thursday, 1 June 2023



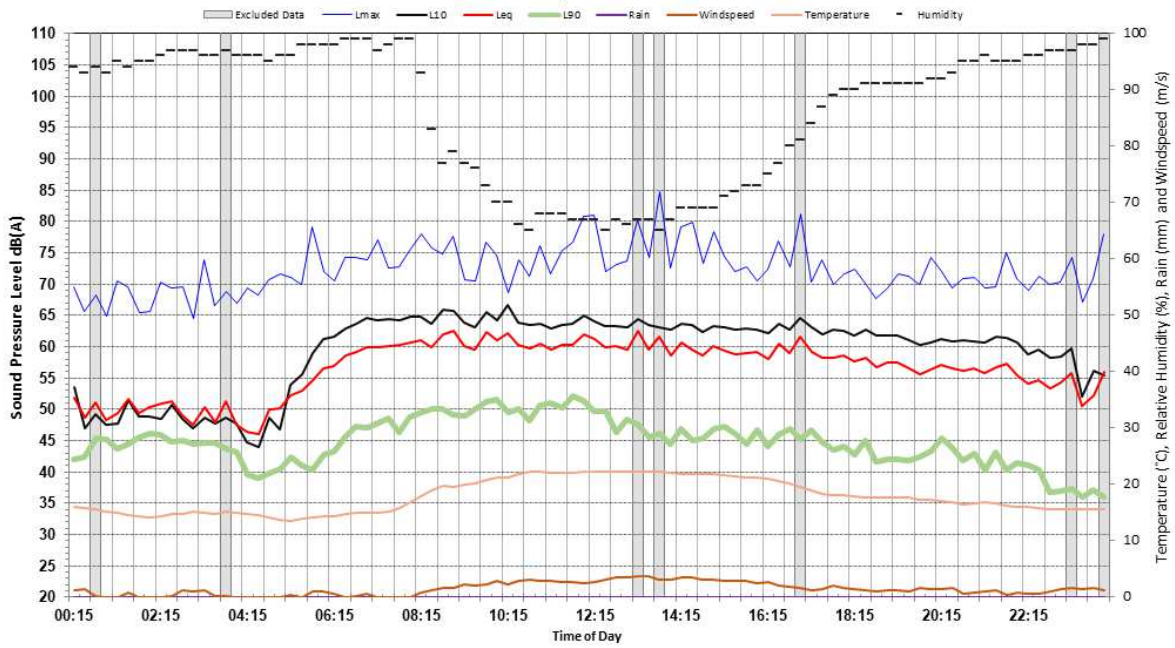
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Friday, 2 June 2023



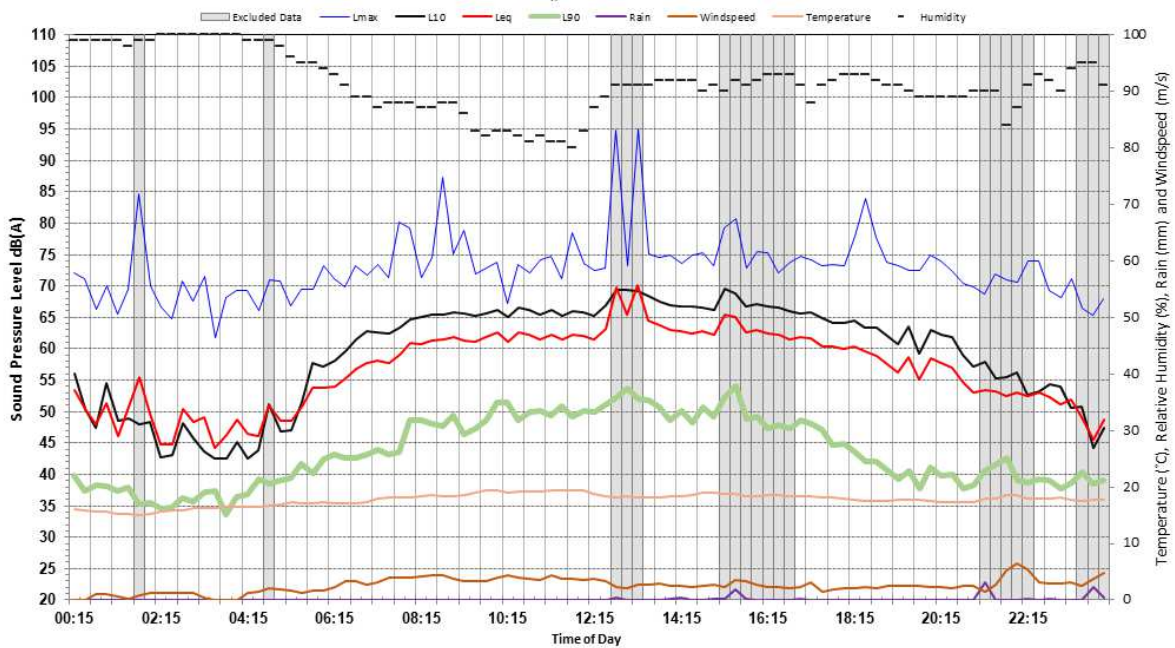
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Saturday, 3 June 2023



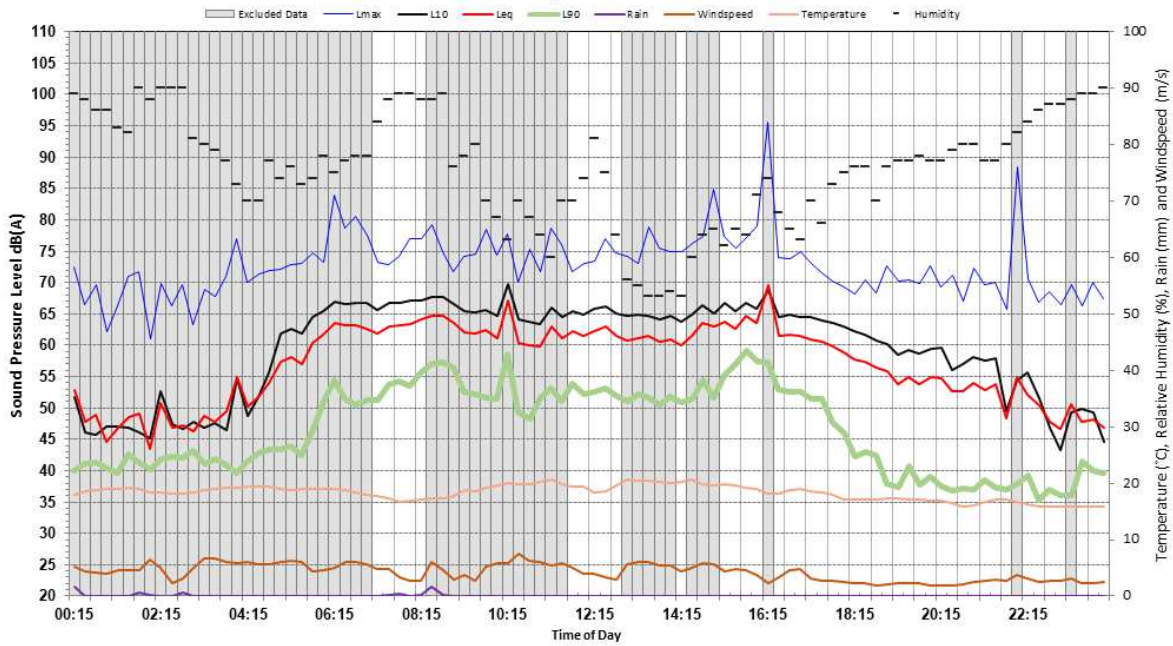
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Sunday, 4 June 2023



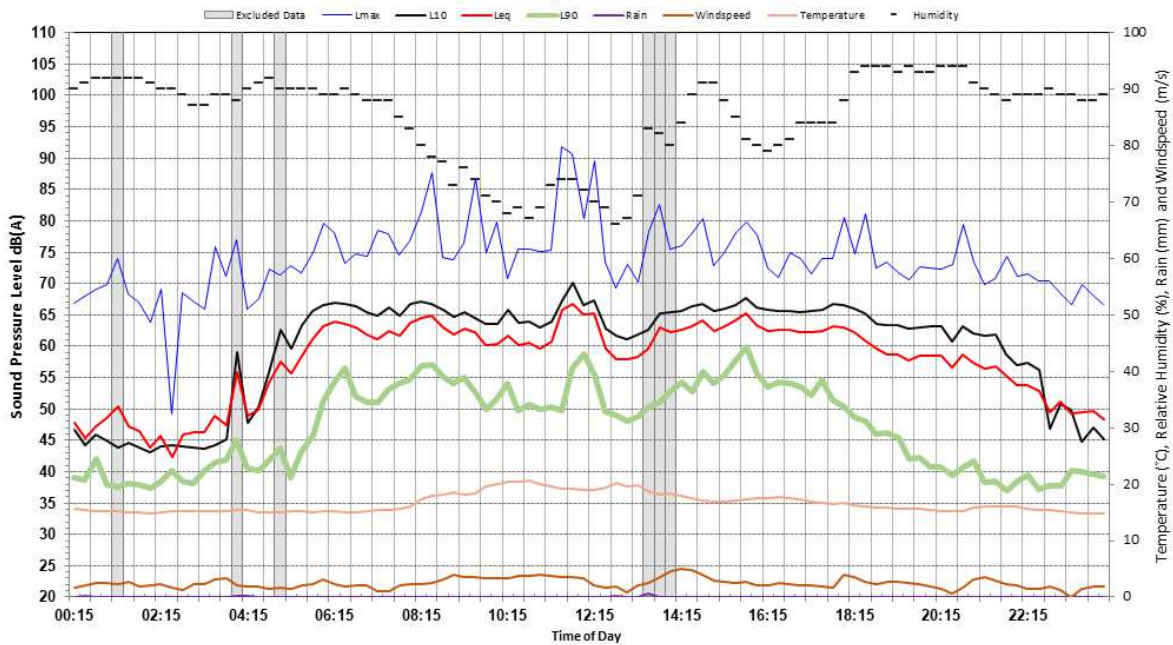
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Monday, 5 June 2023



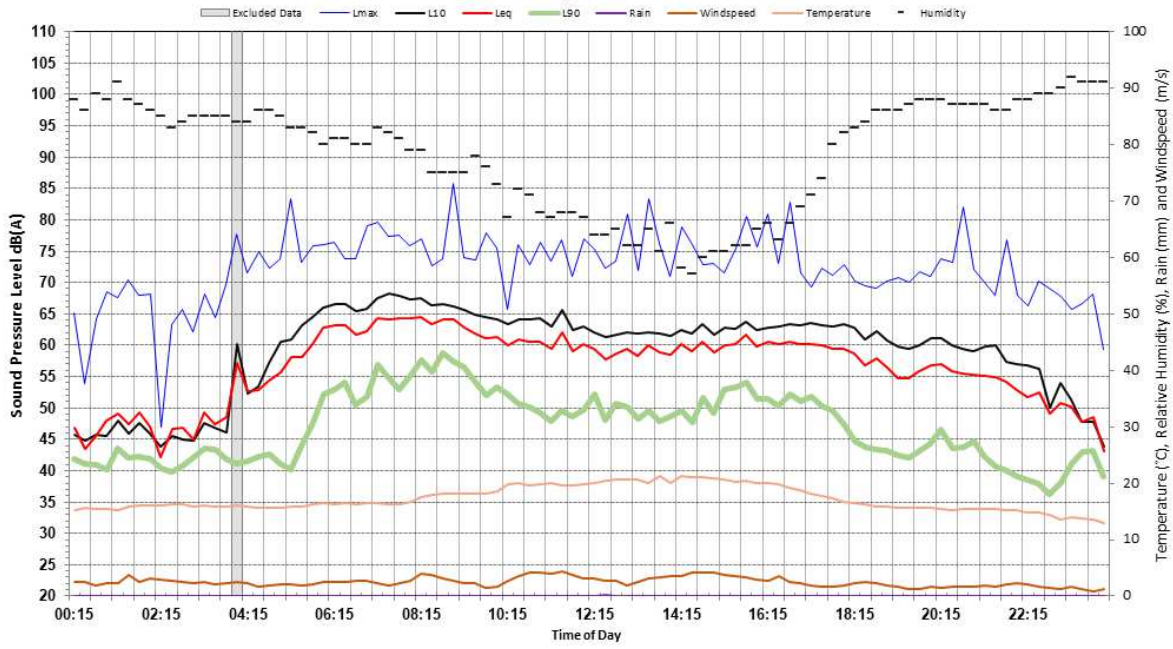
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Tuesday, 6 June 2023



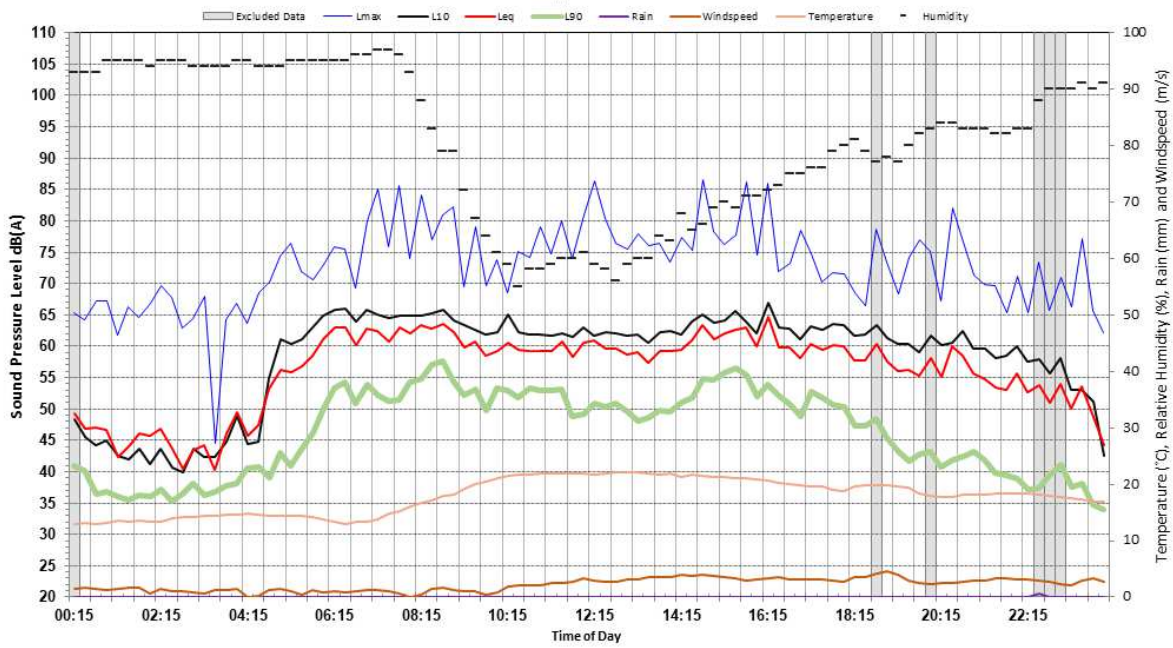
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Wednesday, 7 June 2023



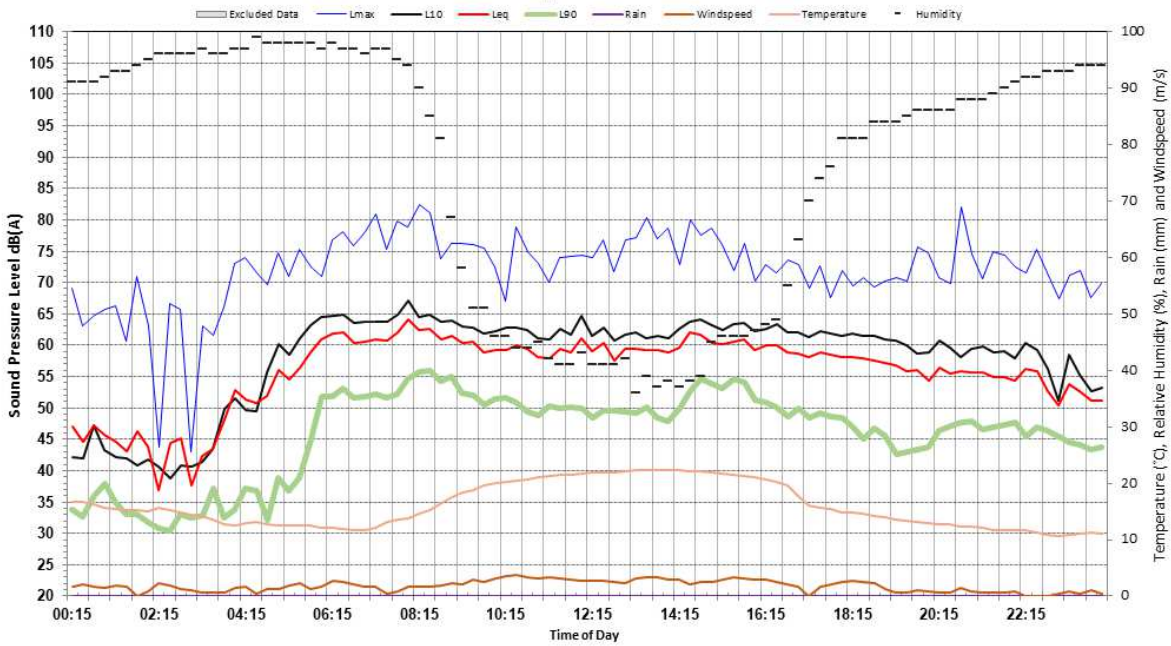
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Thursday, 8 June 2023



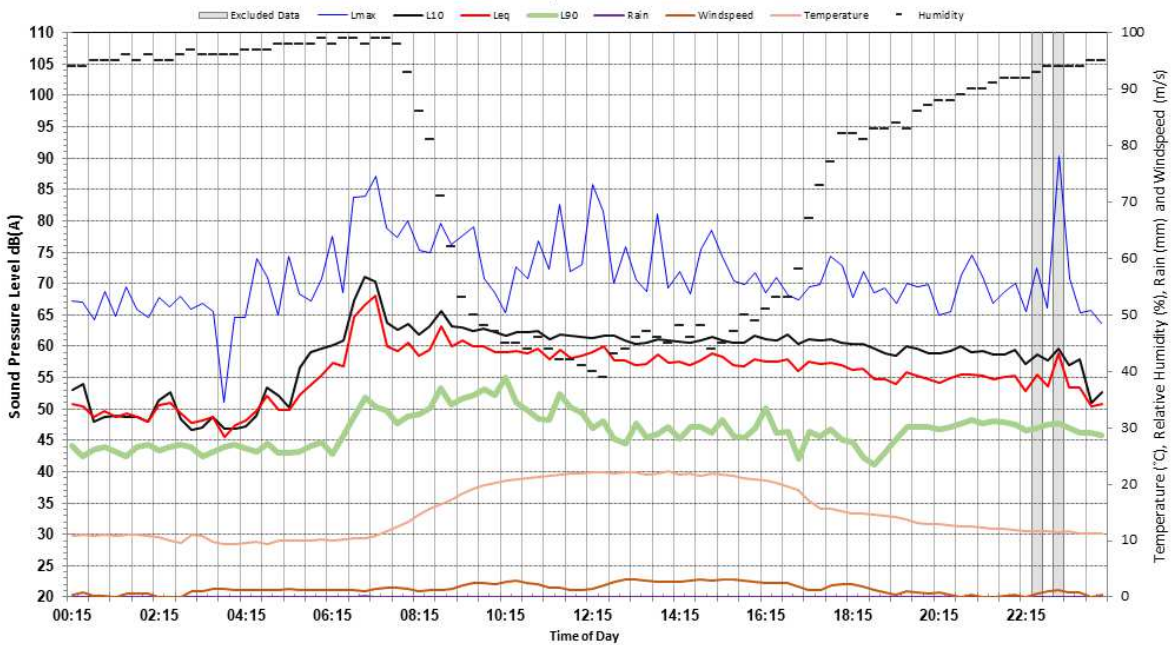
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Friday, 9 June 2023



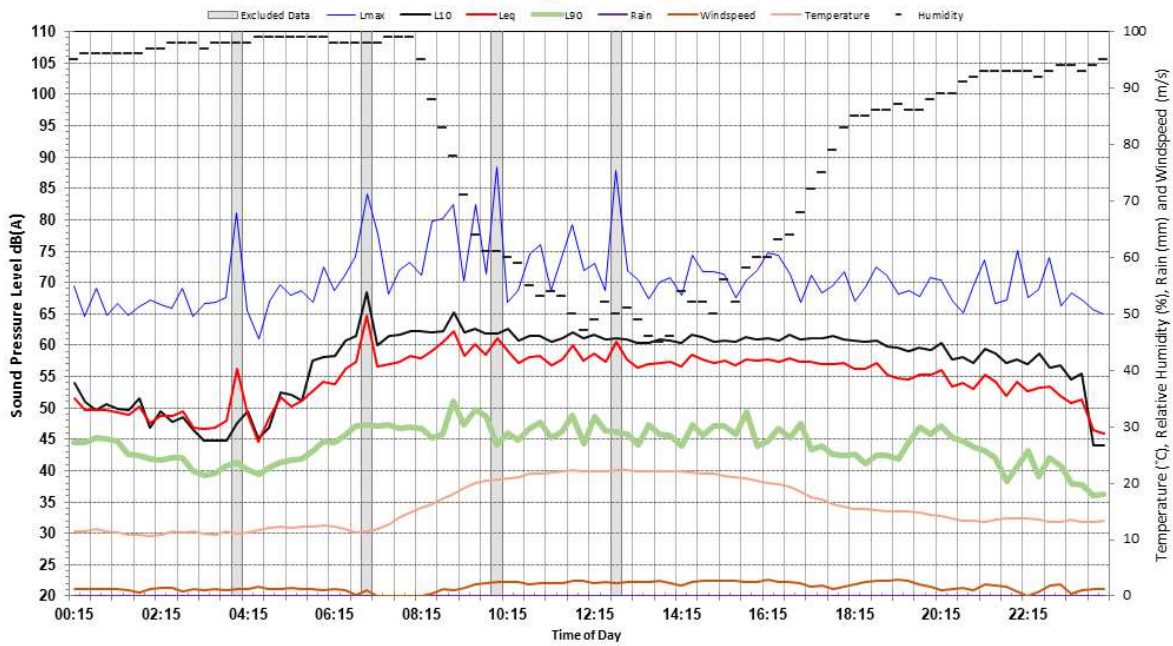
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Saturday, 10 June 2023



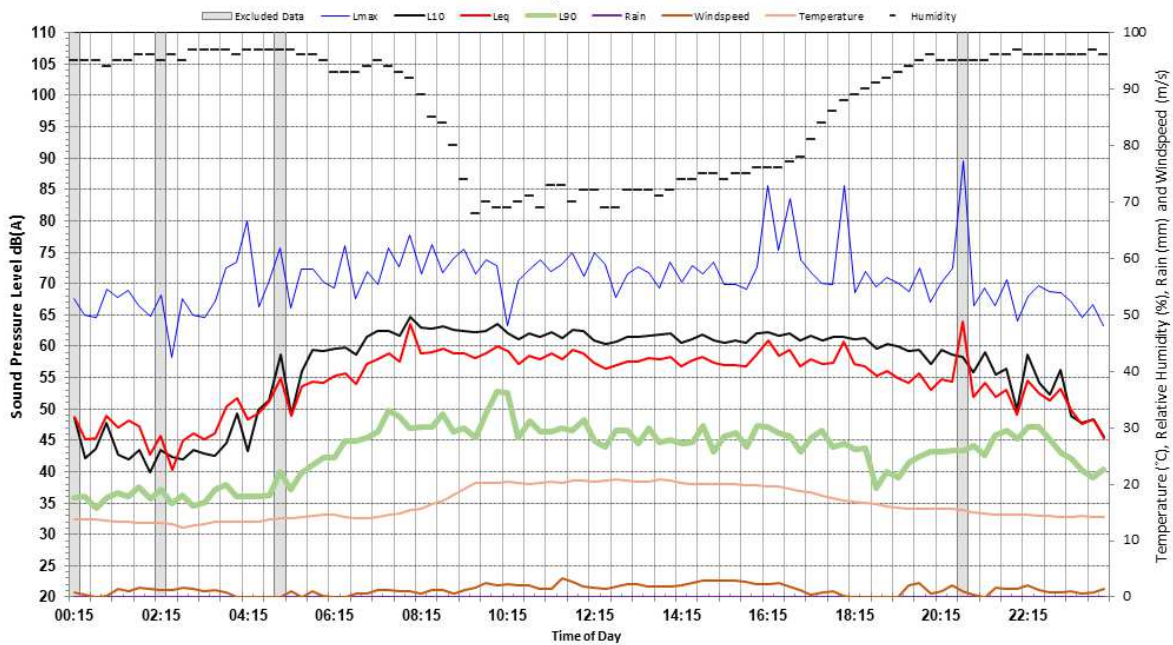
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Sunday, 11 June 2023



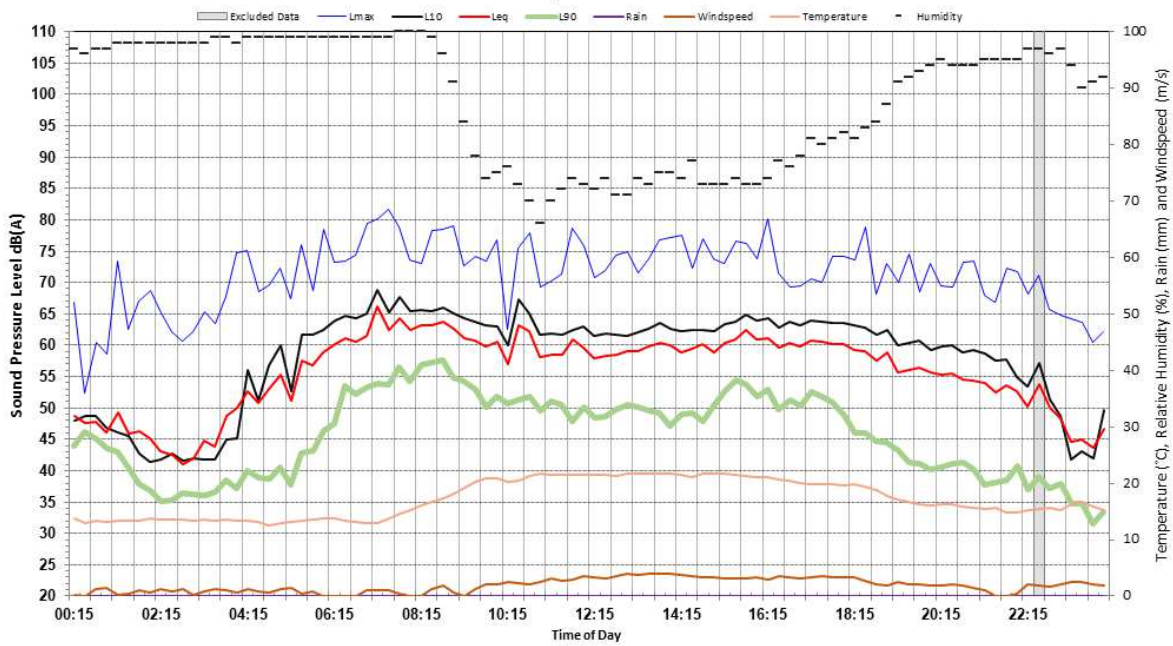
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Monday, 12 June 2023



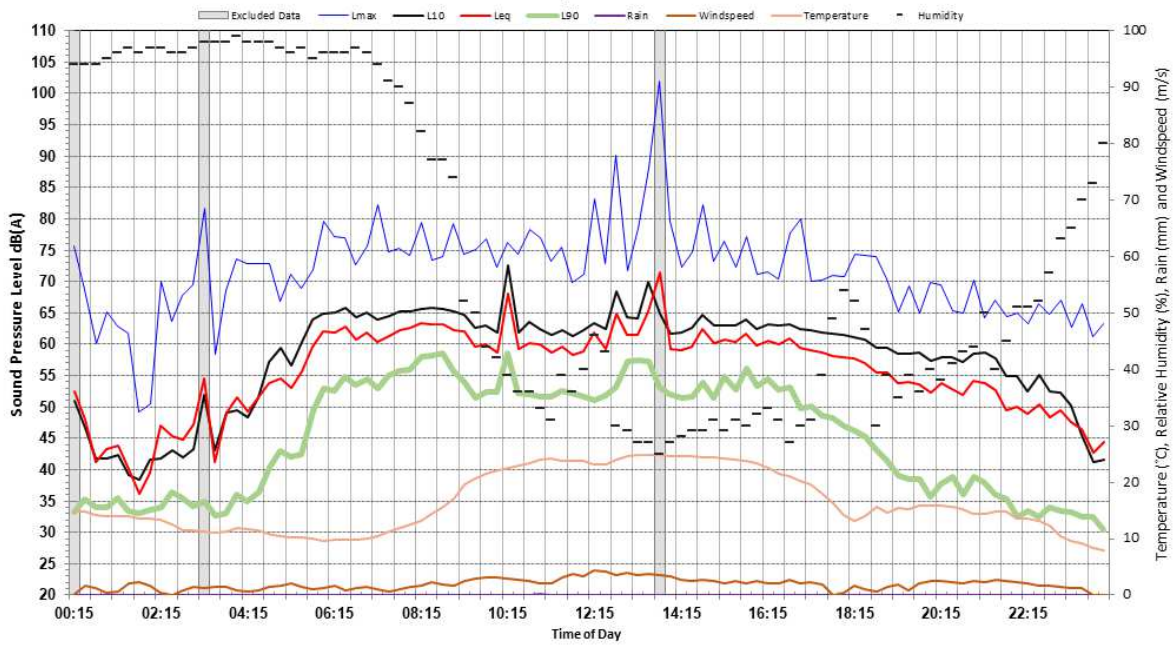
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

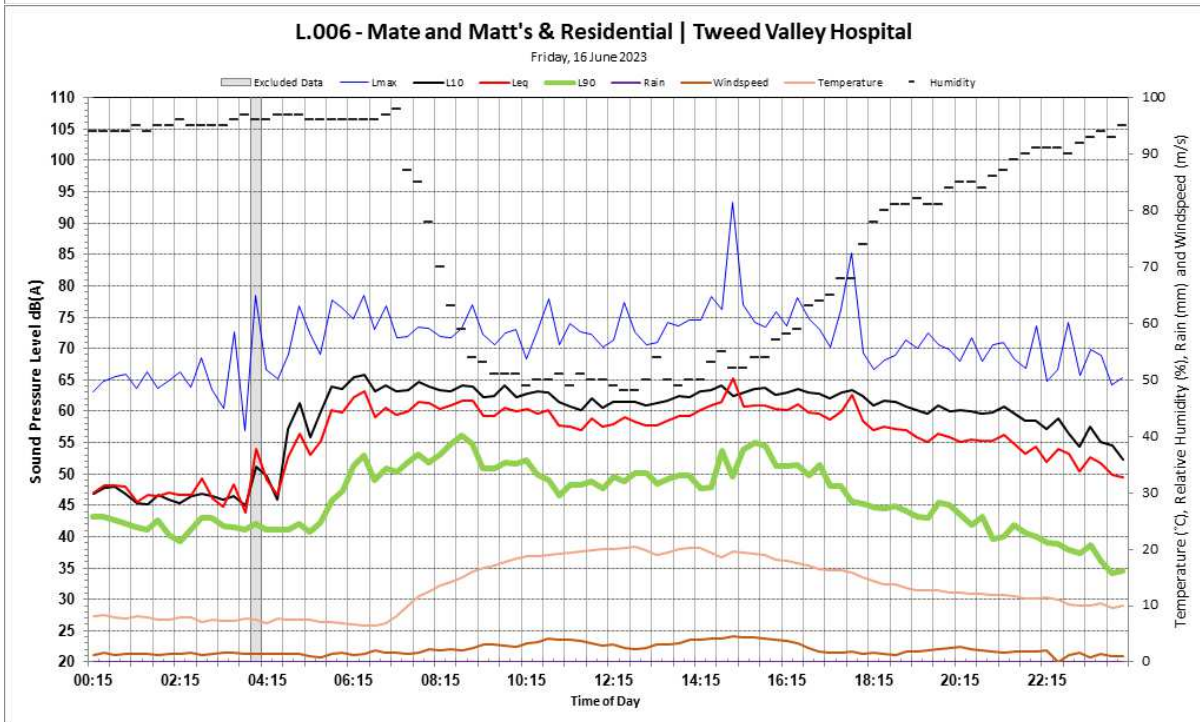
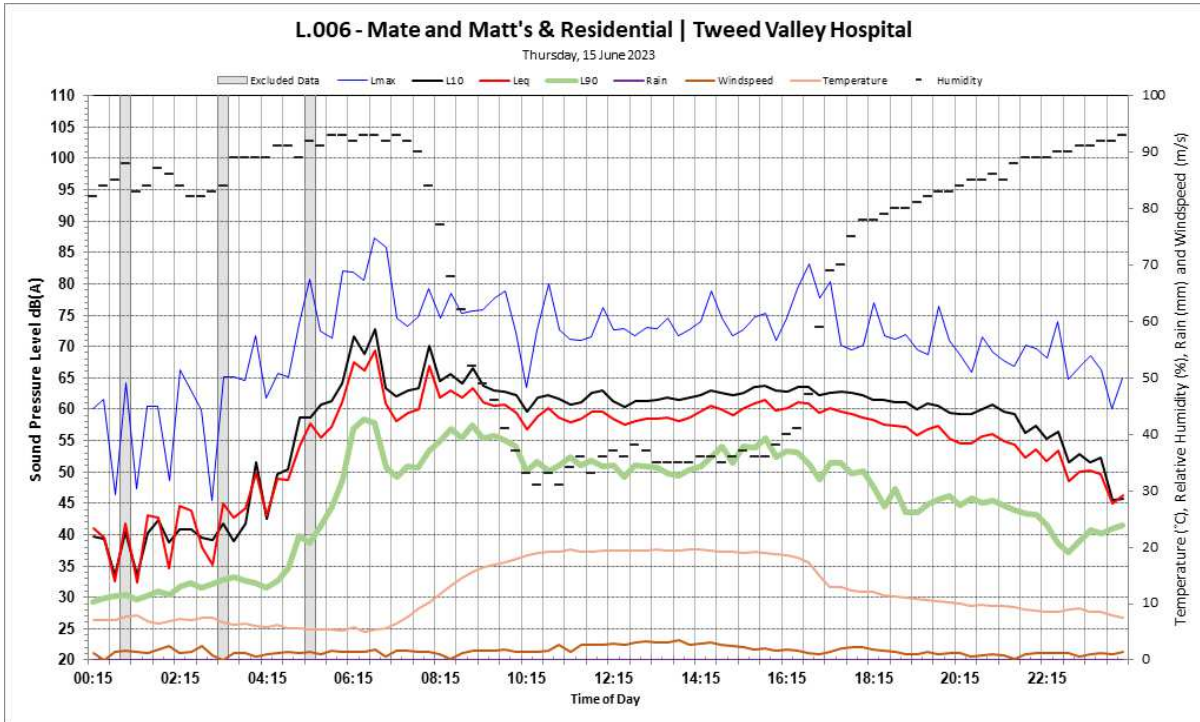
Tuesday, 13 June 2023



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

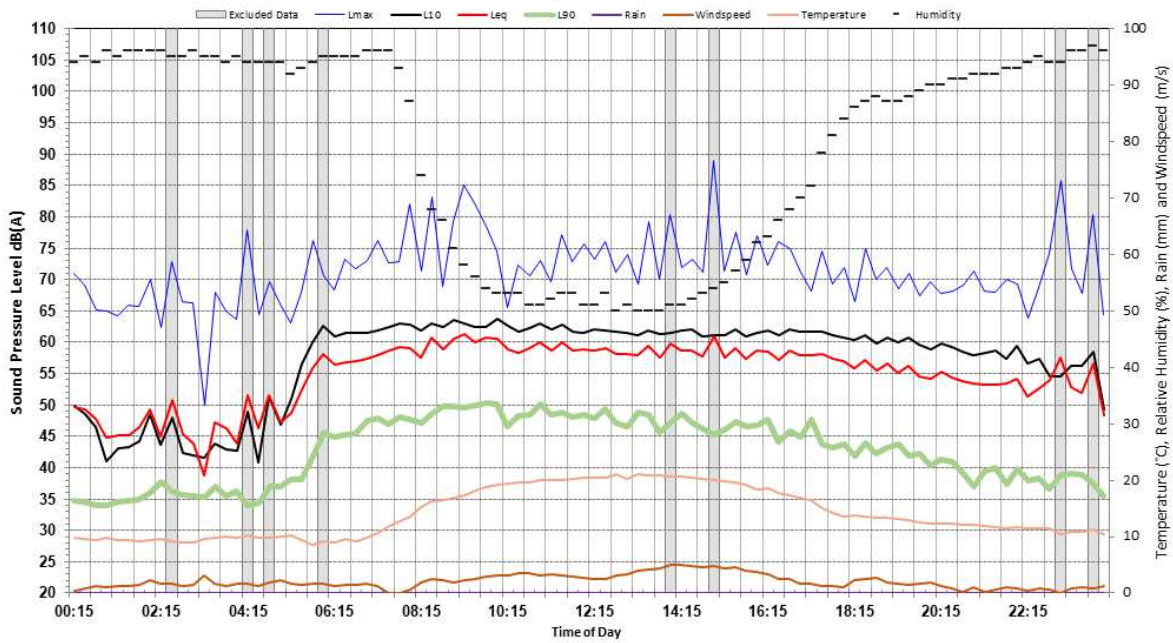
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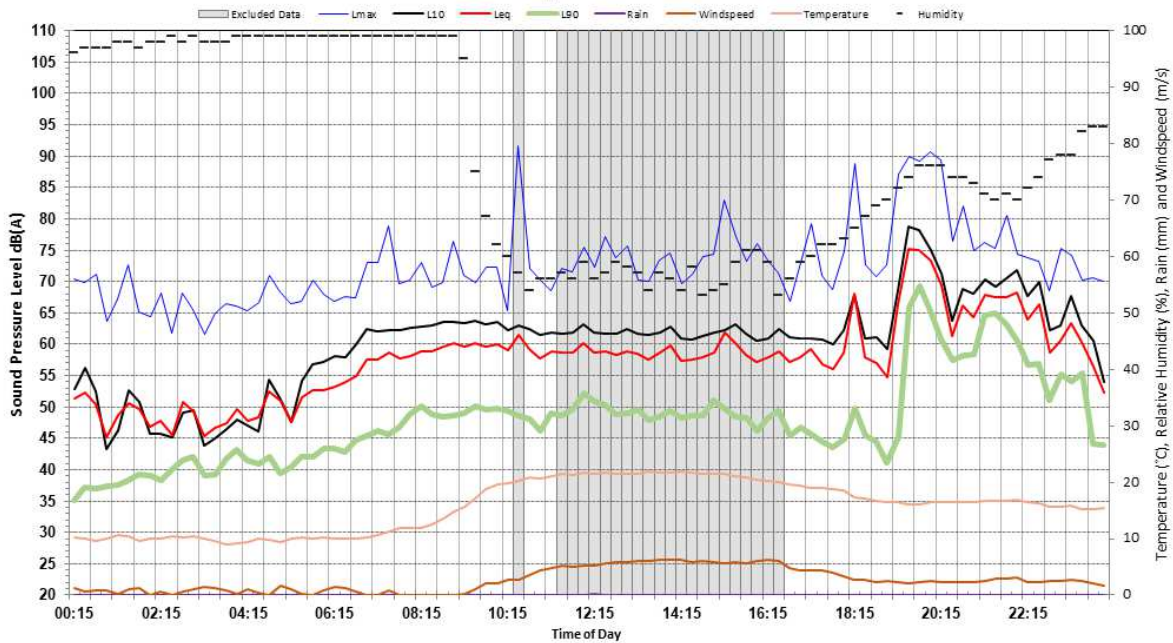
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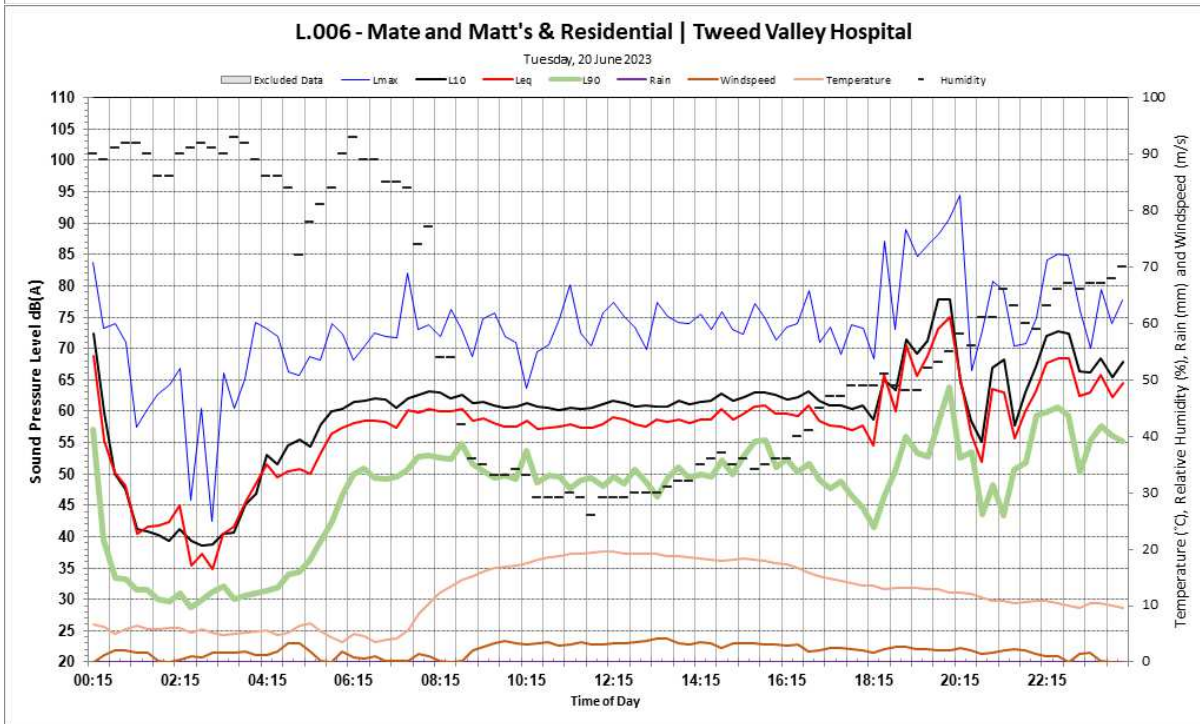
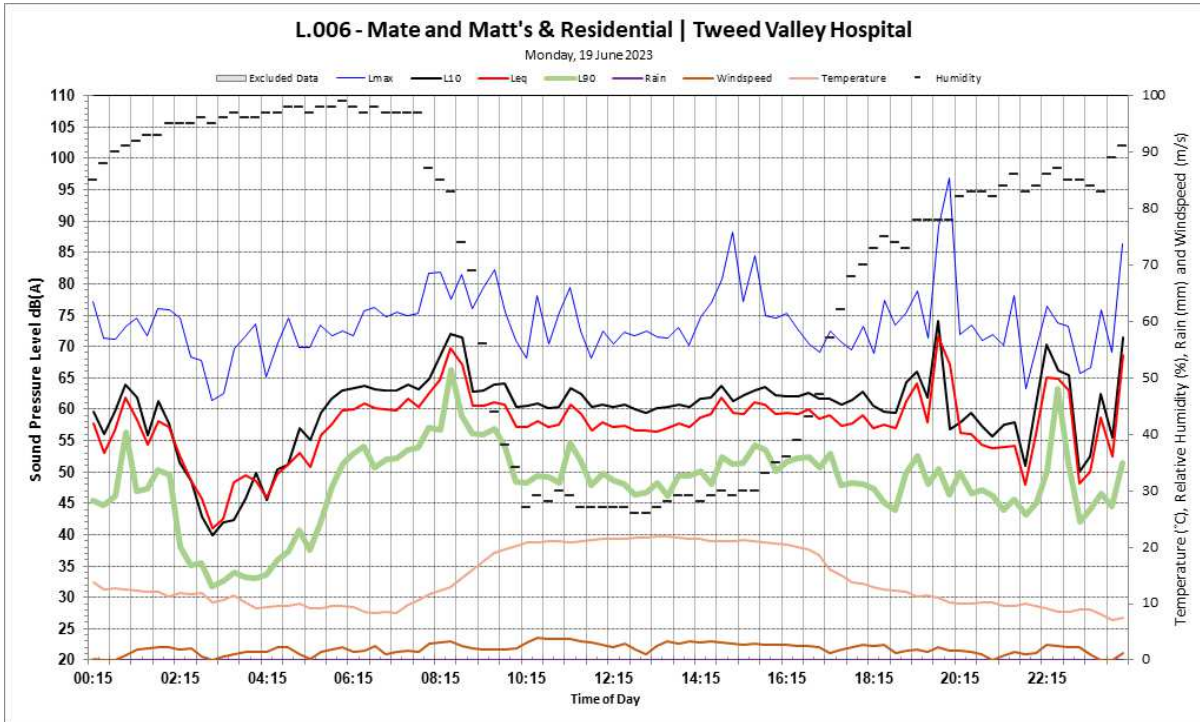
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L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

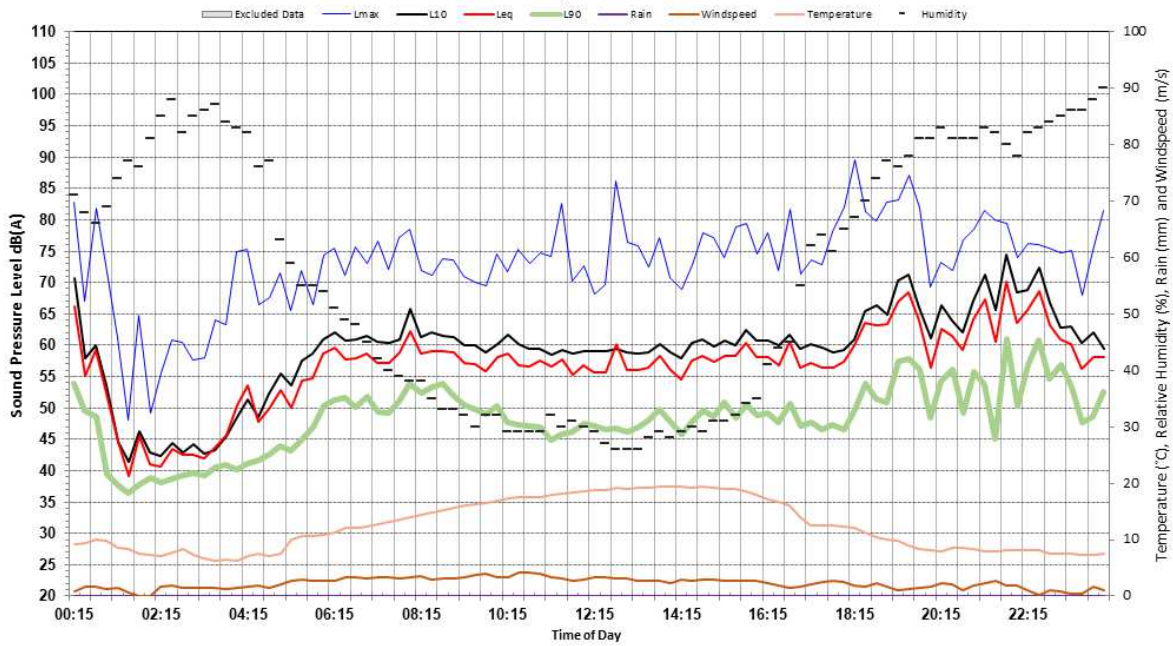
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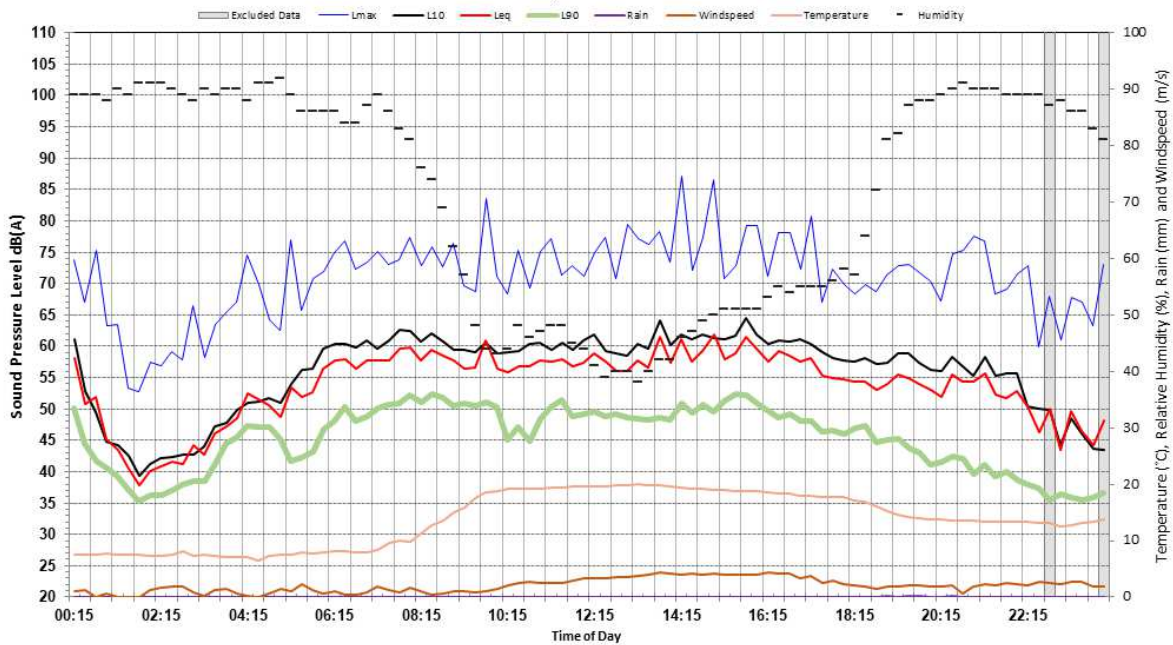
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Wednesday, 21 June 2023



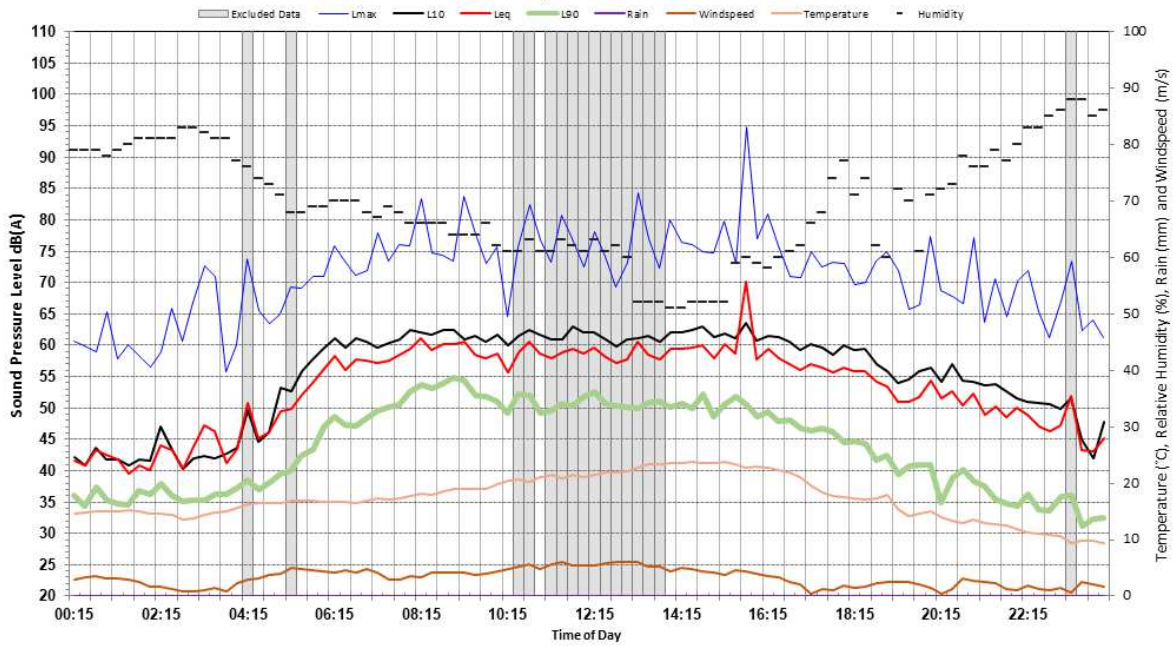
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Thursday, 22 June 2023



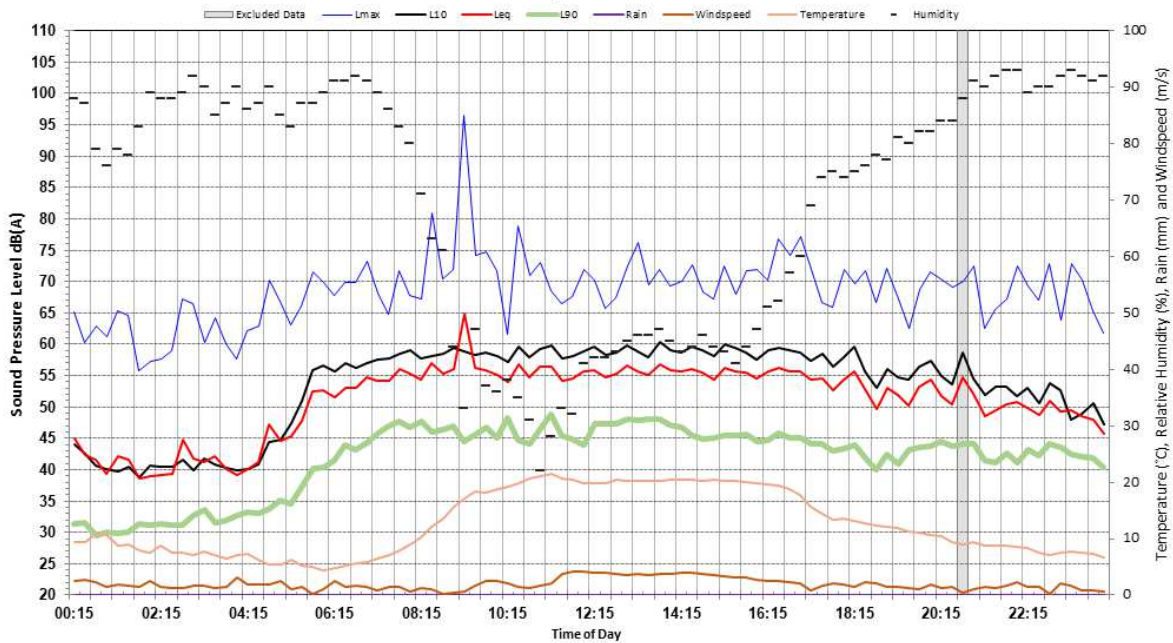
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Friday, 23 June 2023



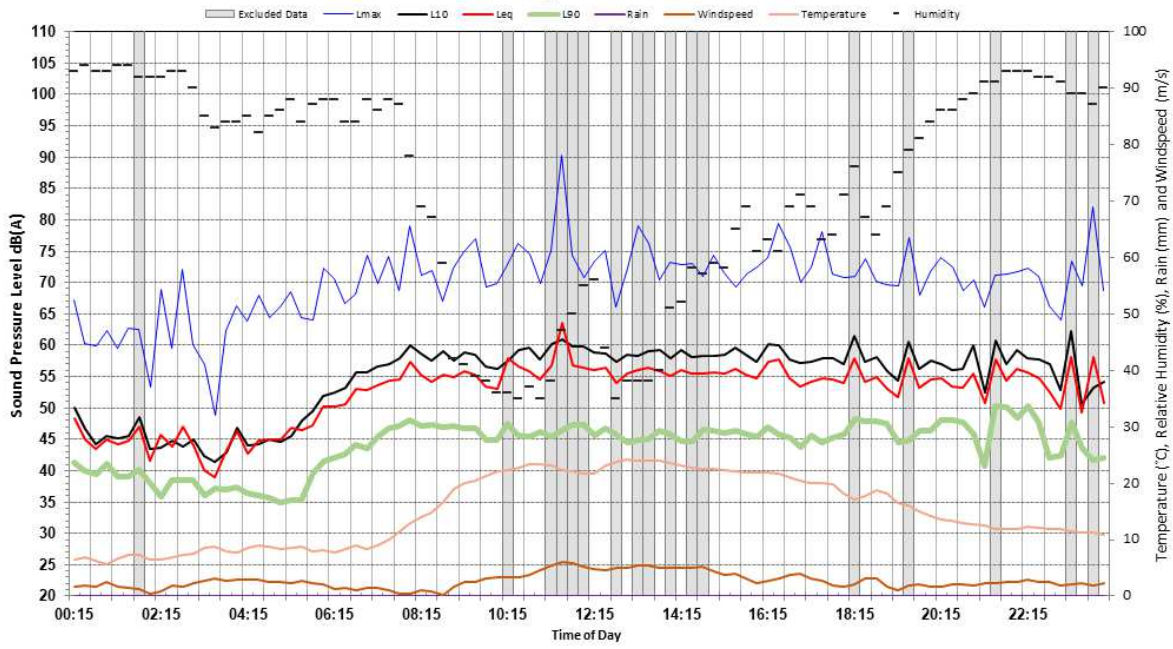
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Saturday, 24 June 2023



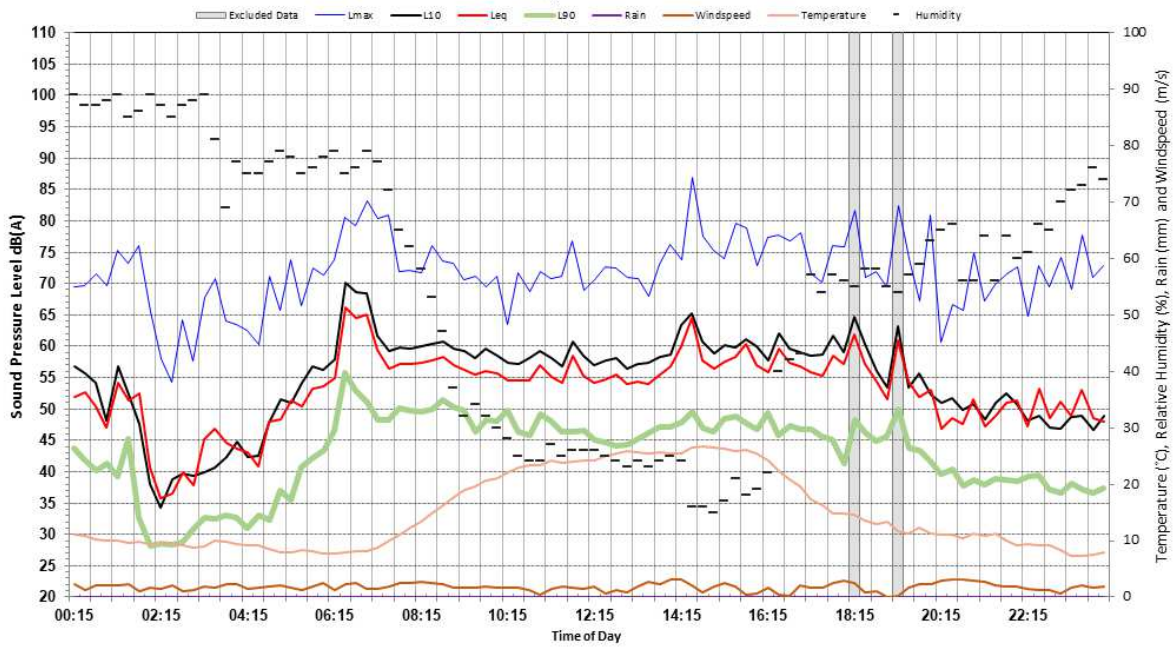
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Sunday, 25 June 2023



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

Monday, 26 June 2023



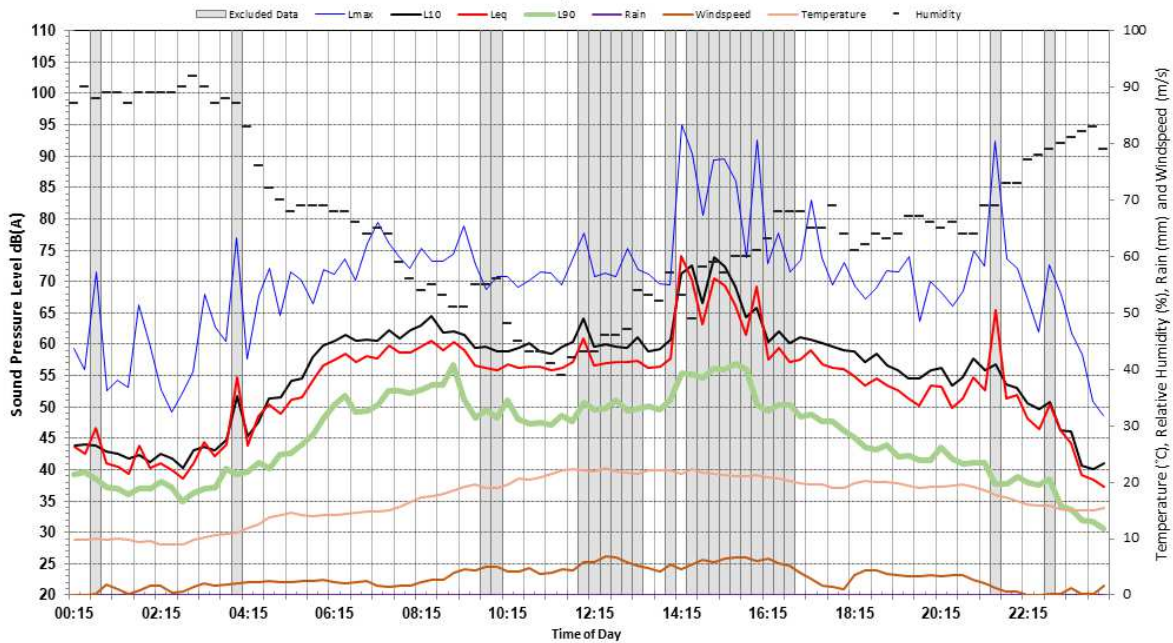
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Tuesday, 27 June 2023



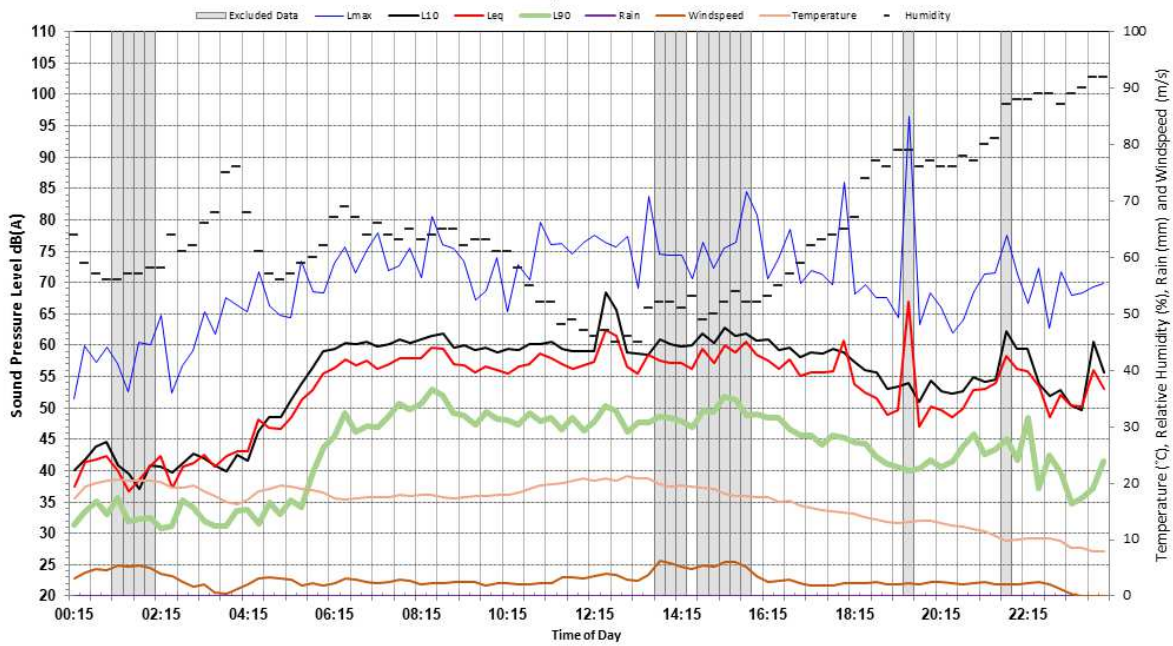
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Wednesday, 28 June 2023



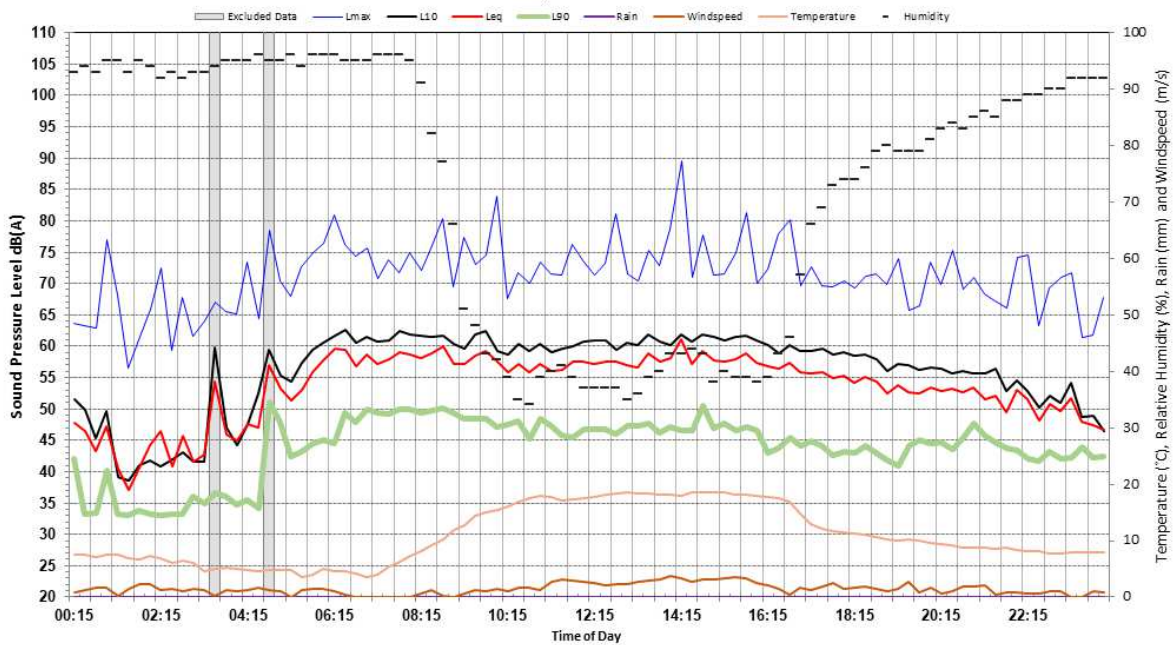
L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

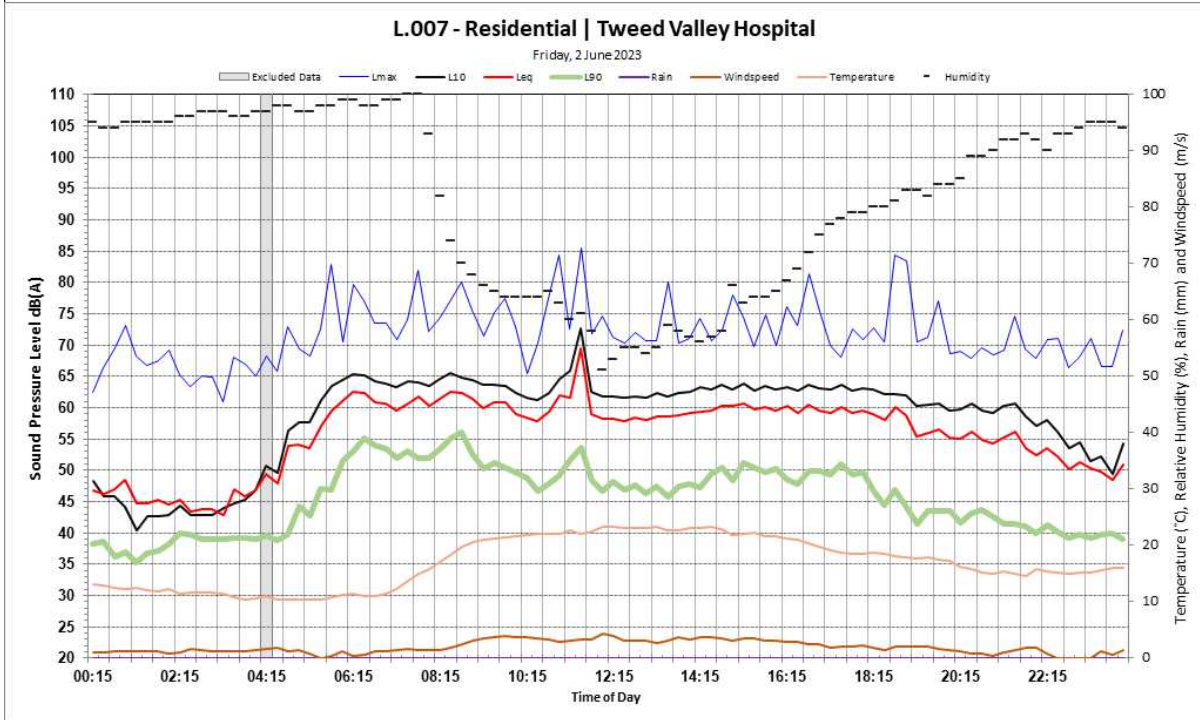
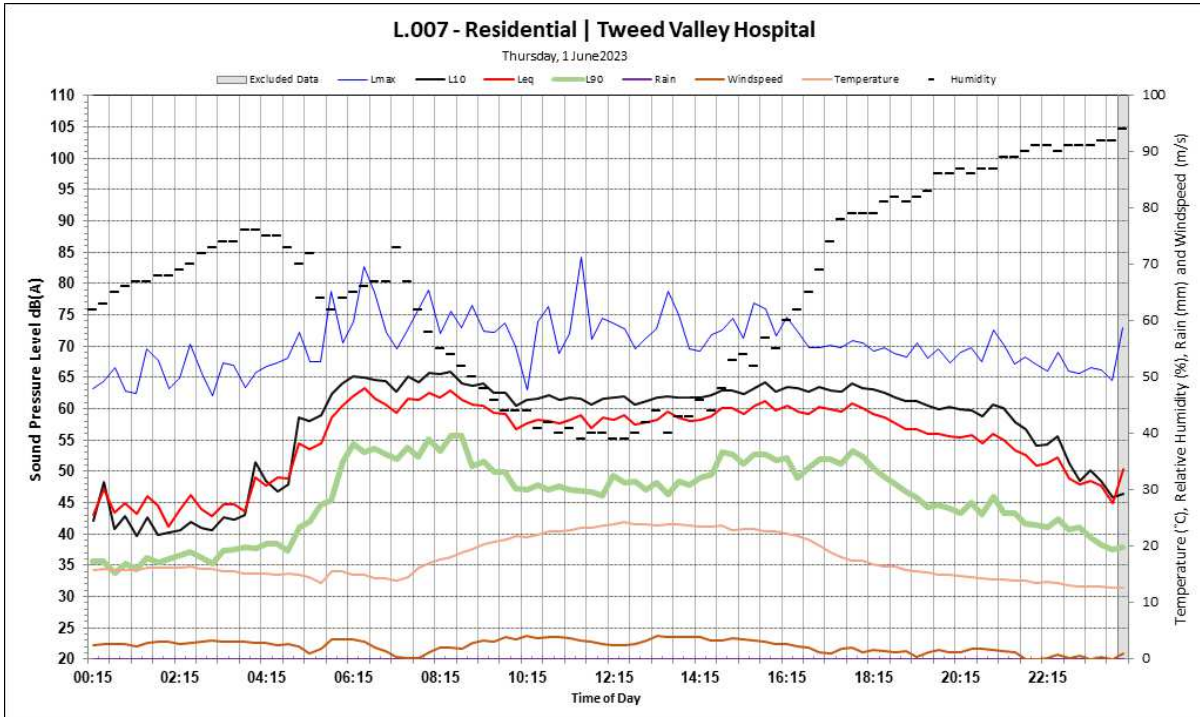
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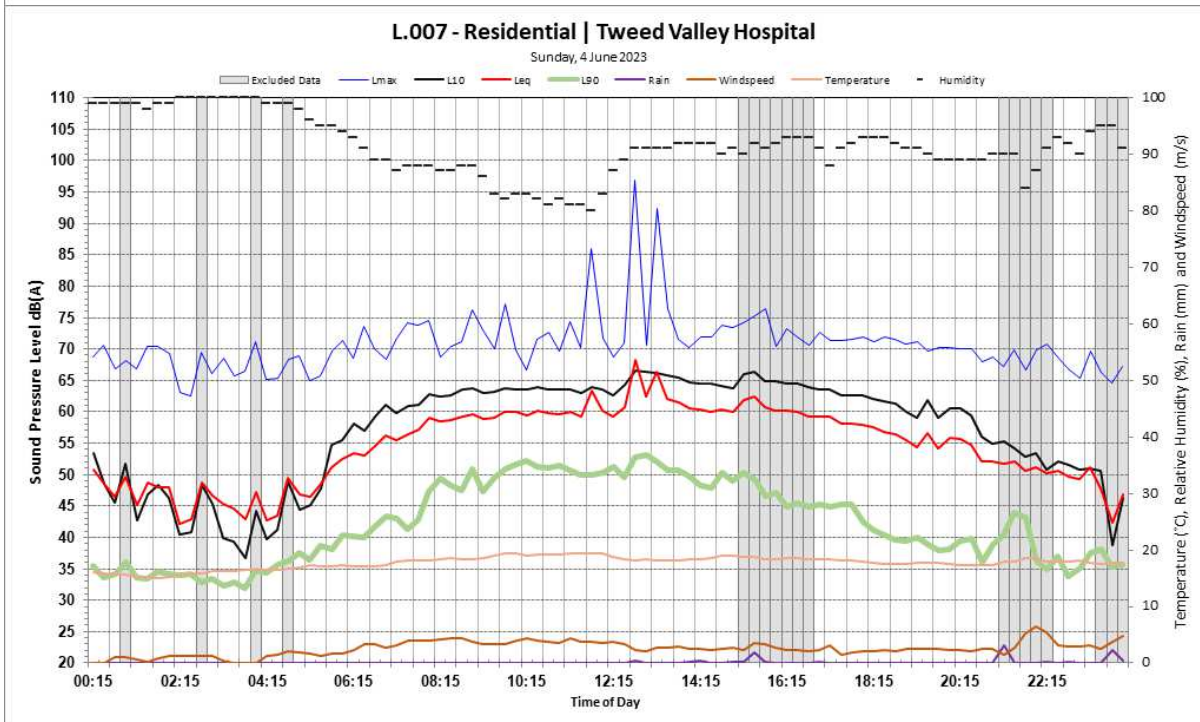
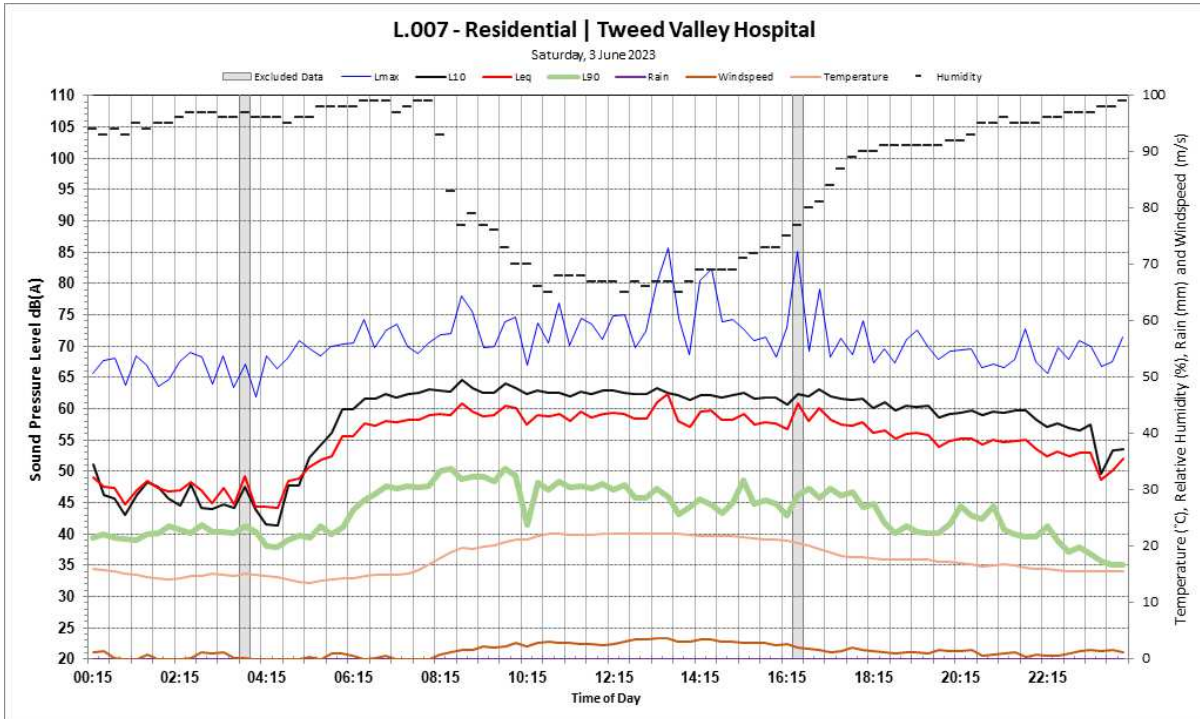


L.006 - Mate and Matt's & Residential | Tweed Valley Hospital

Friday, 30 June 2023

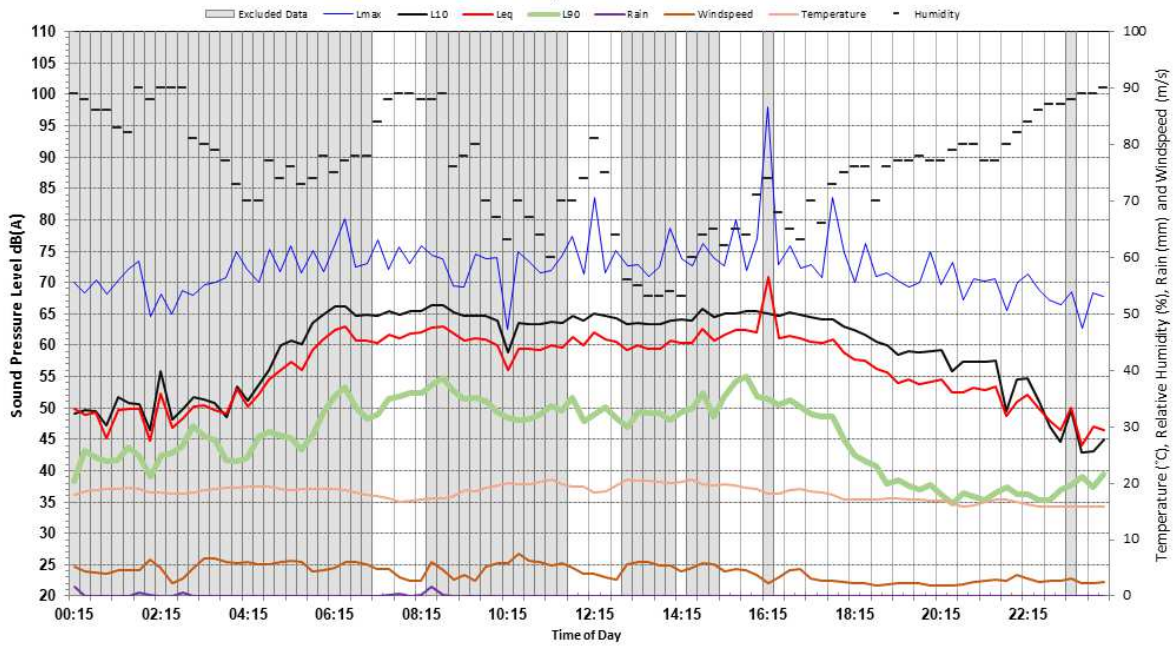






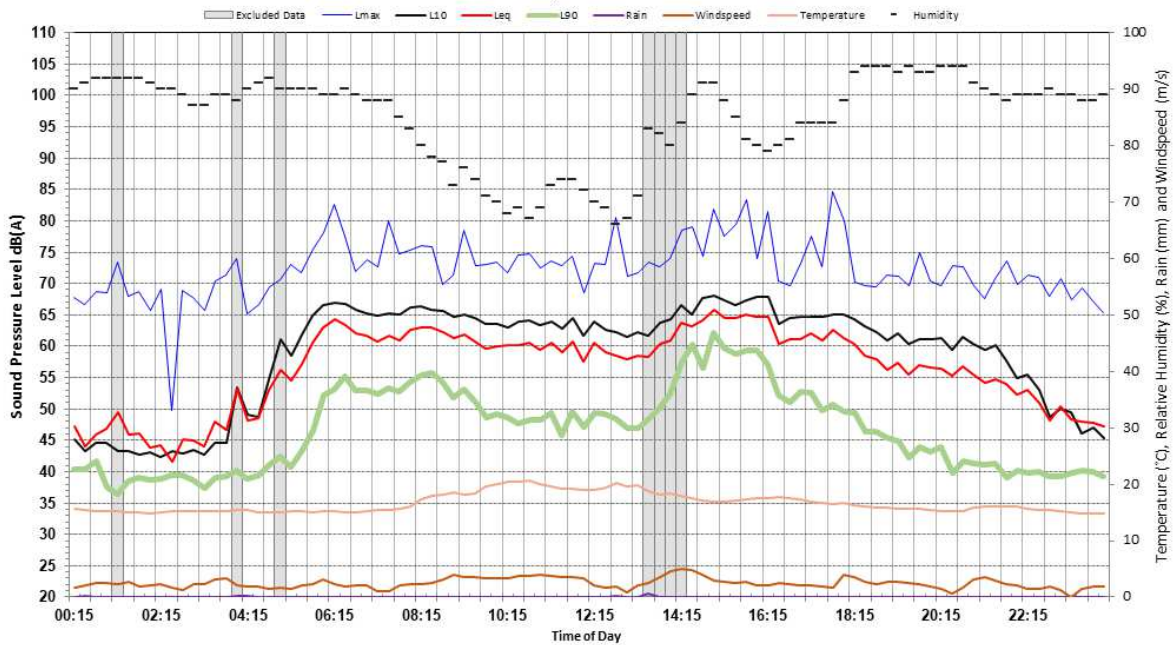
L.007 - Residential | Tweed Valley Hospital

Monday, 5 June 2023



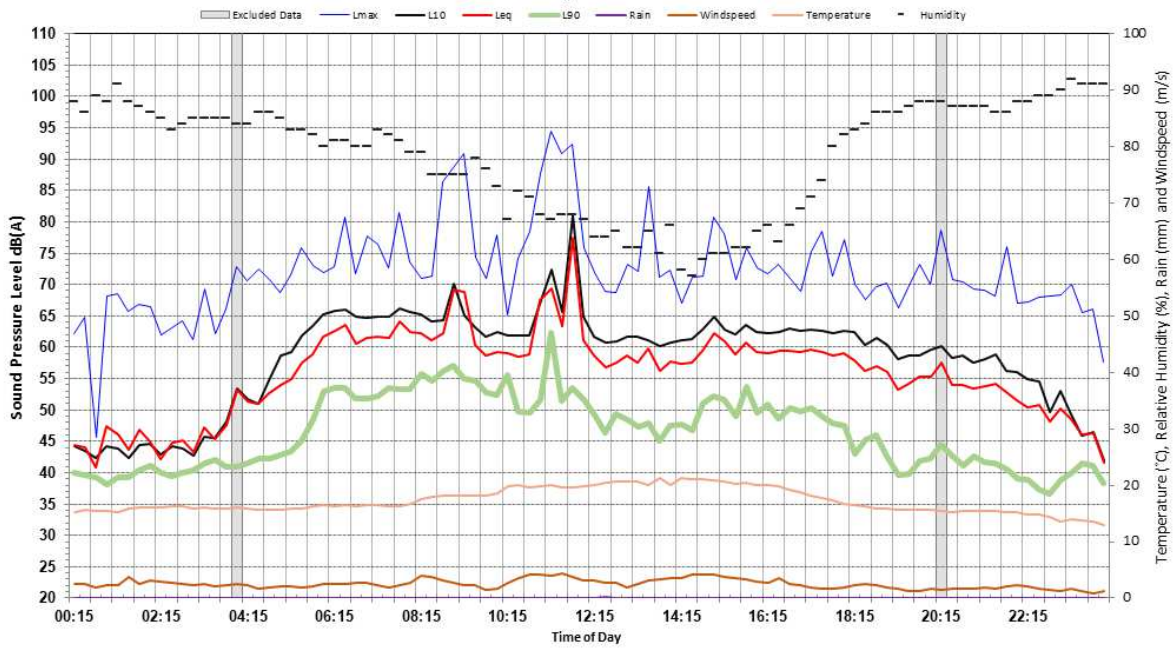
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Tuesday, 6 June 2023



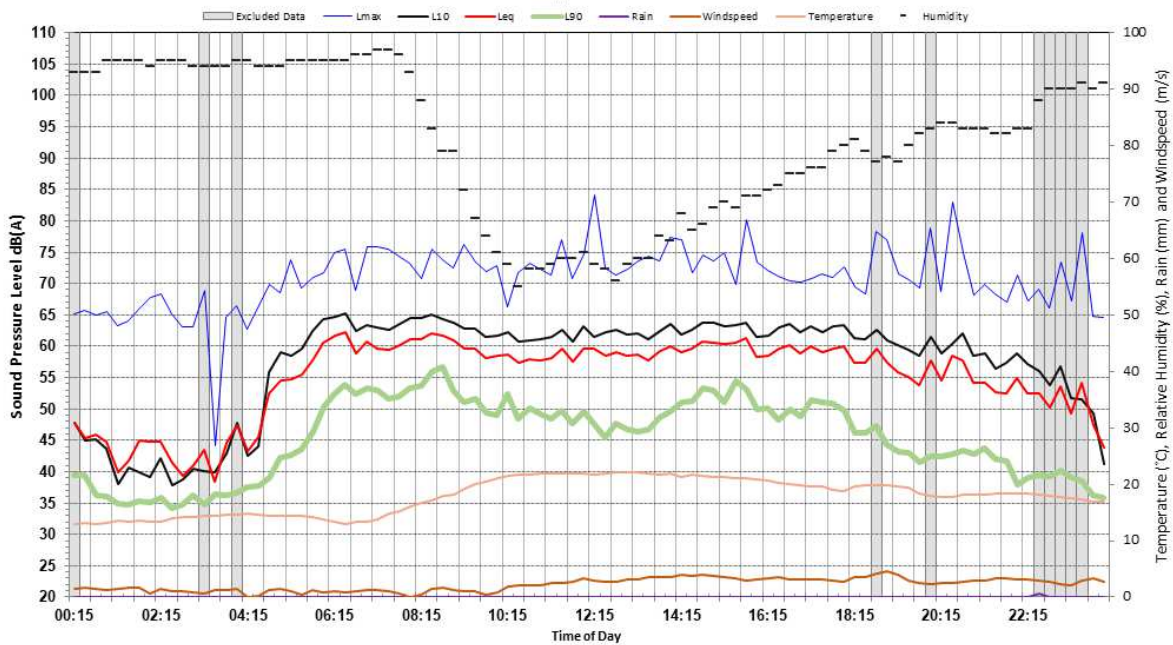
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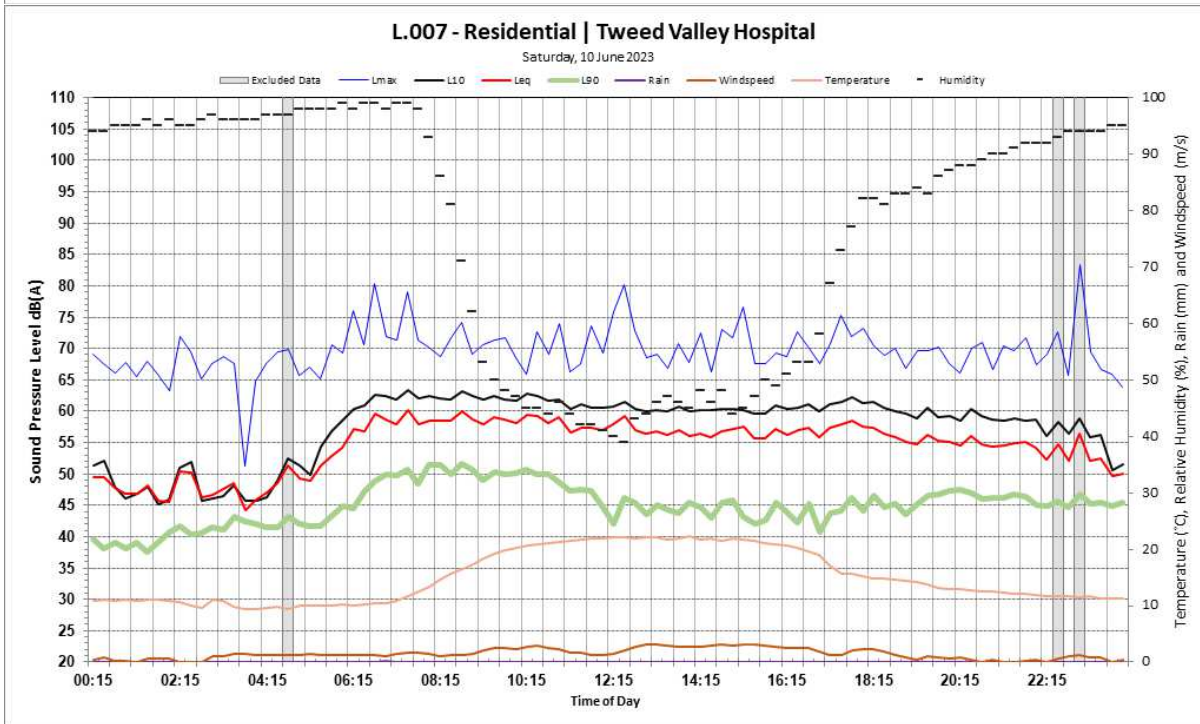
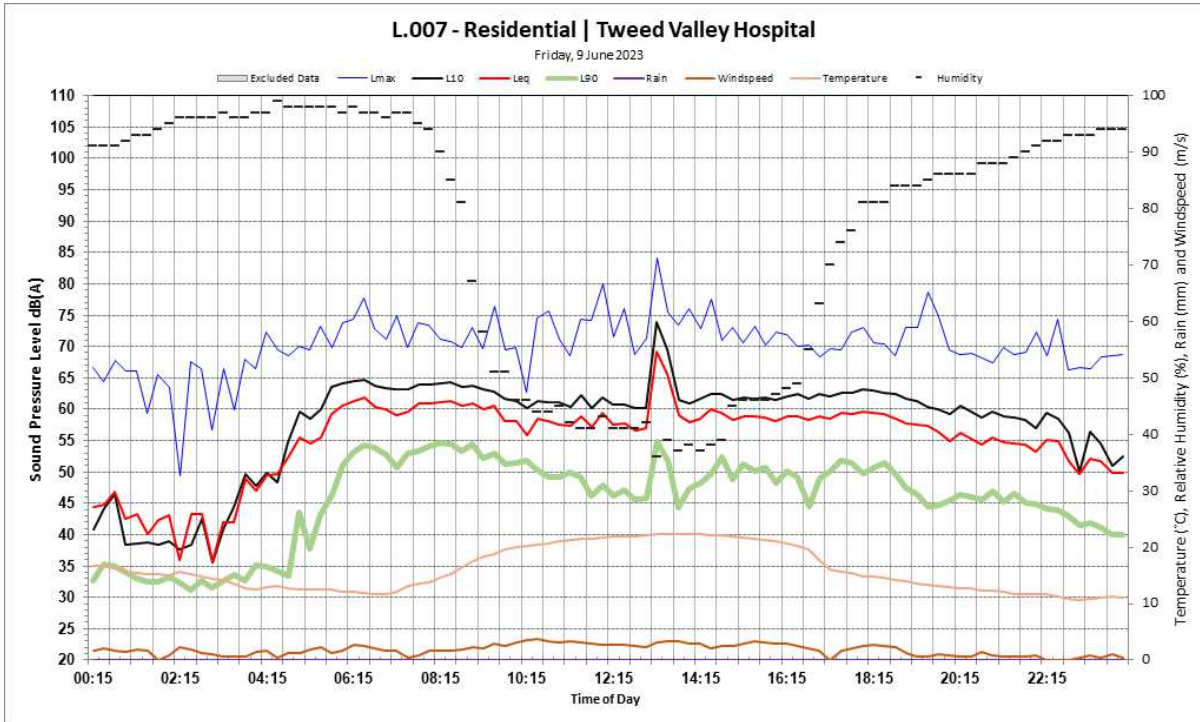
Wednesday, 7 June 2023

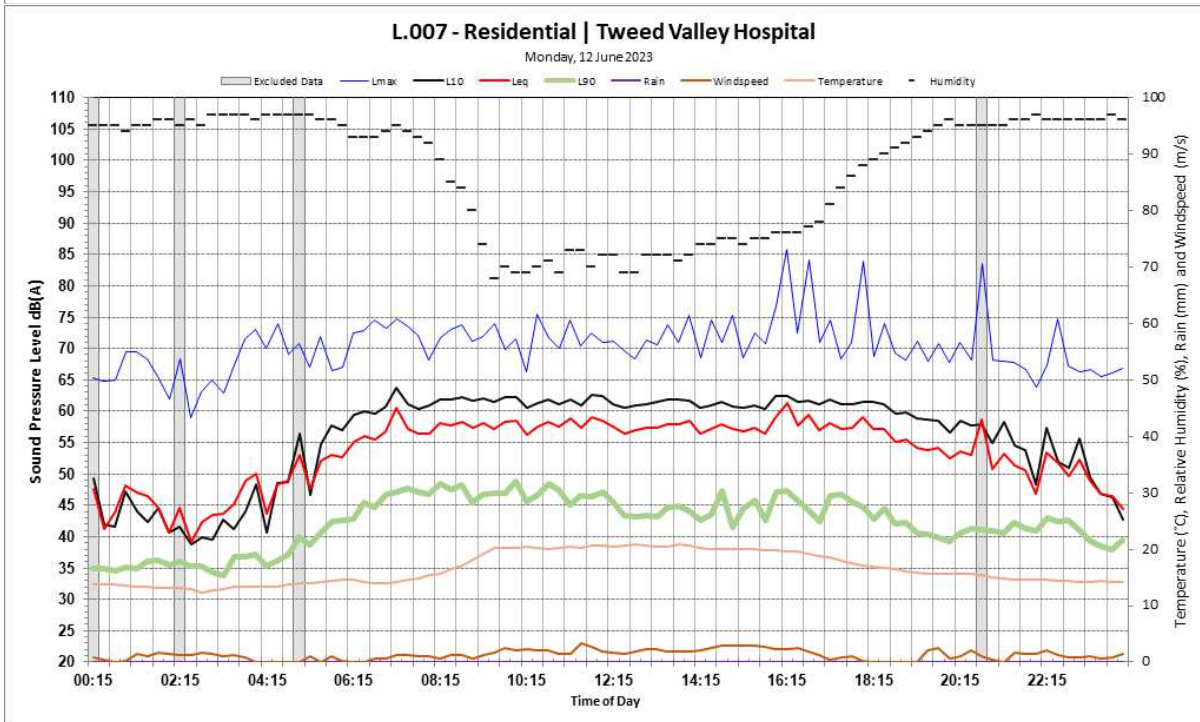
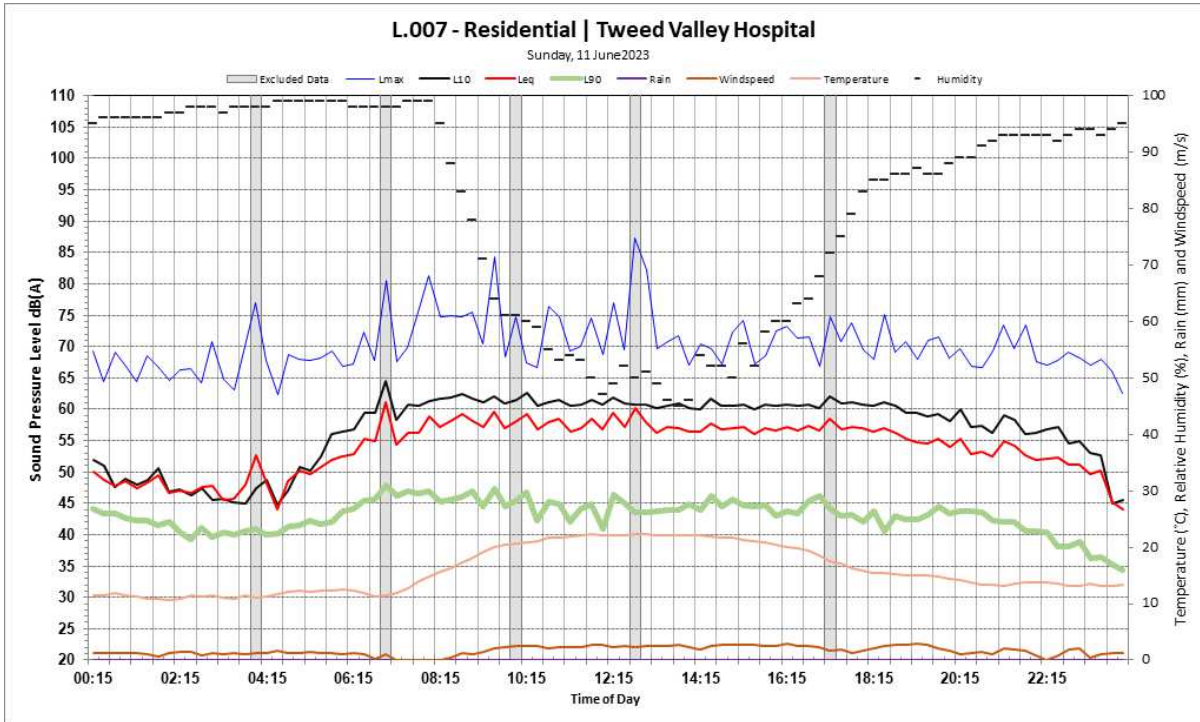


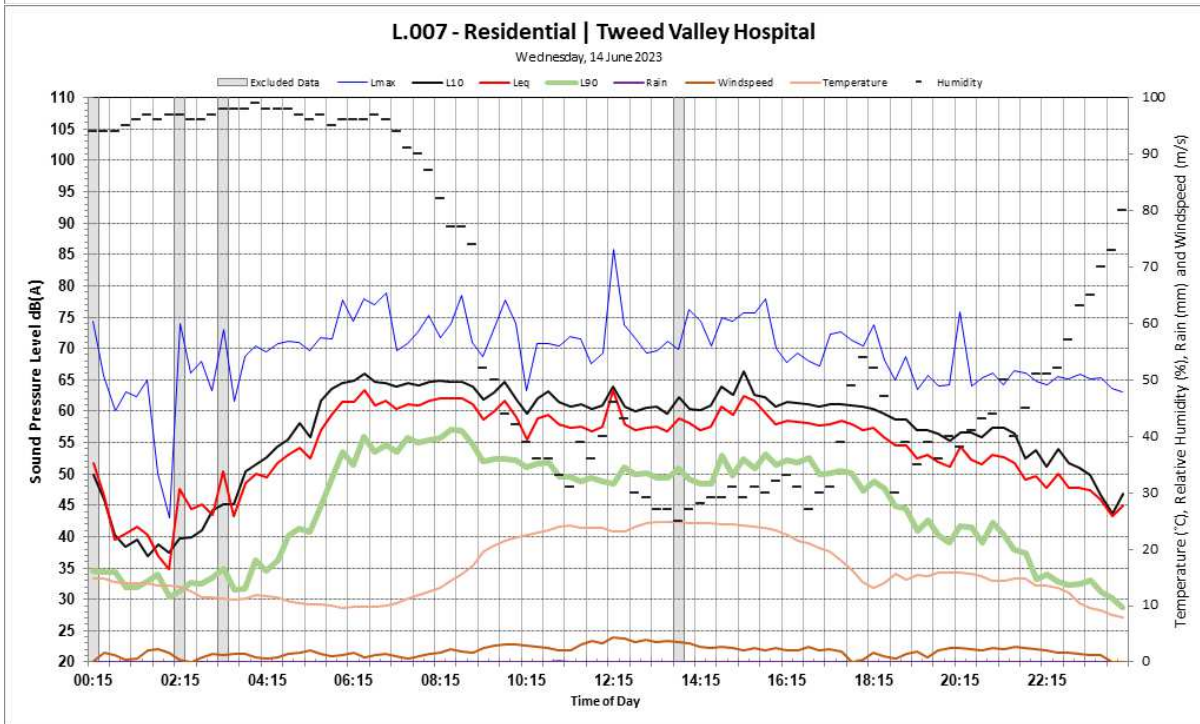
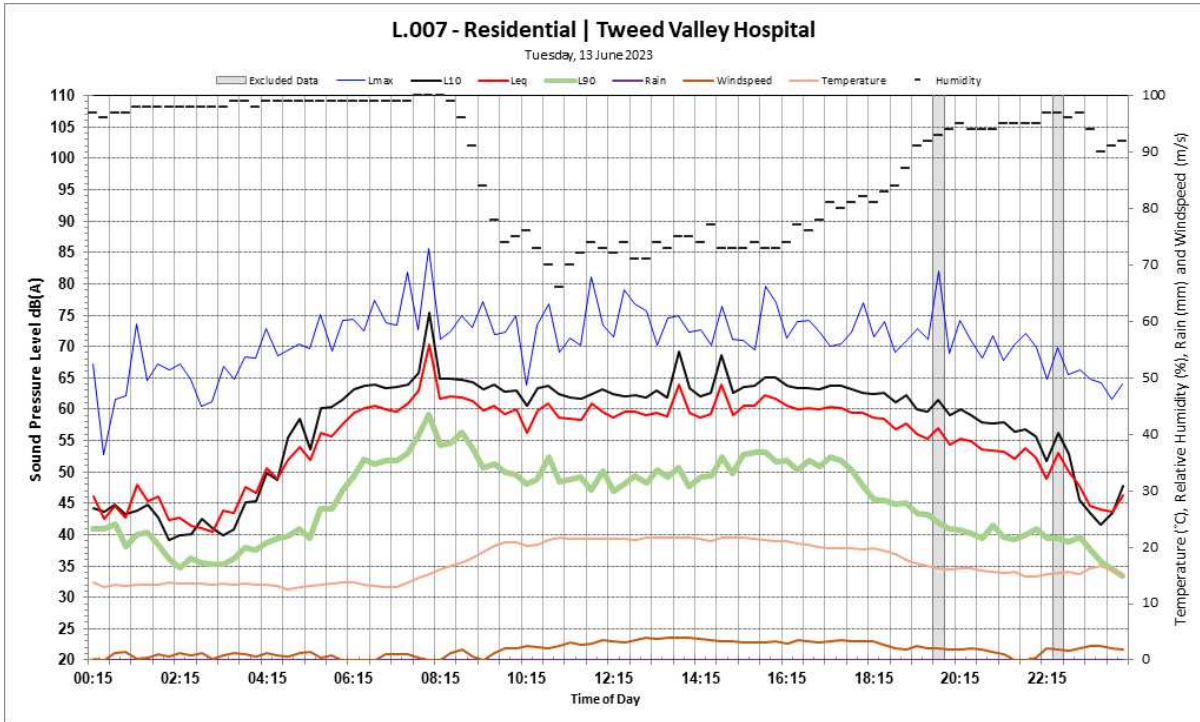
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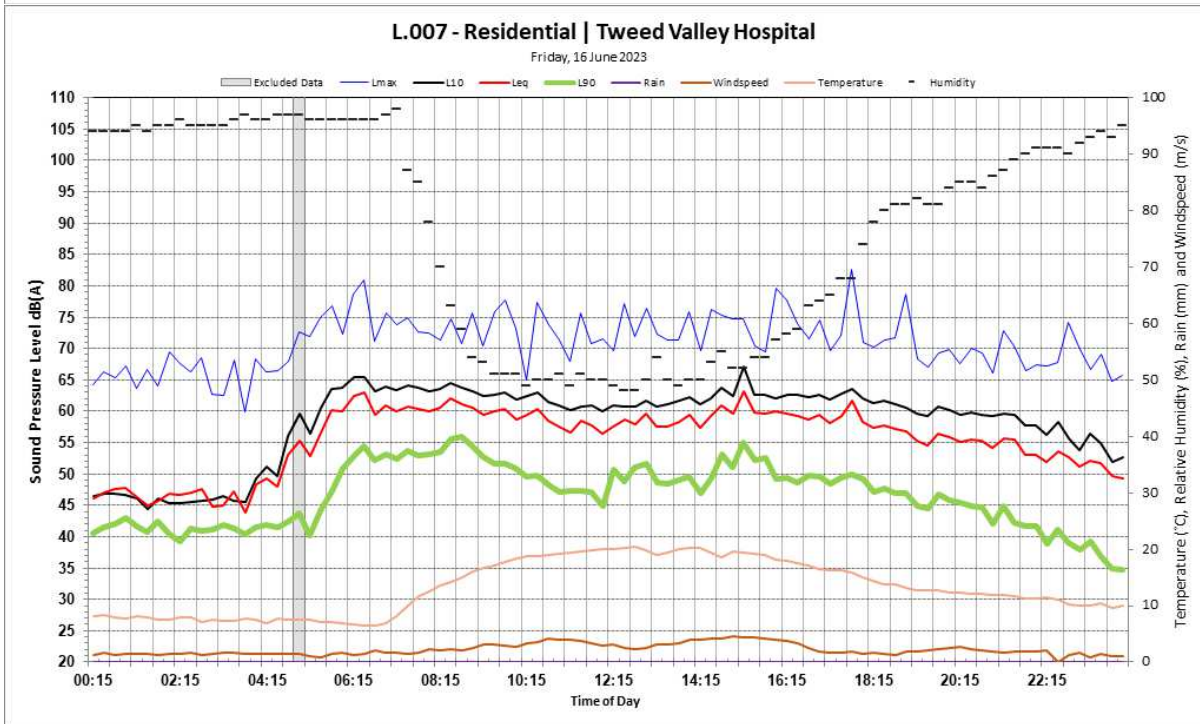
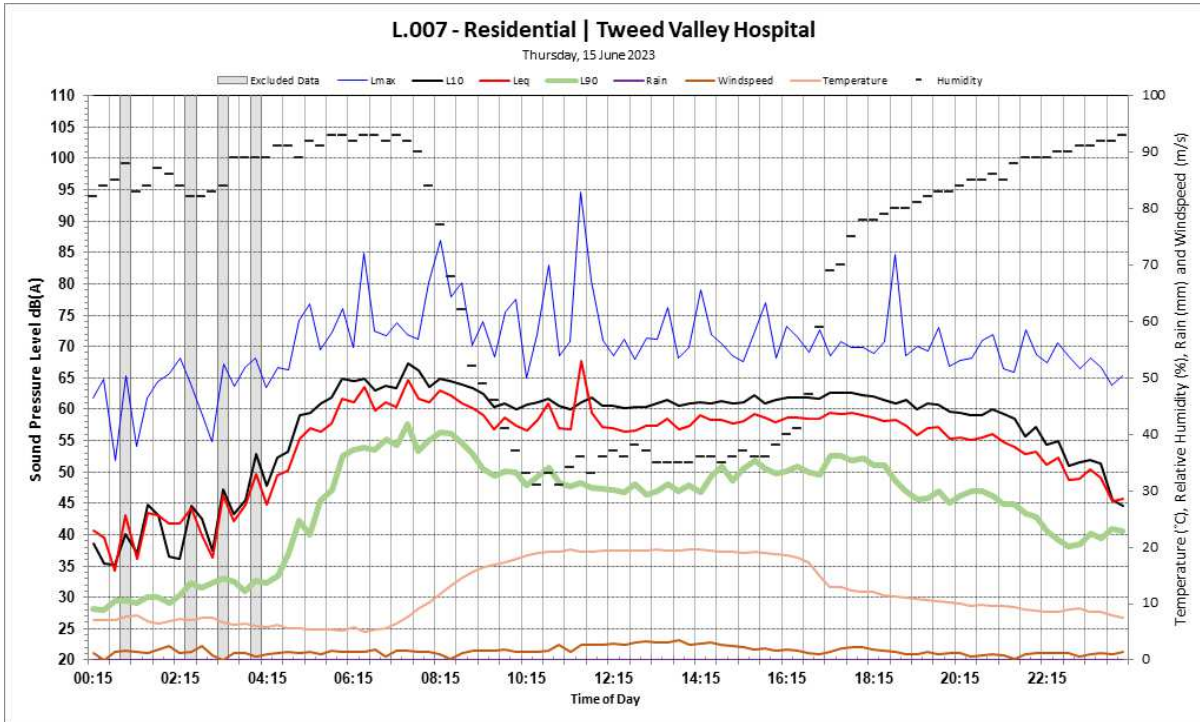
Thursday, 8 June 2023





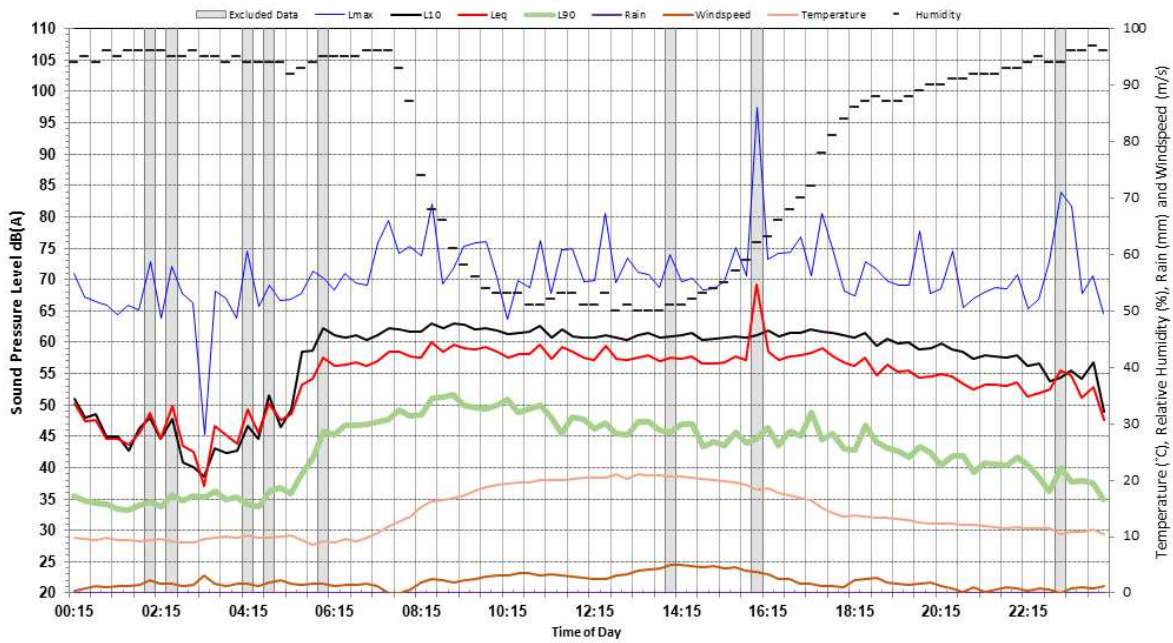






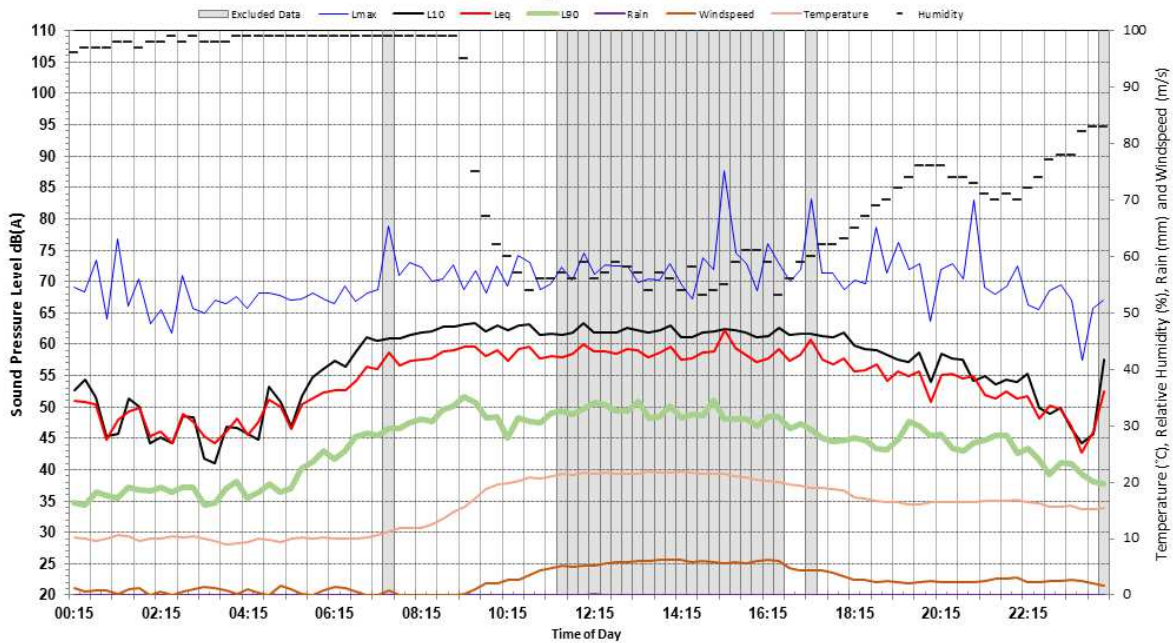
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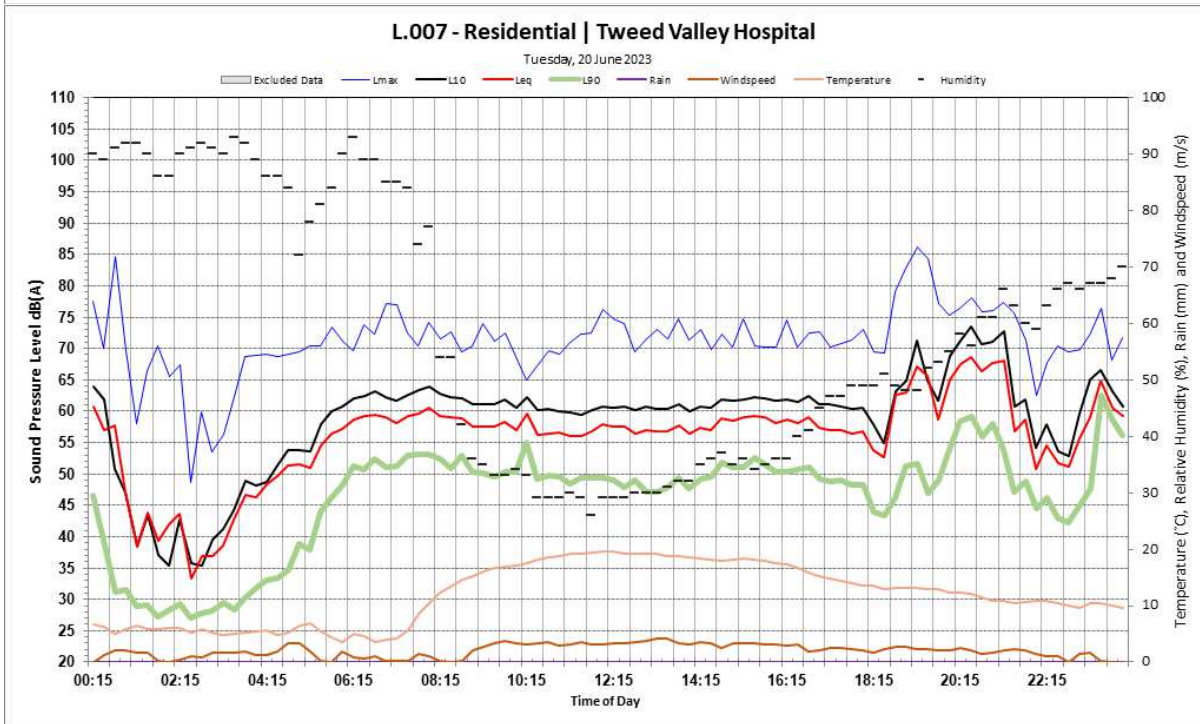
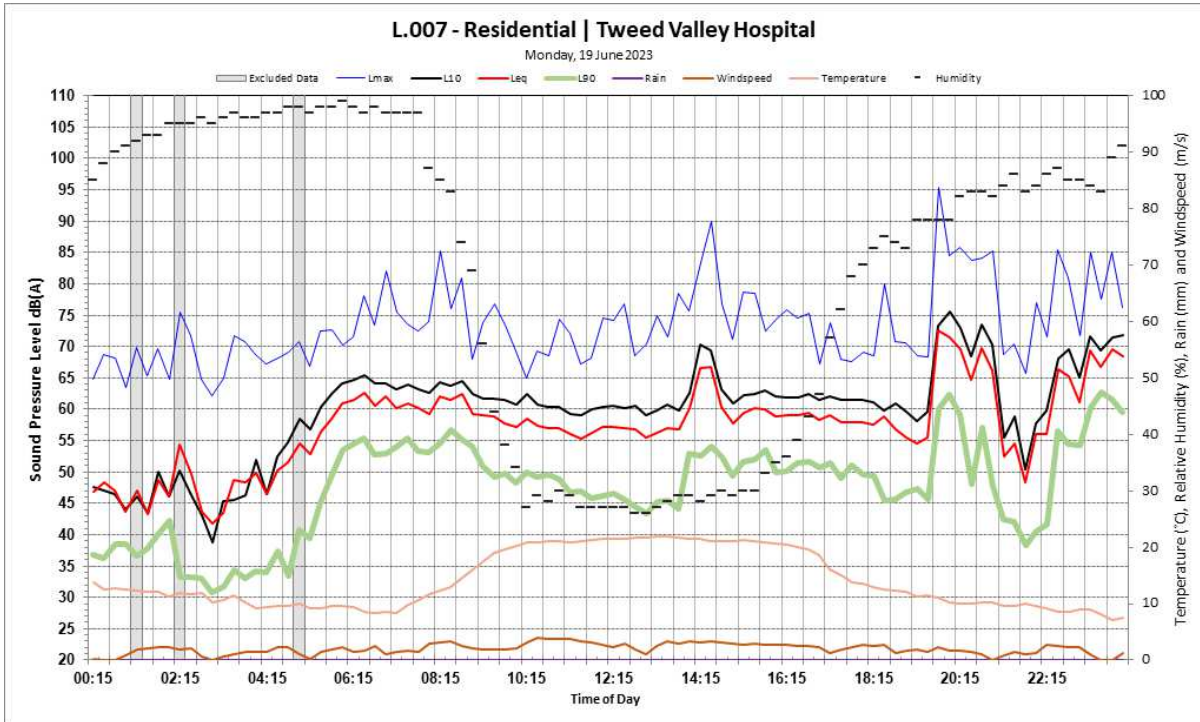
Saturday, 17 June 2023

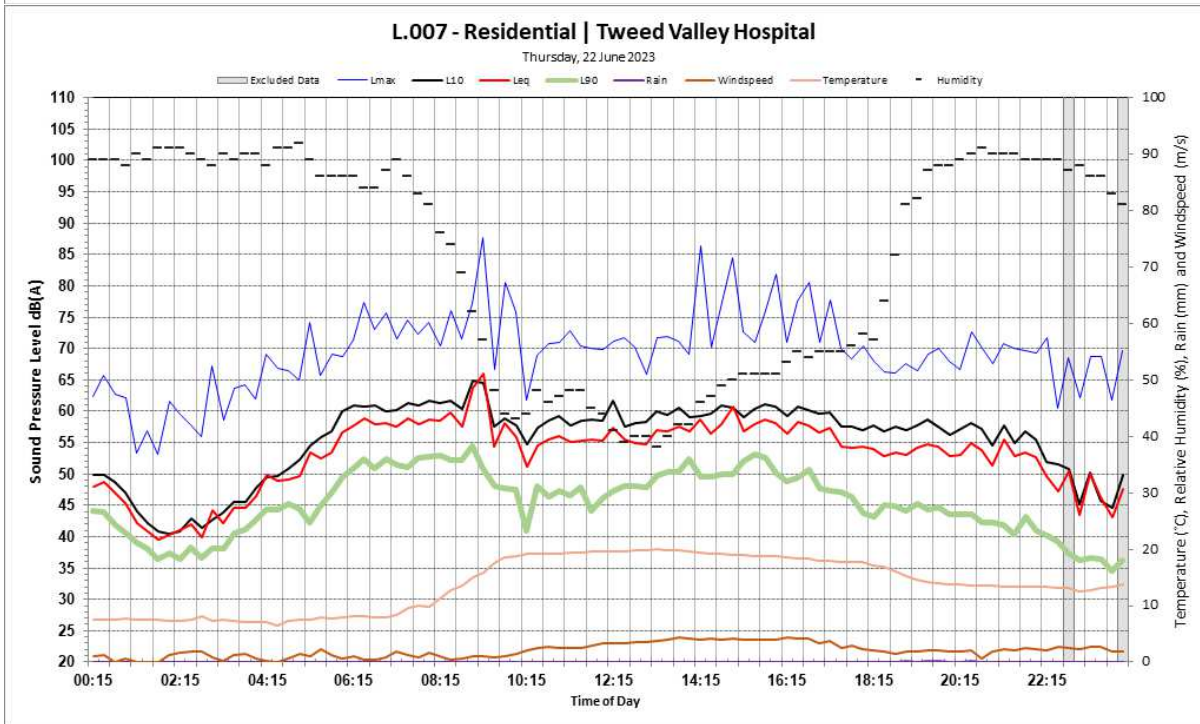
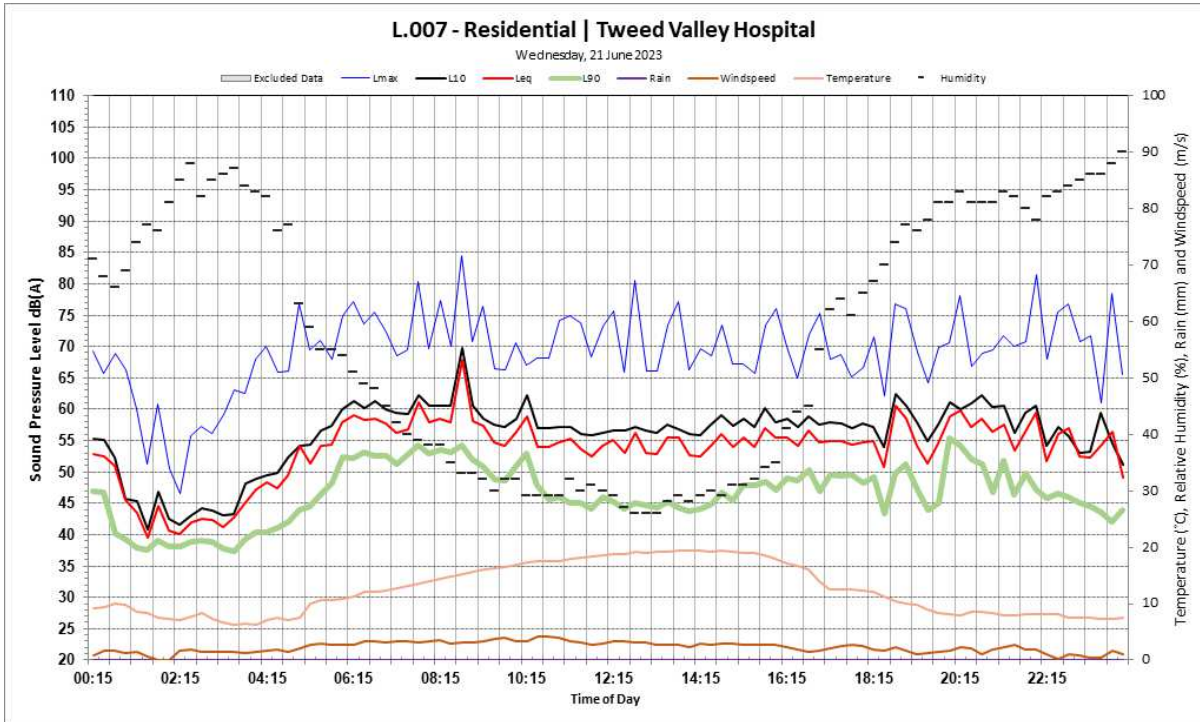


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Sunday, 18 June 2023

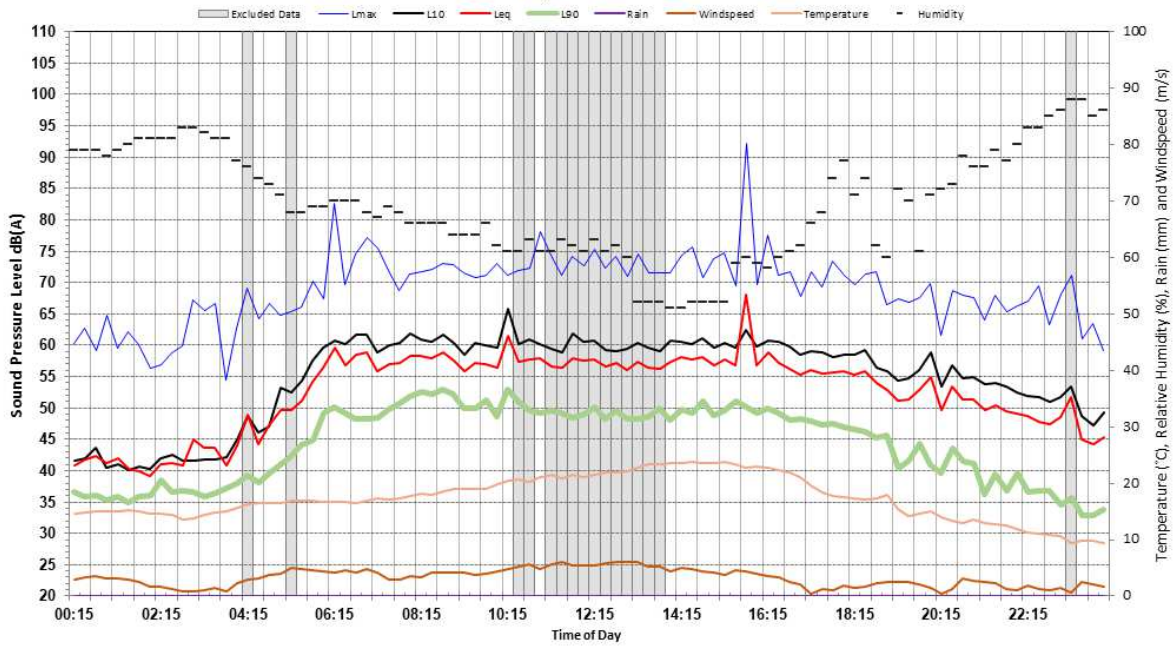






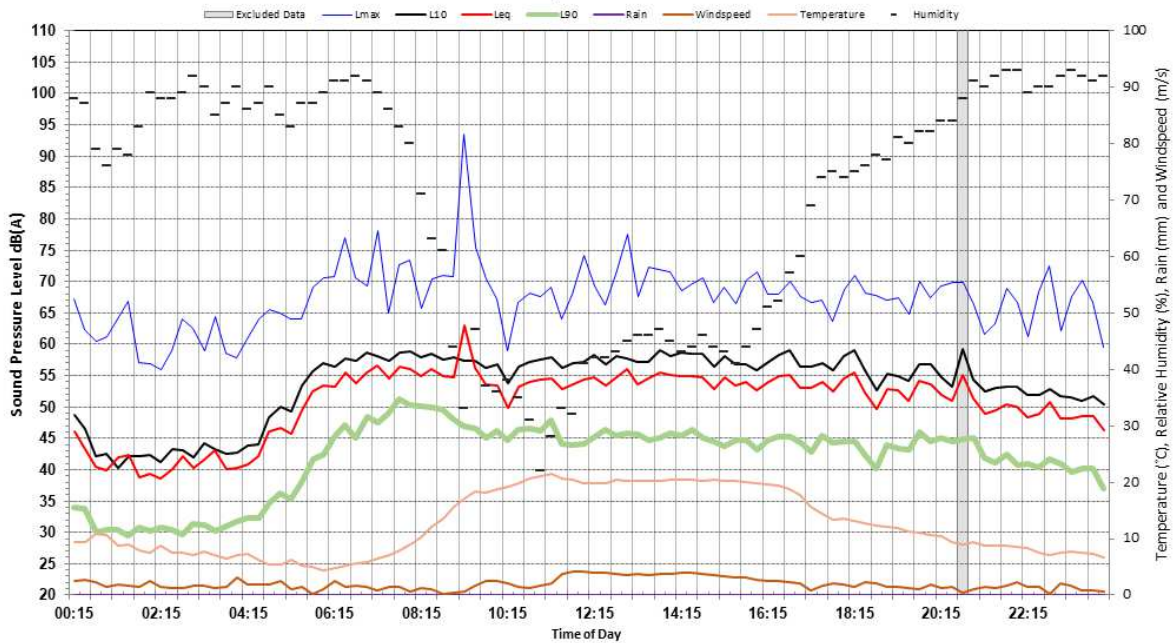
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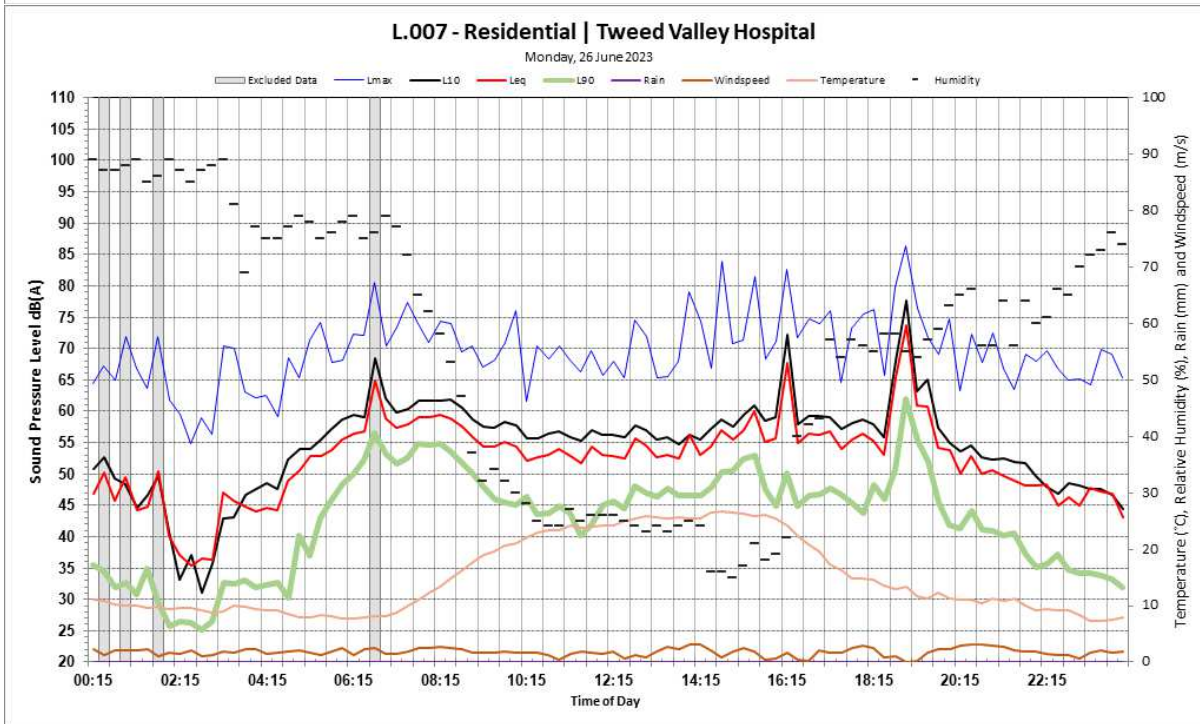
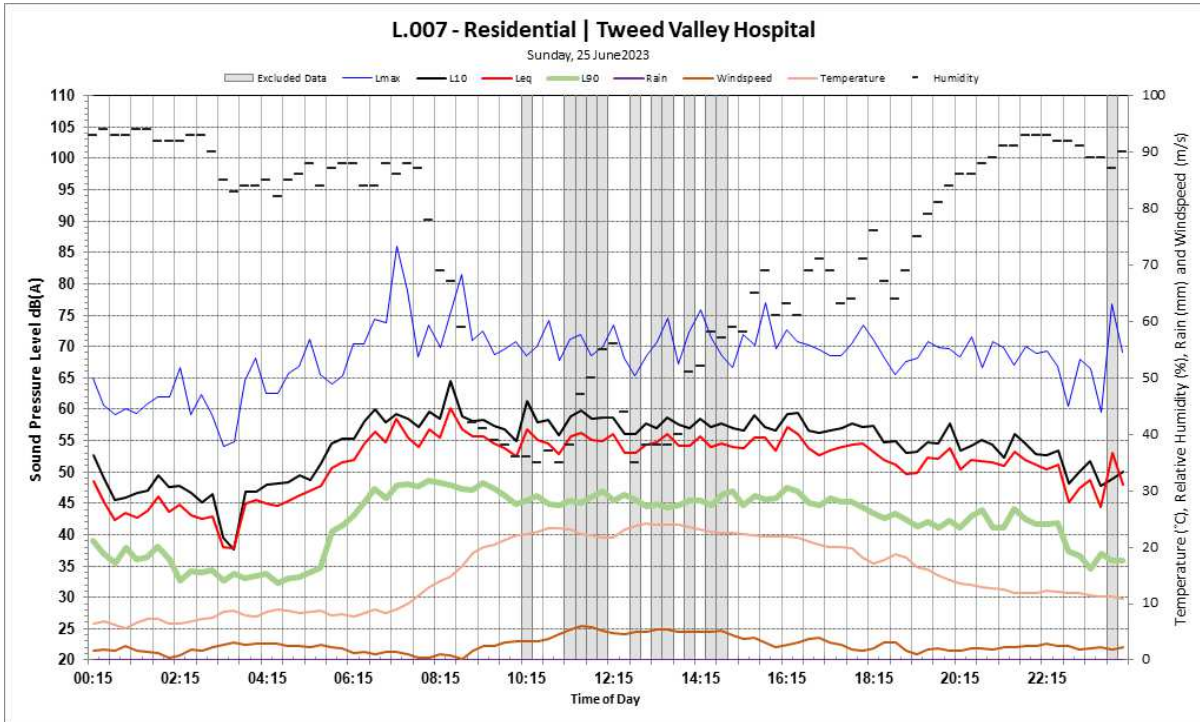
Friday, 23 June 2023



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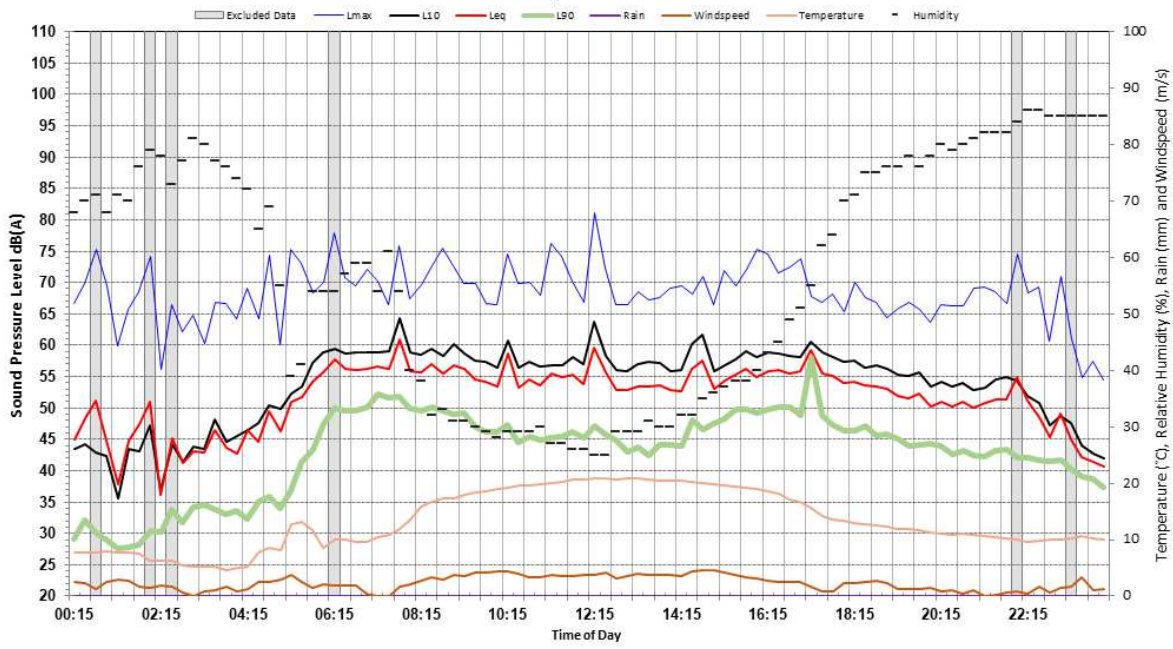
Saturday, 24 June 2023





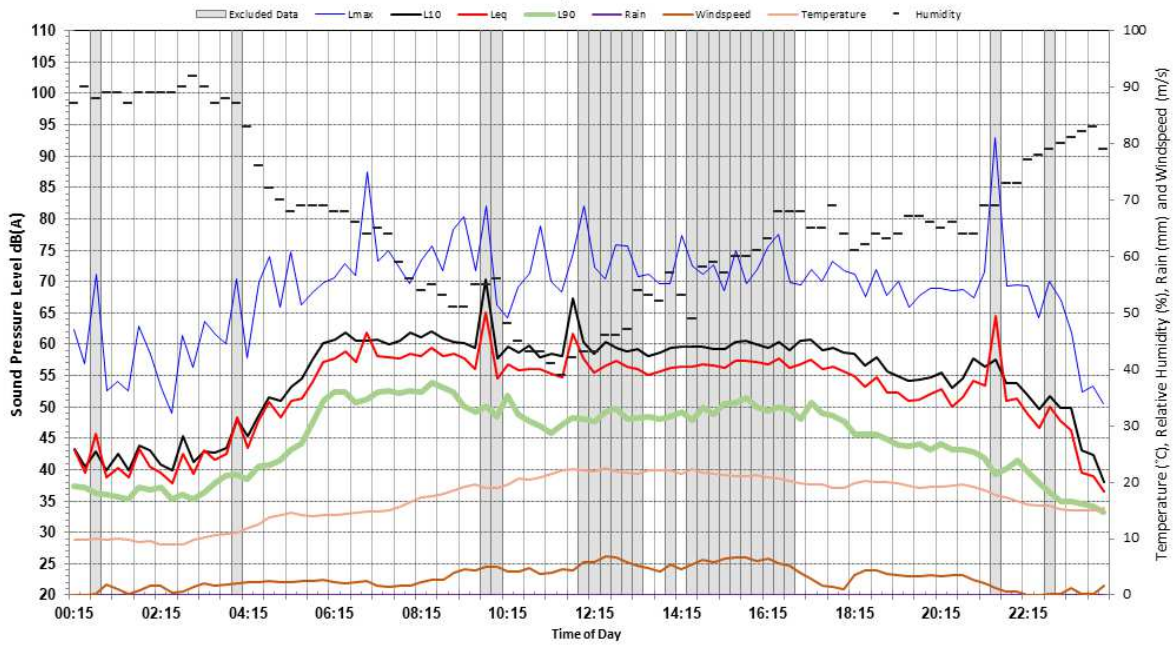
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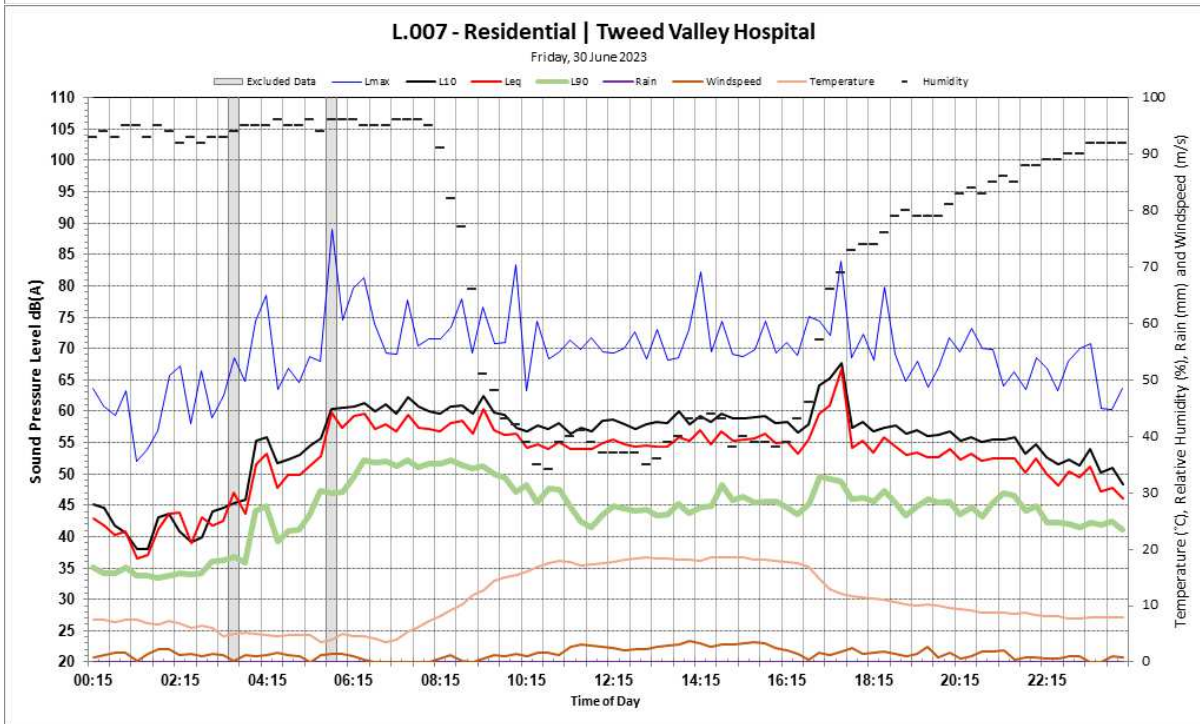
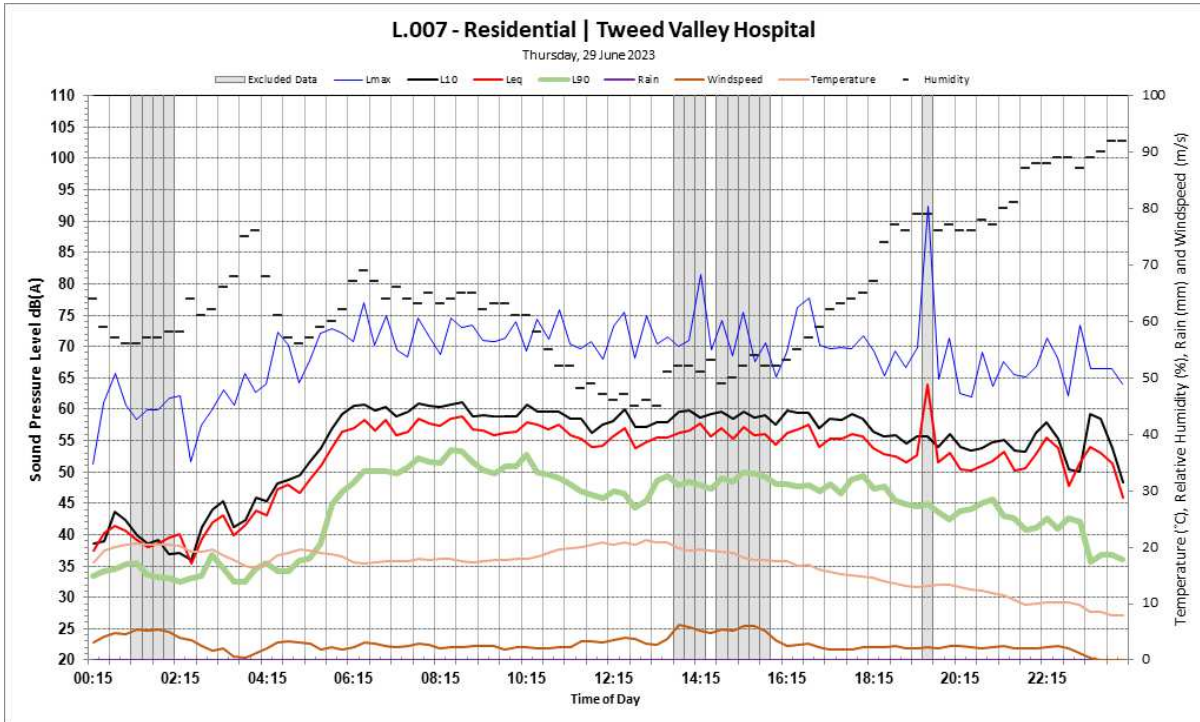
Tuesday, 27 June 2023



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Wednesday, 28 June 2023







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